EFFECTS OF EXPLICIT STUDY STRATEGIES ON ACADEMIC SUCCESS AND PERCEIVED ACADEMIC ANXIETY IN A MIDDLE SCHOOL SCIENCE CLASSROOM

by

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ABSTRACT

Effective study strategies are not innate, but rather are learned behaviors. By middle school students are expected to create and use study materials independently, however they often have not been directly taught such strategies. This study investigated whether explicitly teaching study strategies affected summative assessment scores. This study also investigated whether the strategies had an effect on student attitudes towards assessments, confidence and feelings of academic anxiety. Throughout the study, students learned four different study strategies through scaffolded lessons and were asked to use them to prepare for quizzes. Student attitudes and academic anxiety were analyzed using pre and post-treatment surveys and anxiety questionnaires. The results indicated that the effective use of study strategies increase assessment scores, confidence and organizational skills, as well as decrease feelings of academic anxiety.

CHAPTER ONE

INTRODUCTION AND BACKGROUND

Context of the Study

While school choice is not a new phenomenon, it has become increasingly popular in big cities like Chicago. “In the 2015-2016 school year, 75 percent of Chicago Public School (CPS) ninth-graders opted out of their assigned high school…Selective enrollment high schools (SEHSs) were among the more high-profile and most sought-out options” (Barrow, Sartain, & de la Torre, 2018, p. 1). Chicago private schools, which are majority Catholic, are another extremely popular option for families to choose. Within the city of Chicago there is high competition to attend either Catholic or Selective Enrollment high schools. This fact is because, “When given a choice that is not dependent on residence, students will flow from low-performing schools to better ones” (Sirer et al., 2015, p. 360). With the recent COVID-19 pandemic, this has been even more true. The results from the 2021 Illinois Assessment of Readiness, which is required of all public school students, grades 3-8, showed a 17% decrease in the number of students that were at grade level in English language arts and a decrease of 18% in math since 2019 (Cullotta, 2021). With extended remote learning, days missed for striking and these lower test results, it should be no surprise that families are looking at other options. In the 2020-2021 school year, “the archdiocese schools reported a 5% jump in student enrollment” (Cullotta, 2022) This shift has only increased the competition in private and selective enrollment schools, and produced even more pressure for the students trying to gain acceptance into these schools. The pressure for students to meet these certain expectations seems to come from parents, staff and the students themselves.

St. Josaphat School (SJS) is a Pre-K-8th grade, two-time winner of the Blue Ribbon of Excellence, located in the heart of Lincoln Park, Chicago. The student body consists of 76.3% Caucasian students, 16.0% minority students labeled as Hispanic/Latino, Multiracial, Asian/Pacific Islander and African American and 7.8% listed as "unspecified". Each grade of approximately 34 students consists of two homerooms, and of the 371 student-body, none are eligible for reduced lunch.

In the six years that the author has been teaching at SJS, both a difference in students' classroom performance and assessment scores, as well as their overall demeanor before, during and after taking an assessment has been noted. Although they participate in class discussions and complete activities and homework effectively, many still feel that they are unprepared and label themselves "bad test takers". These feelings only seem to intensify their academic anxiety. This action research project worked to address whether teaching specific study strategies would increase students' confidence and feelings of preparedness, which would in turn increase assessment scores and decrease academic anxiety.

The two sections of 6th grade Earth Science, which total 35 students, served as the subjects in this study. At SJS our 1-to-1 iPad program begins in the 6th grade, of which the author is one of the homeroom teachers. This transition to taking notes, completing homework and studying digitally further organizes and prepares them for 7th grade. In the city of Chicago, 7th grade is the most important year for a student in terms of their academics. It is the 7th grade report card that the competitive high schools scrutinize at the end of the year; making 7th grade grades a key factor in the high school application process. For this reason, emphasis tends to be put on assessment scores, as these are more heavily weighted in a student's overall grade.

Focus Questions

For the reasons above, the choice was made to focus this research project on the effects of study strategies on assessment scores and academic anxiety, as they seem to have a possible correlation. The main question for this action research project was, What is the effect of explicitly teaching study strategies on student success and attitude toward summative assessments?

The subquestions include the following:

1. What are the effects of study strategies on a student's perceived idea of anxiety?
2. When given the option, will students choose to use one of these strategies on their own to prepare for assessments in the future or in other classes?
3. How will the information collected in this study drive my future instruction?

CHAPTER TWO

CONCEPTUAL FRAMEWORK

Background on Cognitive Development

The emphasis on student test scores by high schools has increased over time. For this reason, much research has been done surrounding test preparation and behavior and its impact on student anxiety. The following literature provides support for my own chosen research questions.

One of the most read theories in the field of education is Jean Piaget's theory of cognitive development. According to this theory, "Intelligence is something that grows and develops through a series of stages. Older children do not just think more quickly than younger children...Instead, there are both qualitative and quantitative differences between the thinking of young children versus older children" (Cherry, 2020, para. 5). The four stages of cognitive development, according to Piaget, are sensorimotor (birth - 2 years), preoperational (2 to 7 years), concrete operational (7 to 11 years) and formal operational (12 years and up). As children get older, they transition from one stage to another by learning through experiences and maturation.

One main characteristic of children in the concrete operational stage is that they mostly think literally, but are beginning to think more logically (Cherry, 2020). This means that they are able to use what they are explicitly taught, but are also starting to learn to think and make connections on their own by the end of this stage. At the beginning of the formal operational stage, children pick up from where they left off by continuing to not only think more logically on their own, but also in a more abstract way. An important note that Cherry points out about

Piaget's view of a child's movement from one stage to the next is that it's not about the *amount* of information they know, "Instead, Piaget suggested that there is a qualitative change in how children think as they gradually process through these four stages" (Cherry, 2020, para. 18).

This theory supports the understanding of where students in junior high might be in their cognitive development. Piaget's theory also reinforces the idea that students need to be explicitly taught study strategies to be able to apply them effectively. When students are in the concrete operational stage, they are learning from what they are directly taught, and in the formal operational stage they are using what they have been taught to form their own opinions, ideas and logic. This means that if we want students to be able to self-regulate their learning, they first need to be taught ways in which to do so.

Study Strategies and Academic Anxiety Research

If students participate in class and correctly complete assignments, why aren't assessment scores higher? Research shows that in many cases students perform poorly on assessments, not because they don't understand the material, or because they don't study, but rather, because they don't know how or what to study. Three reasons can be given to support the idea that students lack mature study strategies. First, students have not been taught the strategies; second, students cannot self-regulate the strategies; and third, students do not think to apply them when they are preparing for a test (Simpson, 1984).

Author and researcher, Michele Simpson, expands on each of these reasons to showcase the importance of early strategy instruction at a young age through her study on college freshman. The strategies that students are exposed to in middle school are underlining information, re-reading, and memorization. She says that when students get to higher years of

education, they don't know how to transition to more sophisticated strategies and revert to using the basic ones. She describes self-regulation of learning as, "being able to plan activities prior to understanding a problem, to monitor and revise strategies or activities, and to evaluate the strategies' outcome for effectiveness in terms of the criterion task," (Simpson, 1984, p. 138). In order for students to self regulate study strategies, they need to learn how and when to use them, as this behavior is not innate. Finally, students need to be able to use specific strategies for specific learning tasks. Students are often taught general strategies, for example highlighting important information in a text. However, not every subject or task is best studied by highlighting. Highlighting key terms and definitions in a text about the water cycle would most likely not be as effective as creating a concept map or a diagram. Simpson describes this by stating, "Ideally, teaching students how and when to apply and modify a study strategy should be further reinforced by the content area teachers," (Simpson, 1984, p. 139). By teaching students a variety of strategies, they will be able to create their own strategy "tool kit" in which they can pull from where they see fit.

In addition to the variety and correct use of study strategies, test anxiety plays a large role in students' performance on summative assessments. Perhaps psychologists Kennedy T. Hill and Allan Wigfield said it best when they stated, "As many children become older, motivational factors may exert as much influence on their school performance as do cognitive skills and abilities" (Hill & Wigfield, 1984, p. 106). They describe the findings of studies that have been done, along with their own, to support that different levels of anxiety have an effect on student performance. At one point they claim that "anxious children are more sensitive to failure and react more to evaluation from adults than low-anxious children," (Hill & Wigfield, 1984, p. 106).

Being “sensitive to failure” is a theme that has been personally observed in nine years of teaching in Chicago. Here, students seem to be constantly put under pressure to do well, and live somewhat in fear of making mistakes because it may cause them a spot in their ideal high school. For this reason, many of students at St. Josaphat fall into the “high-anxious” category, rather than the “low-anxious” one.

Methodologies

The major part of this action research project focused on the implementation of explicit learning and study strategies. However, as the research continued, it demonstrated how students could take these strategies themselves to self-regulate their learning. Nist, Simpson, Olejnik and Mealey (1991) discussed their approach to testing whether there was a relationship between using particular study strategies and how a student performed on an assessment in their study of 123 college freshman from the University of Georgia.

In their 10-week study, students studied for three different content areas using a variety of strategies. For each chapter, certain study strategies were taught based on which were most appropriate for the content. After using the different methods to study, they were given a test. Each test was set up in the same way; approximately 35 multiple-choice questions, 10 true/false questions and two essay questions. Multiple choice and true/false questions were scored as one point each, while essay questions were worth 10 points each. Although each test had a slightly different amount of multiple-choice questions, roughly all tests were worth 60-68 points. The researchers used a key to score the multiple choice and true/false questions, and a rubric to score the essay questions.

While studying for the tests in the study, four processes of strategies were used: encoding, word meaning, organizing and executive control. For the purpose of the study, students were taught the encoding strategy of effective annotation. Vocabulary strategies were introduced to students to help with the process of word meaning, and strategies for sorting and classifying information were introduced to teach the process of organization. Concept cards, questions/answers, maps, charts and essay prediction practice were all types of these organization strategies. The executive control strategy followed the PLAE format: Preplanning tasks and goals, Listing appropriate strategies, Activating the plan and monitoring progress and Evaluating the plan after the test is over. To determine which strategies were used more often when preparing for each of the chapters' tests, the researchers created a frequency matrix. "Each time subjects handed in evidence that they constructed and used a strategy, it was coded in the matrix. After coding all the strategies associated with the four study processes, we tallied the strategies for each cell" (Nist et al., 1991, p. 861).

While much of this research focused on study strategies and students' ability to self-regulate, it was also noted how these explicit study strategies affected students' academic anxiety. An instrument used to collect data on changes in anxiety is an academic anxiety scale. An example of such is the Test Anxiety Scale for Children (TASC) developed by Sarason et al. (1958).

The TASC is a 43 true or false item questionnaire about feelings of anxiety relating to tests. A study of this anxiety scale involved students in grades 2 through 5, with approximately the same number of boys and girls in each grade. An example of an item on the questionnaire was, "When the teacher says she is going to give the class a test, do you become afraid that you are going to fail - that you will do poorly?" (Sarason et al., 1958, p. 106). Next, teachers were

asked to complete a 17-item anxiety scale based on what they had observed in the classroom. One example of these statements was, “Does the child exhibit unwarranted fidgeting (e.g. squirming, restless behavior) when called upon to recite in class?” (Sarason et al., 1958, p. 107).

From both of these questionnaires, the researchers were able to come to a few conclusions. To note, the higher the test score, the higher the anxiety level. Next, the correlation between students' perceived test anxiety and IQ was analyzed. The strongest negative correlation coefficient (r) is -1.0. From 2nd grade through 5th grade the r-values were -0.196, -0.214, -0.275 and -0.284. While there seems to be a weak correlation based on their r-values, the correlation continued to get stronger at each subsequent grade level. When teachers were asked to provide feedback about a student’s anxious behaviors, they were also compared to the average achievement within the grade. The correlation coefficient for 2nd through 5th grade is as follows: -0.419, -0.353, -0.361 and -0.127. The researchers explain this surprising data by stating, “Whereas the teachers’ estimate of a child’s anxious reaction decreasingly predicts a performance criterion, the children’s self-estimate tends increasingly to predict the criterion,” (Sarason et al., 1958, p. 110). They go on to say that it’s possible that these results were due to the fact that typically anxious behaviors are more obvious to spot in younger grades.

In summary, the literature above provides methods for treatment as well as data collection techniques that were used to address my research questions on the effects of explicit study strategies on assessment scores and academic anxiety.

CHAPTER THREE

METHODOLOGY

Demographics

Because the two class sizes of 6th graders were fairly small, data was analyzed from both whole group and individual students. All students and parents from both 6th grade homerooms signed a consent form allowing their quiz scores to be collected and analyzed. Table 1 shows the demographics of each homeroom.

Table 1. Homeroom demographics, (*N*=35).

Homeroom	Total students	Boys	Girls	New students	IEP/504
6A	18	7	11	3	0
6B	17	9	8	1	3

The most common accommodation for our students with support plans is extra time on assignments and assessments. For this reason, they were not given a separate test, however they were allowed the time and half encouraged by their plan. In terms of academic ability, students at SJS typically perform very well. There is a high motivation to do well, which is fueled by parents, teachers and their fellow classmates. As previously mentioned, motivation of these students is also influenced by their eventual high school choice. For new students, this emphasis on motivation may be new. Transitioning to a new school can be a challenge, but one with high expectations and highly motivated peers can be especially challenging if students are not used to this environment. For these reasons, it was important to not only categorize gender, but to also identify new students, as well as students with student support plans. The research methodology for this project received an exemption by Montana State University's Institutional Review Board, which can be seen in Appendix A, and compliance for work with human subjects was maintained.

Treatment

The treatment took place over four mini-units that covered topics such as earth's resources and human population, and earth's geological processes. During each mini-unit, students were explicitly taught a type of study strategy that they used in preparation for the quiz. In the fifth and final mini-unit, after the treatment ended, students were asked to self-select the study strategy that they felt best fit not only their learning style, but also the content that they were studying.

In the first mini-unit of the treatment process, students learned and practiced the strategy of generative summarizing. In this type of summarizing, students used their own words, connections and explanations to come up with a summary of the information learned, as opposed to just editing or taking out words to shorten the author's original text. To do this they were given a chart outlining the readings, activities and labs that we would complete throughout the mini-unit. Within the chart there were columns where students recorded the key vocabulary terms, objectives for the lesson, and main findings from that lesson. For the first few lessons, students were guided to find the objective of the lesson and key terms, and shown how to come up with the main ideas to summarize their learning. In the next few lessons, students were asked to work with their table groups to fill out the chart; then, responses were discussed as a class to see if other table groups agreed with the key terms and main ideas. Finally, in the last few lessons students were asked to individually fill out the chart, and answers were gone over as a class to confirm understanding. Each of the mini-units used this type of scaffolding of strategy instruction so that students were able to eventually self-regulate their studying. The summarizing chart can be seen in Appendix B.

In the second mini-unit, students learned and practiced one method of retrieval strategy through gamification using the app, Kahoot. Retrieval strategies are used to recall information

from memory or understanding, without re-reading definitions or concepts. Kahoot is game-based platform that allows students to quiz themselves, or others, in a fast-paced and engaging way. When using Kahoot students received instant feedback, while also remaining engaged in the study process. In the first half of the unit games were created on the content being learned for students to play. After playing, a class discussion was held to talk about the types of questions they had seen - multiple choice, true/false, exception questions, applications, etc. It was important for them to recognize that effective study questions are not all the same. In the second half of the unit students were given two separate assignments. For the first assignment, they needed to search and find a Kahoot on fossils after finishing watching the episode Bill Nye – Fossils in class. They played their "found" games in small groups and discussed the advantages and disadvantages of searching for a game created by someone else. In the second assignment, students were asked to create their own Kahoot game based on a reading that was done in class. In their game they were asked to use everything they had learned about what makes a game an effective study tool. The games were shared with their classmates, and as they were played their successful characteristics and the areas of possible improvement were discussed.

In the third mini-unit, students learned and practiced visualization strategies. Compare and contrast diagrams, cause and effect charts, concept maps and labeled drawings are examples of some of the visualization strategies that we used. These types of study strategies allow students to organize and connect information in a visual way that makes sense to them. A copy of the visualization strategies can be seen in Appendix C. To begin this unit, each of the strategies was introduced on their own using everyday topics, before getting into scientific material. For example, a compare and contrast chart was created to illustrate the similarities and differences between Illinois and Florida, a diagram was generated to show the causes and effects

of childhood obesity, and a concept map was constructed with given terms to show connections between holidays. Once the initial practice was over, students continued the guided practice of these strategies with the material that was being learned in mini-unit three. At the end of the unit, students were asked to create their own study guide using visualization strategies. Students were given vocabulary terms and concepts to know, but instead of simply writing definitions, they were asked to organize them using concept maps, compare and contrast charts and/or cause and effect diagrams.

In the fourth, and final, mini-unit of the treatment, students learned and practiced a second retrieval strategy using flashcards and self-testing. Students used the website and app, Quizlet, to accomplish this. Quizlet's interface allowed students to create, and search for, a study set of flashcards for the material they wanted to study. Once found or created, students had the option to study them as normal flashcards, or complete the "learn" module. This module categorized the terms that students were able to correctly identify from the ones that they needed to practice again. This fulfilled the retrieval portion of this study strategy. Quizlet also provided a "test" module where students were tested on the terms using multiple-choice, true/false, written and matching questions. This fulfilled the self-testing portion of this study strategy. In the first part of this mini-unit students were assigned study sets to use in the classroom and as homework. This gave them a chance to familiarize themselves with the "learn" and "test" features. Then, before the quiz, students were asked to create their own study set using all of the terms they learned. To confirm that they had used this strategy they were asked to provide a picture of their 100% completed "learn" section and at least a 90% or above on the "test" section.

Data Collection and Analysis Strategies

The treatment of this study began after the first short unit of the school year on experimental design. At the end of this unit, students took a quiz on what they learned about the design process. A particular study strategy was not encouraged, so these assessment results acted as baseline scores. In addition to these baseline scores, opinions and feelings about test taking was collected before implementing the treatment. One of these instruments was a "Pre-Treatment Survey" and the other was an "Academic Anxiety Questionnaire". These instruments would be given at the end of the study as well for comparison. A copy of these can be found in Appendices D and E.

In addition to the quantitative data that was being collected from the quiz scores, qualitative data was also being taken. After each quiz, students were asked to complete a "post-treatment survey" to reflect on the ease and effectiveness of each strategy that was taught. From the results of those surveys two to three students were chosen at random to complete a follow up interview. This provided further explanation of their initial answers. In the final weeks of the study the "Post-Treatment Survey" and "Academic Anxiety Questionnaire" were distributed, which were copies of the instruments that had been taken at the start of the study. These results were compared for changes in attitude and anxiety over the course of the study. A copy of the timeline of the treatment can be seen in Appendix F.

Table 2. Research Matrix.

Questions	Summative Quiz Scores	Treatment Surveys	Parent Survey	Student Interviews	Academic Anxiety Survey	Teacher Journal
Main Question	X	X	X	X		
Sub Question #1		X			X	X
Sub Question #2		X		X		X

Sub Question #3	X			X	X	X

The research matrix in Table 2 outlines the triangulation strategy used to ensure validity and reliability. Each question used multiple instruments to collect data from different perspectives.

For the main focus question, “What is the effect of explicitly teaching study strategies on student success and attitude toward summative assessments?” data was collected through summative quiz scores, post-treatment student surveys, post-treatment parent surveys and student interviews. The summative quizzes were designed to include questions of increasing levels of Bloom’s Taxonomy. Bloom’s Taxonomy, created by Benjamin Bloom in 1956, is a hierarchical classification system of cognitive skills. The more complex and involved the question is, the higher it will be ranked on the framework. There were five Bloom sections, each with five points, totaling 25 points. This was done to make scores comparable, as well as identify levels of Bloom’s Taxonomy that posed more of a challenge. The quizzes, along with the other instruments, were both peer and professor reviewed for inconsistences, misconceptions and errors. An example of a quiz can be seen in Appendix G. This data, along with the surveys and interviews, provided insight into whether the strategies taught were effective at increasing information retention and students’ attitudes towards learning and studying information for tests. The information collected from these instruments was quantitative which allowed comparison of data as the weeks of the study progressed. It also allowed comparison of the final scores to the baseline scores to get an overall conclusion.

The first subquestion, “What are the effects of study strategies on a student's perceived idea of anxiety?” was measured using the post-treatment surveys and an academic anxiety questionnaire. The academic anxiety questionnaire was a slightly edited version of the “Test

Anxiety Questionnaire" from the Student Learning Assistance Center at Texas State University (Hoang, 2014). This previously vetted and published questionnaire was chosen to certify results as it used questions that had been extensively investigated and tested. To confirm that students understood how to answer the questions a few edits were made. These edits that were made can be found in the wording of the questions. For example, "my professor" was changed to "my teacher". This subquestion specifically focuses on student's perceived anxiety levels, therefore, data was collected directly from them. The student post-treatment survey responses allowed probing of whether their anxious feelings changed from learning and using strategies to prepare for assessments. Junior high students are typically apprehensive about sharing their feelings of anxiety, nor do they always know how to express them, so using an anxiety questionnaire at the beginning and end of the study was a good second source of information.

The second subquestion, "When given the option, will students choose to use one of these strategies on their own to prepare for assessments in the future, or in other classes?" was addressed using qualitative data collected from both student surveys and interviews. These interviews took place after each treatment quiz, at the end of the study, and as well as a few weeks after the study had ended. These results allowed me to see whether the strategies were transferable to other quizzes and content classes.

The final subquestion, "How will the information collected in this study drive my future instruction?" was created as a way to organize what was learned in this study, as well as identify impacts on current and future teaching. Student assessment scores, student interviews, the anxiety questionnaire and teacher journal served as important data points to drive this future instruction. The conversations had with students, and the reflections that were made in the journal, provided qualitative feedback, while the summative quiz scores provided quantitative

feedback. The combination of these two types of data produced conclusions about whether study strategies impacted student achievement and anxiety, and whether teaching them was an effective use of instructional time in the classroom.

CHAPTER FOUR

DATA ANALYSIS

Results

Throughout the study both qualitative and quantitative data were collected to provide answers to the research questions. The largest part of the study focused on whether explicitly teaching study strategies would affect the scores on summative assessments. Before completing the study it was hypothesized that learning different ways to organize and analyze information would result in overall higher scores. Figure 1 displays the mean scores on each of the six quizzes given during this study.

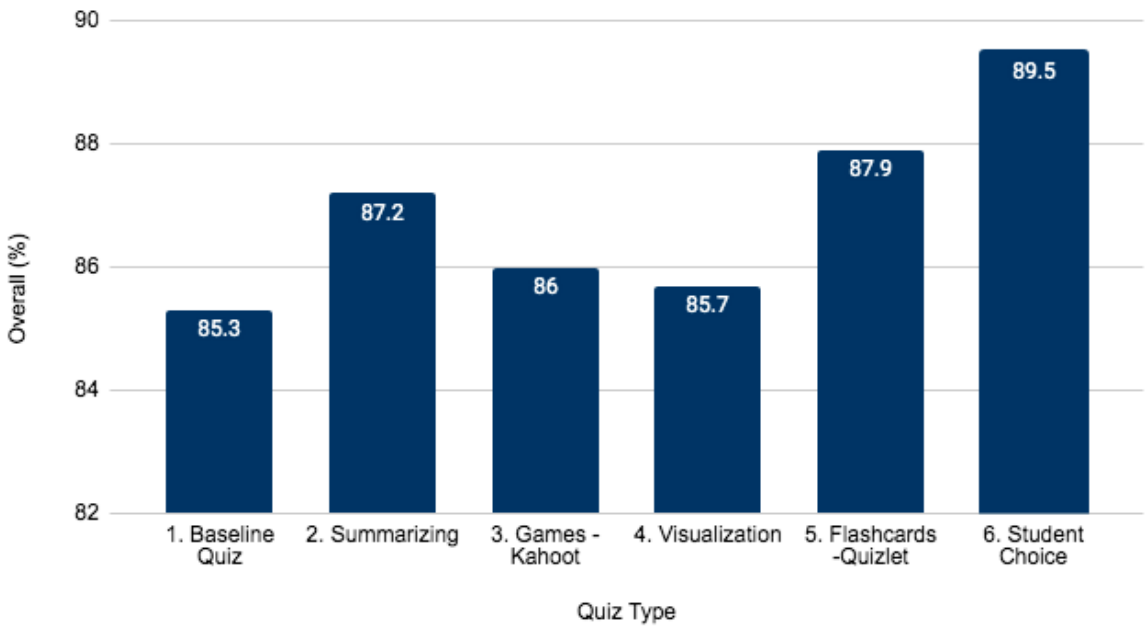


Figure 1. Average scores on each quiz by percentage, (*N*=35).

For quizzes one and six, students were not encouraged to use a particular study strategy. Quizzes two through five were given during the treatment, and therefore, students were asked to prepare for the assessment by using the specific strategy taught during that unit.

Most noticeably, there was an overall increase from the first to the final quiz by 4.2%. Each treatment quiz score averaged higher than the baseline score of 85.2%. The flashcard and summarizing strategies provided the highest treatment scores on average with 87.9% and 87.2% respectively. The lowest treatment mean score was when the visualization strategy was used (85.7%), which scored only slightly above the baseline quiz. Finally, when students were given the opportunity to use the study strategy of their choice, the highest percentage was achieved at 89.5%. Figure 2 shows the breakdown of student strategy choice for the final quiz.

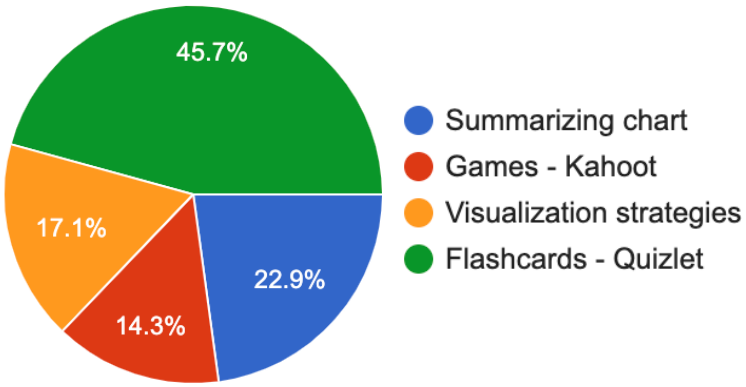


Figure 2. Student chosen strategy breakdown, (*N*=35)

While the mean is a helpful measure of center for data when first identifying trends, it does not account for outlying data points that may affect the average. The box and whisker plots shown in Figure 3 allow for a different perspective.

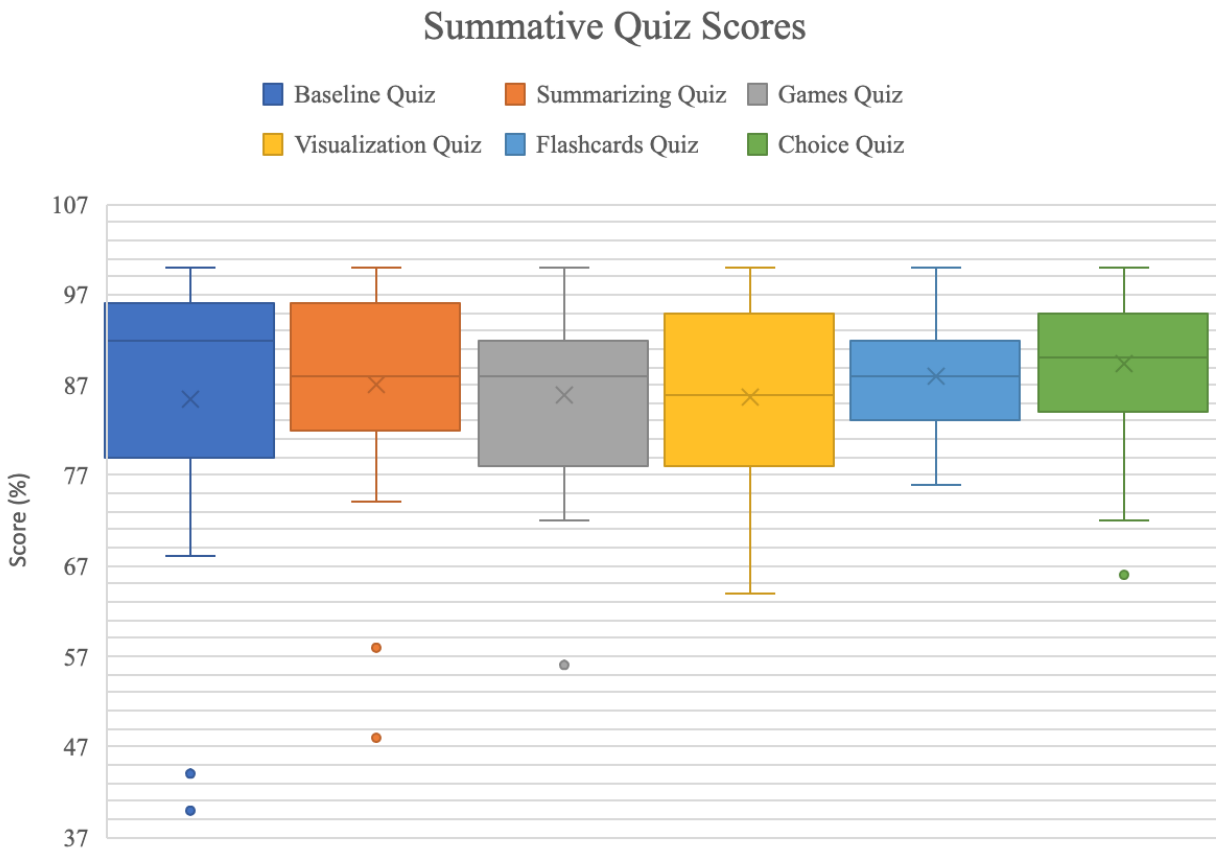


Figure 3. Box plots of student quiz scores by strategy instruction type, (*N*=35).

The averages for each quiz were approximately the same, which can be seen by the Xs in the center of each box; however, the entire box plot provides additional information. Most obvious is the appearance of outliers. Outliers are points that are located one and a half times outside the interquartile range (IQR), or the middle 50% of the data. In other words, outliers are abnormal in the data sample. Based on where the median scores were, the outliers had a significant impact on the means of each of the first three quizzes. However, as the treatment continued, the quizzes showed less dramatic, and eventually no, outlying scores. In addition to the use of study strategies, these results could have been due to comfort with assessments and material, as well as external factors such as mood, hunger and classroom drama.

The IQR for a set of data can be found by subtracting quartile three from quartile one. The IQR from the baseline quiz to the choice quiz are as follows: 17%, 14%, 14%, 17%, 9% and 11%. Because the IQR represents the middle 50% of the data, the higher it is, the more spread out the data is. Conversely, the lower it is, the more clustered the middle values are. Although the visualization quiz had a higher IQR, as quizzes went on, the lower their IQR became. This data can be coupled with the standard deviation of each quiz, which was 14.45, 11.33, 9.78, 10.34, 6.65 and 8.32 respectively. The standard deviation is a measure of how far the data is in relation to the mean. Even though the visualization quiz had the same IQR as the baseline quiz, its standard deviation was smaller, due to the weaker pull of the outliers. Lower IQR and standard deviation values show that more students were scoring closer to the mean by the end of the treatment.

Table 3 illustrates student performance on each of Bloom's categories that were assessed on each quiz, as well as the overall average percentage score.

Table 3. Percentages for each of Bloom's Taxonomy categories on given quizzes, (*N*=35).

	KEY:	No Treatment Quiz	Treatment Quiz	Lowest Bloom Section	Highest Bloom Section	
Quiz Type	Remembering (%)	Understanding (%)	Applying (%)	Analyzing (%)	Evaluating (%)	Overall (%)
1. Baseline Quiz	93	83.5	87	61.5	88	85.3
2. Summarizing	94	74	91	84	92	87.2
3. Games - Kahoot	90	85	90	87	77	86
4. Visualization	86	90	84	80	88	85.7
5. Flashcards -Quizlet	95	87	88	87	82	87.9
6. Student Choice	88	93	88	85	92	89.5

The "remembering" section is the first, and lowest, category on Bloom's Taxonomy pyramid. The questions involve memorizing and recalling vocabulary terms and facts. This section had the highest mean on four of the six quizzes, regardless of treatment. The remaining two quizzes held their highest mean in the "understanding" section, which is right above

"remembering". These types of questions ask the student to go a step beyond recall and answer questions that show understanding of the material.

The lowest section of almost all of the quizzes was found in the top two sections of the taxonomy. The "analyzing" section was the lowest on three of the quizzes, and "evaluating" was lowest for two. These kinds of questions require students to analyze tables, graphs and information to make inferences and conclusions. They are typically subjective responses, rather than multiple choice, matching or true/false answers. They must be able to know, understand and apply definitions and ideas to be successful in these areas. These results provide evidence that students may need more practice and support when learning to answers questions such as these. One result worth noting is that the summarizing treatment quiz held its lowest section in "understanding". This did follow the pattern that was seen over the course of the study: regardless of study strategy instruction, the highest sections were found on the lower half of Bloom's pyramid, and the lowest sections were found on the upper half.

Six weeks after the treatment ended, students were surveyed to determine whether they continued to use one or more of the study strategies taught. Figure 4 shows the breakdown of continued users versus non-users. The pie graph shows the responses to the question: "Have you been continuing to use one or more of the following study strategies since we've learned them this year: summary chart, Kahoot games, visualization strategies, Quizlet?"

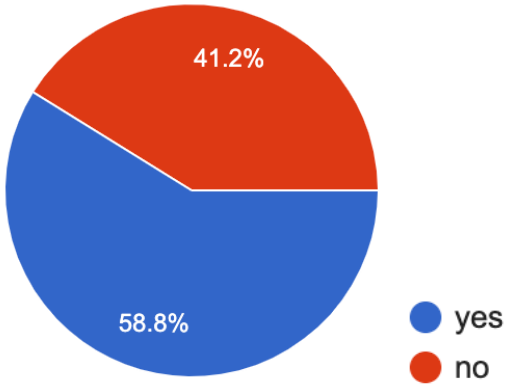


Figure 4. Percentage of students who did and did not continue to use the study strategies taught, (*N*=35).

Over half of the students, 58.8%, shared that they had continued to use one or more of the study strategies to help them prepare for assessments in science and their other classes. Of the four strategies, Quizlet was the most popular way of reviewing. When probed further for reasons for not continuing to use the strategies, one student said, “It takes up a lot of time to make a strategy that is useful. I have a busy schedule after I get off of school so it’s difficult for me to add information.” Other students also mentioned that having a busy schedule compromised their ability to study. One said, “I don’t always feel like making them because I like using my free time to rest and relax after school. Homework already takes up a chunk of that time, so I don’t really want to create a Quizlet or something else.” Students were also fairly candid, mentioning that they were too lazy to create and use study materials. One student said, “I haven’t used them since because I have lots of activities after school and sometimes I don’t have time to study. I do better without doing a study strategy, and really I’m too lazy to do it.” It seems as though students have the strategies to study, however getting them to use them to use them may require teaching time management skills and getting them to see the value studying brings.

Academic Anxiety Effects

In addition to the possible benefits on summative assessment scores, this study also aimed to uncover the effects of study strategies on students' academic anxiety. Results from the pre- and post-treatment Academic Anxiety Questionnaire can be seen in Figure 5.

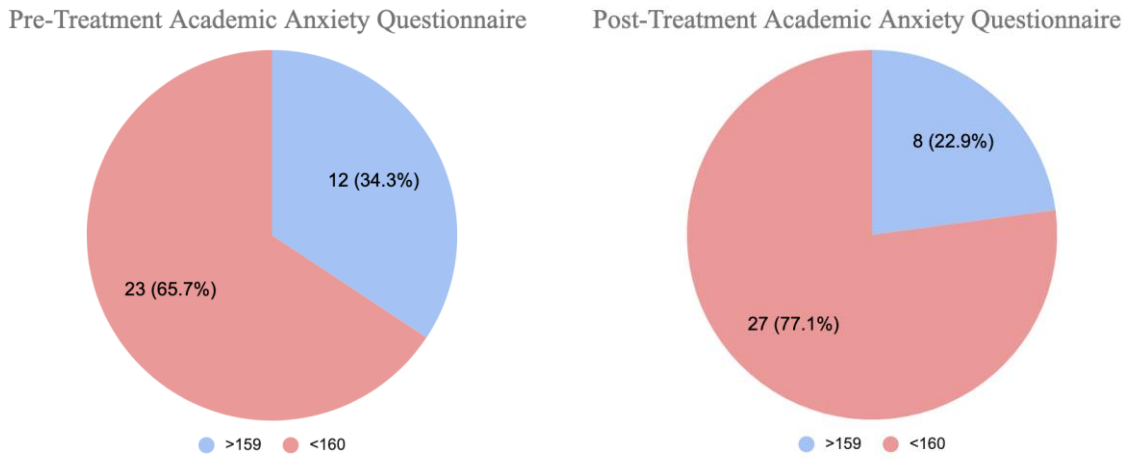


Figure 5. Academic Anxiety Questionnaire results, (*N*=35).

According to the Academic Anxiety Questionnaire, any student with a total score of 160 or higher on 48 Likert-type questions signals the possibility of having academic anxiety. After the treatment, four students who had previously scored in the 160+ range no longer did. In a closer look at the individual before and after results, a large number of students who were not in the 160+ category also decreased their anxiety score. Some were small decreases, but others were large. For example, one student dropped from 145 to 85, another dropped from 159 to 110, and yet another dropped from 120 to 72. During an interview one student commented, "I have very bad stomach aches before a test or anything I'm nervous for, and I didn't have one before the last quiz." In terms of whether they thought the strategies helped them with their anxiety another stated, "I was nervous for the last quiz because I chose the games strategy. I thought that it wouldn't be enough to help, but I was overall ready for it." Although the trend decreased

overall, there were a handful of students that slightly increased their score. Curiously, something happened with the new 6th graders. Of the four new students this year, all of them reported an increased anxiety score after the treatment was completed. Perhaps at the beginning of the year these students were not aware of the expectations or the rigor of the assessments taken at our school compared to the school they came from.

The final piece to the data collection process was the results of the student and parent surveys. Students were surveyed before the treatment began on current study strategies and habits, as well as their feelings of preparedness and success when it came to assessments. They were then given the same survey after the final quiz was taken. The results of the pre- and post-treatment surveys can be seen in Figure 6 and 7.

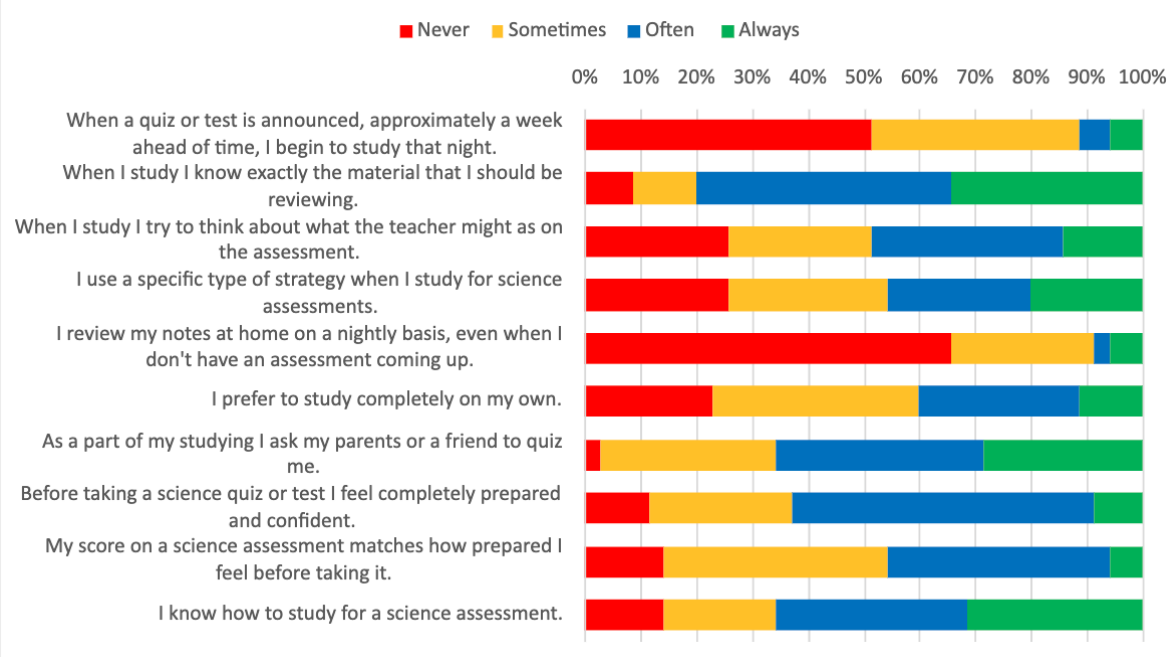


Figure 6. Pre-Treatment survey results, (*N*=35).

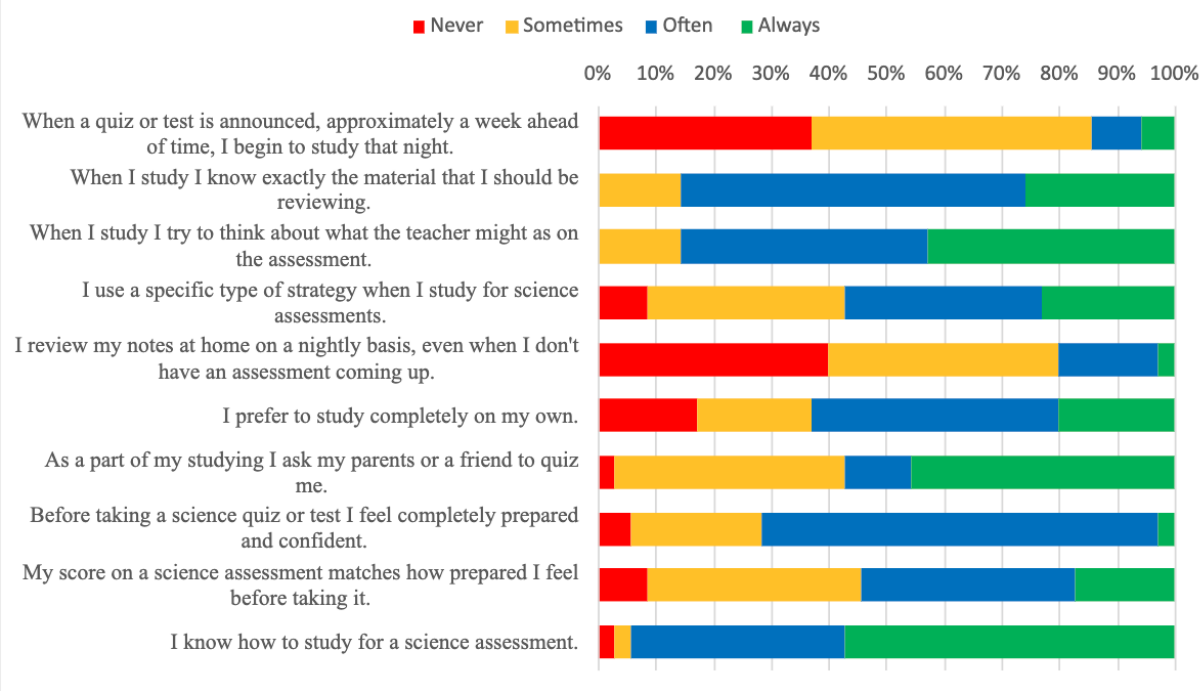


Figure 7. Post-Treatment survey results, (*N*=35).

At first glance it is clear to see a few obvious changes that happened from the pre to the post survey. The first of those being that the *never* option was indicated much less after the treatment was given. Most notably this happened in the statements, “When I study I know exactly the material that I should be reviewing,” and, “I use a specific type of strategy when I study for science assignments.” One student noted, “My parents used to always ask me where my study materials were and I never knew. We would both get frustrated. Now I know where and how to find the information,” and another said, “I tried to imagine what you (the teacher) are going to ask me. Like types of questions, especially short response ones.”

The statement, “I know how to study for a science assessment,” showcased a much higher percentage of students that responded with *often* and *always* after the treatment was given. When interviewed, one student elaborated on their choice saying, “The summarizing strategy helped me to organize all the information I had to study. At first, I thought I wouldn’t know the

answers to some questions, even though I had filled out the chart correctly. But, it ended up being easier than I expected."

Because this study held academic anxiety as a focal point, it should be noted that the statement, "Before taking a science quiz or test I feel completely prepared and confident," held a similar amount of students in the *never* category, but largely increased from *sometimes* to *usually.* More than 50% of students responded that they usually felt completely prepared and confident. When asked about this change one student shared, "I feel more prepared before a quiz now because I've found a strategy that I like." For students who remained in the *never* and *sometimes* categories they held the same reasoning as this student who said, "I still feel nervous anytime that I take a test, even if I study. The strategy did help, and I think I'll do well, I just don't think I'll do perfect." Another focused on the fact that he needed more practice with the strategies to increase his confidence in using them. Overall increased confidence can be linked to the fact that students knew what and how to prepare for the quiz.

Finally, one statement that didn't receive much change after the treatment was, "My score on a science assessment matches how prepared I feel before taking it." Because there was such an increase in feelings of preparedness and confidence, it is interesting that this did not increase with it.

The goal of the parent survey was to see whether parents had noticed any kind of effect on their child after learning and using the specific study strategies. In the survey, Likert-type questions focused on whether they felt there was an increase, decrease, or no change in student independence, confidence, assessment scores and organization. There was also an option of *I don't know* in case students weren't sharing this information at home. The results of this survey can be seen in Figure 7.

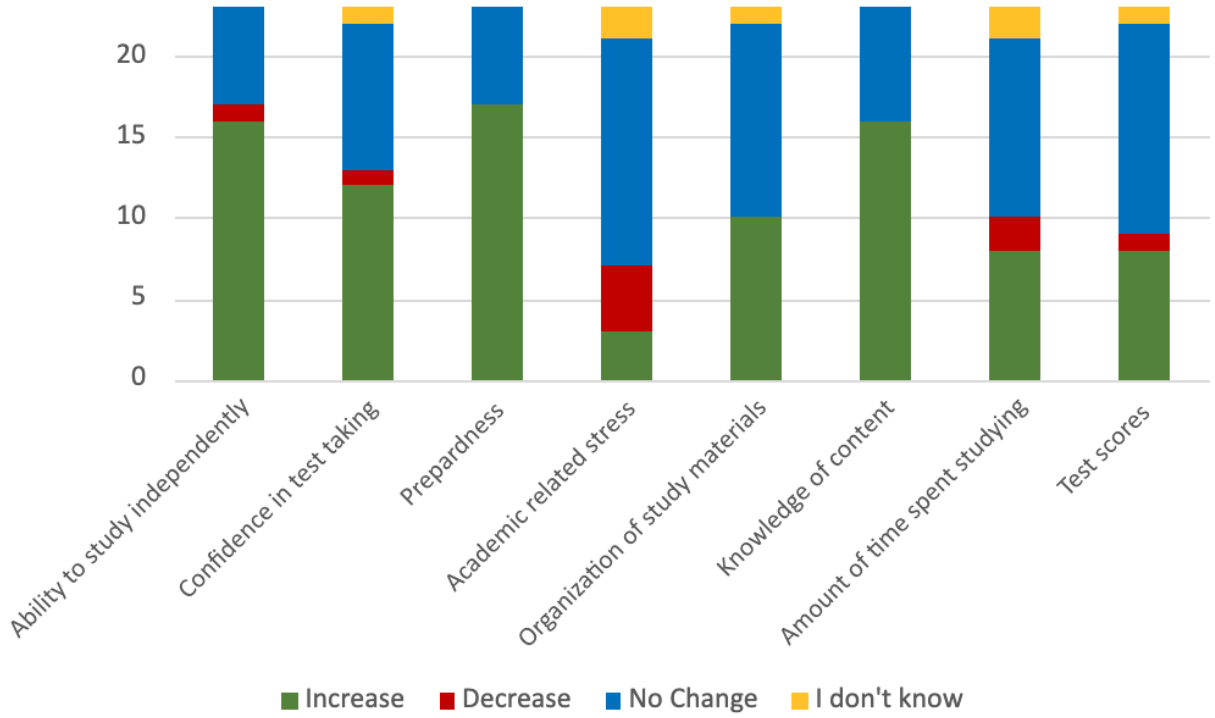


Figure 7. Results of post-treatment parent survey, (*n*=23).

Of the parents surveyed, there was a large increase in independence, confidence and preparedness when it came to studying. Sixteen parents, or 70%, saw an increase in their child's ability to study independently, 12 parents, or 52%, saw an increase in confidence towards test taking, and 17 parents, or 74%, noticed an increase in preparedness. In the additional information section of the survey one parent stated, "I have noticed a maturing of (child)'s study habits and a greater level of comfort managing his academic schedule." Only one parent reported a decrease in independence and confidence in test taking.

About half of the parents saw an increase in their child's organization of study materials, while the other half didn't notice any change. This was about the same trend in student's knowledge of the content taught.

Although minimal, it was encouraging to see that there was a larger decrease in academic related stress than increase. Most parents, about 61%, didn't notice a change in their stress levels.

Finally, the response for the question about the amount of time their child spent studying turned out to be difficult to analyze. It was hypothesized that because students had a strategy to use, they would spend less time studying, as they would be able to focus on one thing. However, one parent remarked, "The study strategies that you've been teaching have been great for (student name). She is able to spend more time studying because she knows what to focus on." That being said, it may also be true that using strategies may increase the amount of time they spend studying.

The final piece of this research study involved using the data to conclude how teaching study strategies impacted the researcher. This information can be found in the Values section of Chapter Five.

CHAPTER FIVE

CLAIM, EVIDENCE, AND REASONING

Claims From the Study

Student Success and Attitude

When students explicitly learn different study strategies to prepare for assessments, their scores increase. For the final quiz in which students were asked to choose a strategy from the four we had focused on, students scored the highest average of the year. By this point in the study, students had built a strategy toolbox in which they could self-select the one that worked best for their own learning. It is clear that knowing how and what to study plays an important factor when it comes to preparation. There are other factors that also may play into the success of scores including interest in the specific content covered on the assessment, comfort with quiz questions over time, and even day-to-day factors like emotion, hunger, relationships and illness. Because these factors are more variable, it is difficult to weigh in on how they may have affected the outcome.

Not only did scores increase, but also the amount and severity of outlying scores decreased. For the baseline quiz there were two students who scored more than one and a half times the IQR below the lower quartile. This distance from the IQR labeled them as outliers. These students were two of our newer students this year. One reason for this may have been due to the time spent out of the classroom. Both students came from Chicago Public Schools who had been remote learning since March of 2020. They had not been in a classroom or given a traditional assessment in over a year and a half. Over the next few quizzes, these two students continued to score higher until they were no longer outlying. The IQR of each quiz's boxplot,

and the standard deviation of scores, showed that the range of scores relative to the mean grew smaller over time, thus providing that through these strategies students were able to show a wide range of improvement. Students who scored around the mean throughout the study showed small improvements after each quiz, but the students who began as outliers showed much higher individual improvement. This finding provides evidence that the structure and organization of study strategies supports the success of all students, but more drastically, the lower achieving students.

While the use of study strategies showed an overall improvement of quiz scores, it is worthwhile to look beyond the overall number and focus on the complexity of the questions. Not every strategy is an effective tool for any subject, so it is possible that these strategies may not prepare students to answer questions of differing complexity. Based on the data, when study strategies were used to prepare, less complex questions were answered correctly most often. These questions include recalling, understanding, and applying definitions of terms and ideas. Questions involving analyzing data to draw conclusions and evaluating situations to formulate opinions had the lowest scores in each of the six quizzes.

Each of the four study strategies, first and foremost, reviewed definitions and basic concepts. In addition to the understanding of definitions, they were set up to support students in making connections between them. For example, when creating a concept map students drew lines and arrows between terms to identify possible connections or examples. However, the strategies were shown to be limiting. A study strategy will never include all possible scenarios or questions that will be seen on the actual assessment. Rather, certain skills need to be practiced. For example, the skills of reading and understanding data present in a graph or chart, and using both given and learned information to organize and evaluate a situation. For these higher order

type questions, practice of the skills should be coupled with review of the definitions and ideas. This may result in increases in the higher categories of Bloom's Taxonomy.

Academic Anxiety

The use of effective study strategies decrease students' ideas of academic anxiety. Before the treatment of this study students completed a questionnaire to determine the possibility of academic anxiety based on their total score after 48 statements. Each Likert-type response matched a point value. *Never* responses scored a one, *Sometimes* scored a two, *Often* scored a three and *Always* scored a 4. Any total score 160 or above indicated the possibility of academic anxiety.

It was determined that 12 students, about 34%, held strong worries or fears surrounding their academics that could be flagged as anxiety. In student interviews, these students mentioned feeling worried that they would fail their quiz, even though they had studied. In turn, these failing quiz grades would result in inadequate final grades, which might mean that they wouldn't earn honor roll at the end of the trimester, or that they might not be accepted into their preferred high school. From their responses it seemed as though one small quiz score would lead to a series of unfortunate events, rather than being an isolated event. They also discussed the competitiveness between classmates when it came to assessments and grades; according to the students, grades tend to be a topic of conversation amongst their peers and a way to rank themselves. Another group mentioned the pressure that they feel from their parents, and the frustration they have felt when they don't meet their expectations.

Once the treatment was over, students were asked to complete the same questionnaire again. This time eight students, or about 23%, scored 160 or above, resulting in a 11% decrease from the beginning. As mentioned in the data collection section, not only was there a decrease in

the students who were flagged with possible anxiety, but there was a decrease amongst many students overall. Students shared that the strategies allowed them to organize information into one place, which not only helped prepare them for the quiz, but made them feel less worried and more confident because they knew what to study. On the post-treatment survey students responses of *often* and *always* were higher than they were on the pre-treatment survey for statements such as, "When I study I know exactly the material I should be reviewing," and "Before taking a science quiz or test I feel completely prepared and confident." These heightened feelings of preparedness and confidence provide reasoning for the decline in academic anxiety.

There were, however, students who increased their academic anxiety as the treatment continued and finished. All of our first year St. Josaphat 6th graders this year fell into this group. When probed further about some of the statements, they confessed feeling overwhelmed with the amount and rigor of assessments. One said, "At my old school I didn't really have to study too much, the tests were pretty easy. Sometimes I feel embarrassed when I get my quiz back because everyone asks me what I got and I haven't done as well as them." Transitioning to a new school can be challenging both socially and academically. Expectations and classroom culture when it comes to academics can be difficult to adjust to, and so it is clear that feelings of being inadequate amongst peers may have added to nervous or anxious feelings.

Still, there were a few students whose higher total score did not change. These students continued to put pressure on themselves, and feel pressure from external sources. These students made comments such as, "Even if I feel like I've studied a lot I never feel prepared when it comes time to take the quiz. I don't know that I'll ever feel 100% prepared, that's just who I am." In the teacher journal that was kept throughout this experiment, it was noted that students would make comments like this on each post-quiz survey. In one journal post it is written, "How

do you instill the feeling of confidence in students by the time they get to junior high? By the time they are here they have labeled themselves as either good or bad test takers. How do I undo the self-doubt that they have built up for themselves?" These are not the first frustrations that have been felt about academic anxiety in junior high. It is, however, the first time the data surrounding it has been front and center. With this numerical data and student input perhaps it will allow next steps to be made. Opening lines of communication between students, parents and teachers about realistic requirements for high schools, debunking myths about "good" and "bad" test takers and teaching calming strategies before assessments may help academic related anxiety continue to reduce. The next section of this chapter will discuss what this means for future instruction and what the possible next steps may be.

Value of the Study and Consideration for Future Research

On their own, approximately half of students continued to use one or more of the study strategies to prepare for future assessments. Six weeks after the treatment ended students were asked whether they had continued to use any of the strategies learned to prepare for assessments in both science and their other classes. Of all 6th graders, 58.8% of them reported that they had continued to use them. Of those students, about half of them stated that they continued to use Quizlet. The remaining half were split between the summarizing chart, Kahoot games and visualizing strategies. It was encouraging to see that at least a few students found each strategy beneficial. One of the main purposes of this study was to teach study strategies in a way that students would see the value in them. When students can see their effectiveness, they are more likely to continue to use and build on them.

Unfortunately, not all students saw or felt the effectiveness of the strategies. Just under half of students, 41.2%, marked that they did not use one of the four strategies they learned anymore. A few elaborated on the question stating that they still used a strategy, just a different one from the four. For example, rereading notes that had been taken in class, or rereading the chapter. On the other hand, a large group of students who said that they no longer used the strategies gave the reason that they were too lazy, or they didn't have time.

Kids today have a lot on their plate; extracurricular activities and sports take up a lot of free time after school. It is easy to understand why they wouldn't want to spend their little bit of extra free time doing more work. The goal though is to encourage the creation and building of the strategy over a period of time, rather than in one or two nights. This can take planning and time management. There is perhaps a level of maturity that plays a role in this piece, as well as intrinsic motivation that may be missing. It is also possible that once they continue to mature and/or have time in their schedule, that even those who did not initially use the strategies will do so in the future.

Impact of Action Research on the Author

Explicitly teaching study strategies during the school year is a valuable and effective use of instructional time. Both students and parents made it clear in their survey and interview responses that overall independence, confidence, preparedness and organization have increased due to these strategies. It is easy to assume that students already have the ability to organize and review information by the time they get to junior high. However, these misconceptions may lead to never learning them if it is not addressed.

These study strategies could be even more effective if taught at an earlier age. With more exposure and more practice students may feel confidence early on, and therefore the labeling of “good and bad test takers" may decrease. Unfortunately, we cannot change the process of school choice and the way that high-achieving high schools in our area choose students. However, we may be able to alter the school climate when it comes to the pressure that is put on our junior high students. Study strategies play only a small role when it comes to that transformation, but it may be a good place to start.

As the researcher, the results of this study went beyond test taking and a student’s ability to perform. It illustrated that organization of material can increase understanding of content, and lead to more in-depth classroom discussions. While the school year can already feel short, taking time to teach study strategies to students has been proven to be worthwhile and invaluable. For this reason, the study strategy portion of the curriculum this year will carry over to next year, and the years that follow. The increase in both summative scores and confidence in students indicate the necessity to do so. The post-assessment surveys also provided quick check-ins with helpful feedback to gage how well the strategies were being implemented, and so they will also continue. As mentioned in the introduction, the pressures to do well academically have only increased student academic anxiety, particularly in schools that offer school choice options. The results of this study suggest that learning and using these strategies will decrease that anxiety for most students.

The results of this study only revealed more questions to be answered. How can we get junior high students to use time management skills to build studying into their daily routine? What are effective ways to manage academic anxiety and stress? How do schools build in study strategy support from an early age? What are ways that the school and parent communities can

work together to deflate the pressures of high school choice? Only with data collection and analyzing might we find answers in the conclusions and begin small steps towards solutions.

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APPENDICES

APPENDIX A

INSTITUTIONAL REVIEW BOARD EXEMPTION



Beiswanger, Kelly <kelly.beiswanger@montana.edu> Thu, Sep 16, 2021, 11:11 AM

to me

Dear Carolyn,

Thank you for your application. This email acknowledges receipt of the request for IRB Review and serves as the Approval Letter for your research. Your new **IRB Exempt Protocol # is CM091521-EX**. Please find your approved/stamped Consent Form attached.

As the PI, it is your responsibility to facilitate subject understanding by informing subjects of all aspects of the project, providing an opportunity to ask questions, and describing risks and benefits of participation. Submit any new changes to the research protocol to the IRB via Amendment Form prior to implementing.

The research described in your submission is exempt from the requirement of additional review by the Institutional Review Board in accordance with 45 CFR 690.104(d). The specific paragraph which applies to your research is:

> (1) Research, conducted in established or commonly accepted educational settings, that specifically involves normal educational practices that are not likely to adversely impact students' opportunity to learn required educational content or the assessment of educators who provide instruction. This includes most research on regular and special education instructional strategies, and research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

Thank you,
Kelly Beiswanger

IRB Administrator & Program Manager
Office of Research Compliance
Hamilton Hall 114
Montana State University

APPENDIX B

STUDY STRATEGY – SUMMARIZING CHART

Activity Summaries for Earth's Resources and Human Population

Activity Name	Objective(s) / Guiding Question	Key Vocabulary	What Was Learned?
1. Observing Earth's Resources	What are natural resources?	Natural Resource: Renewable: Nonrenewable:	
2. World Resource Consumption	How has an increase in population affected resource consumption?	Consumption: Properties: Deposits: Fossil Fuels:	
Bill Nye: Populations	What are populations and what do they require?	Population:	
Renewable and Nonrenewable Resources Homework	What is the difference between renewable and nonrenewable resources?		
3. Properties of Natural Resources			
4. Per Capita Consumption			
World Population Homework			
5. Finding Resource Deposits			
6. Extracting Resources			

APPENDIX C

STUDY STRATEGY – VISUALIZATION STRATEGIES

Geological Processes - Visual Strategies

Nuclear vs. Fossil Fuel Plants - compare/contrast

	Fossil Fuel Plant	Nuclear Plant
Advantages		
Disadvantages		

What happened in Chernobyl - cause and effect chart

Cause (Why something happens)	Effect (What happened)

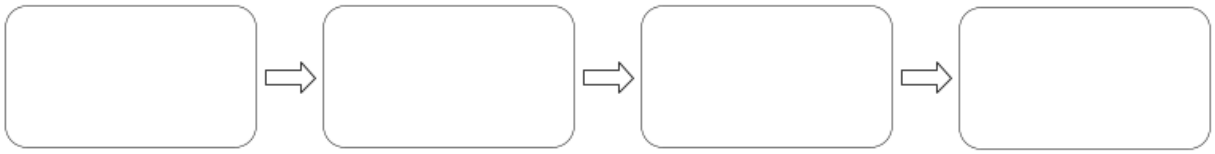
Storing Nuclear Waste - concept map



Investigating Groundwater - labeled drawing of aquifer and aquitard

Aquifer	Aquitard

Modeling Landslides - cause and effect



Beneath Earth's Surface - scaled diagram of earth's interior

Earth Layer	Lowest depth of layer below surface (km)	Scaled depth below surface (cm)
Crust	40	
Mantle	2,800	
Outer Core	5,200	
Inner Core	6,400	
Lithosphere	100	
Asthenosphere	250	

**Scale: 1 cm = 800 km

APPENDIX D

PRE AND POST-TREATMENT SURVEY

Pre-Treatment 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.

Directions: The statements in this questionnaire have to do with your opinions and beliefs about studying for science assessments. Please read each statement carefully, and circle the phrase and number that best describes your feelings.

1. When a quiz or test is announced, approximately a week ahead of time, I begin to study that night.
Never **Sometimes** **Often** **Always**

2. When I study I know exactly the material that I should be reviewing.
Never **Sometimes** **Often** **Always**

3. When I study I try to think about what the teacher might ask on the assessment.
Never **Sometimes** **Often** **Always**

4. I use a specific type of strategy when I study for science assessments.
Never **Sometimes** **Often** **Always**

5. I review my notes at home on a nightly basis, even when I don't have an assessment coming up.
Never **Sometimes** **Often** **Always**

6. I prefer to study completely on my own.
Never **Sometimes** **Often** **Always**

7. As a part of my studying I ask my parents or a friend to quiz me.
Never **Sometimes** **Often** **Always**

8. Before taking a science quiz or test I feel completely prepared and confident.
Never **Sometimes** **Often** **Always**

9. My score on a science assessment matches how prepared I feel before taking it.
Never **Sometimes** **Often** **Always**

10. I know how to study for a science assessment.
Never **Sometimes** **Often** **Always**

APPENDIX E

ACADEMIC ANXIETY QUESTIONNAIRE

The items in the questionnaire refer to experiences that may cause fear or apprehension. For each item, place a check in the box under the column that describes how much you are frightened by it. Work quickly, but be sure to consider each item individually. For each box you check, write down the corresponding number of points: Not At All = 1; A Little = 2; A Fair Amount = 3; Much = 4; Very Much = 5.

SITUATION	NOT AT ALL	A LITTLE	A FAIR AMOUNT	MUCH	VERY MUCH
1. Going into a regularly scheduled class period in which the teacher asks the students to participate.					
2. Rereading the answers I gave on the test before turning it in.					
3. Sitting down to study before a regularly scheduled class.					
4. Turning my completed test paper in.					
5. Hearing the announcement of a coming test.					
6. Getting a graded test back.					
7. Reading the first question on a quiz or test.					
8. Studying for a class in which I am scared of the teacher.					
9. Being in class waiting for my corrected test to be handed back.					
10. Seeing a test question and not being sure of the answer.					
11. Studying for a test the night before.					

12. Waiting to enter the room where a test is to be given.					
13. Waiting for the teacher to pass out the blank test.					
14. Being called on to answer a question in class by a teacher.					
SITUATION	NOT AT ALL	A LITTLE	A FAIR AMOUNT	MUCH	VERY MUCH
15. Waiting for the day my corrected test will be given back.					
16. Looking at my test score and comparing it to my friends.					
17. Discussing with my teacher an answer I believed to be right, but that was marked wrong.					
18. Waiting to see my letter grade on the test (A, B, C, D, F).					
19. Studying for a quiz.					
20. Studying for a test.					
21. Studying for a final test of everything learned in a trimester.					
22. Discussing my upcoming test with friends a few weeks before the test.					
23. After the test, listening to the answers that my friends selected.					
24. Looking at the clock to see how much time remains during the test.					
25. Seeing the number of questions that need to be answered on the test.					

26. Seeing a short answer response that I cannot answer.					
27. On a multiple-choice test, seeing a question I cannot answer.					
28. Being asked by someone if I am ready for an upcoming exam.					
29. Being the first one to finish a test and turn it in.					
30. Being asked by a friend about how well I am doing in a class.					

SITUATION	NOT AT ALL	A LITTLE	A FAIR AMOUNT	MUCH	VERY MUCH
31. Being asked by a friend how well I did on a test when I did poorly.					
32. Discovering I need an A or B on the next test in order to pass the class.					
33. Discovering I need an A or B on the final to maintain the overall grade that I want.					
34. Remembering my past reactions while preparing for another test.					
35. Going to the teacher to ask for advice or help.					
36. Being tasked to see the teacher about my classwork.					
37. Asking for a make-up exam after missing the scheduled test.					
38. Being the last one to finish an exam and turn it in.					

39. Reviewing for a test just before entering the classroom the day of the test.					
40. Reviewing study materials the night before a test.					
41. On the first day of school hearing the teacher announce the days of the first upcoming quiz and test.					
42. Having the teacher ask a question about what we are learning and then look in my direction.					
43. Setting up a time to see my teacher about the material we are learning.					
44. Thinking about an upcoming test *3 weeks before* it's scheduled.					
45. Thinking about an upcoming test *1 week before* it's scheduled.					

SITUATION	NOT AT ALL	A LITTLE	A FAIR AMOUNT	MUCH	VERY MUCH
46. Thinking about an upcoming test *the weekend* before it's scheduled.					
47. Thinking about an upcoming test *the night before* it's scheduled.					
48. Thinking about an upcoming test *the hour before* it's scheduled.					
TOTALS FOR EACH COLUMN					

APPENDIX F

TREATMENT TIMELINE

Time	Activities
Strategy - None August 23 - Sept. 14 (15 days)	**QUIZ #1**: First unit - Scientific Method - no study strategy - baseline scores
Strategy - Summarizing using a summary chart September 15 - October 14 (20 school days)	**Fill in summary chart as a class:** 1. Observing Earth's Resources (Act. 1) 2. World Resource Consumption (Act. 2) 3. Bill Nye: Populations (have students take a pre quiz on what you call groups of different animals) 4. Renewable or Nonrenewable Homework
	Fill in summary chart in small groups: 5. Properties of Natural Resources (Act. 3) 6. Per Capita Consumption (Act. 4) 7. Per Capita Homework
	Fill in summary chart on own: 8. Finding Resource Deposits (Act. 5) 9. Extracting Resources (Act. 6)
	QUIZ #2
Strategy - Gamification using Kahoot! October 15 - Nov. 7 (13 days)	1. Geological Processes (Act. 7) 2. EdPuzzle Fossil Fuels Homework **Kahoot: teacher made on #1 and 2** **I showed them the LabSent for Activity 8 to understand aquifers better 3. Modeling Rock Layers (Act. 9) 4. Clues to Earth's Past video Law of Superposition Task Cards **Kahoot: teacher made on #3 and 4** 5. Earth's History (Act. 10) 6. Fun with Stratigraphy Homework 7. Geological Event Cards ordering and Fossil Activity **Kahoot: teacher made on #5, 6 and 7**
	8. Reading Rock Strata (Act. 12) 9. Bill Nye: Fossils **Kahoot: students search and find a Kahoot on fossils; share in small groups**
	10. Impact on Earth's Systems (Act. 13) **Kahoot: Students make their own based on reading in Act. 13**
	QUIZ #3 (Thursday, Nov. 7)
	First, review how to create concept maps, cause and effect charts and compare and contrast diagrams (2 days?)

Strategy - Visualization November 17 - November 22 (14 days) Concept maps, cause and effect chart, compare and contrast, picture/diagram	1. nuclear vs fossil fuels (compare and contrast table in video for students to copy) 2. Introduction to Chernobyl explosion video (cause and effect diagram; open page in Notability and complete while watching video) 3. Chernobyl video homework cause and effect 4. Storing Nuclear Waste (Act. 1) concept map 5. Investigating Groundwater (Act. 2) labeled drawing comparing aquifers and aquitards 6. Modeling Landslides (Act. 3) cause and effect diagram 7. Beneath Earth's Layers - diagram of earth's interior 8. Earth's Layers Notes - concept map of layers
	Have students create a study guide using visualization strategies
	QUIZ #4
Strategy - Flashcards and Self-Testing November 23 - December 13 (12 days)	1. Natural Hazards of Earthquakes and Volcanoes (Act. 4) 2. Modeling Volcanic Eruptions (Act. 5 - Lab) **Teacher made Quizlet on #1 and 2**
	3. Bill Nye: Volcanoes 4. Mapping Locations of Earthquakes and Volcanoes (Act. 6) **Teacher made Quizlet on #3 and 4**
	5. Earthquake and Volcano Notes 6. Should Yellowstone's Supervolcano be used for energy? Homework 7. Earthquake Lab **Student made Quizlet on #6 and 7**
	QUIZ #5
Strategy - Student Choice December 14 - Jan 11 (11 days)	1. Understanding Plate Boundaries (Act. 11) 2. Snack-Tectonics 3. Plate Boundary homework 4. Student created plate boundary notes 5. The Continental Puzzle (Act. 12) 6. The Theory of Plate Tectonics (Act. 13) 7. Alfred Wegener Evidence 8. The Rock Cycle (Act. 15) 9. Rocks as a Resource (Act. 16) Google Forms survey on study strategy choice
	QUIZ #6

APPENDIX G

GEOLOGICAL PROCESSES AND EARTH'S HISTORY QUIZ

Geological Processes and Earth's History Quiz (Activities 7 - 13)

Name: _____

Remembering (5 points)

1-3. Directions: Match the vocabulary word with the correct definition. (½ point for each)

A cylindrical piece of rock removed from earth used to study the layers ___	a. Geological processes
The "calendar" of events in Earth's history. ___	b. sediments
Small pieces of Earth's materials including sand, dirt and shells. ___	c. aquifers
Actions that shape Earth's surface layer are known as this. ___	d. strata
Rock layers are also known as this. ___	e. Geological time scale
Underground areas of rock that contain large amounts of trapped water. ___	f. Drill core

4. A tree has fallen in a lake close to where an active volcano is located. After an eruption, the ash has sunk to the bottom of the lake and the tree continued to soak it in. After many years the water in the lake has gone and the tree is left behind. What kind of fossil is being described?

a. Trace b. Imprint
c. Petrified d. Amber

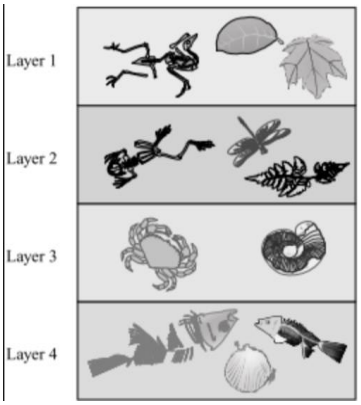
5. Subsidence is mainly caused by:

a. Glaciers b. Fracking c. Emptying aquifers d. The greenhouse effect

Understanding (5 points)

6. In which layer to the right are you most likely to find **fossil fuels**?

a. Layer 1 b. Layer 2
c. Layer 3 d. Layer 4



7. All of these are examples of ways humans have keep up with resources demands **except**:

a. Fish farms b. Fracking c. Closing mines d. Draining aquifers

8. A map showing the location of ancient oceans can be used to determine:

a. The location of metal ore deposits b. The location of fossil fuel deposits

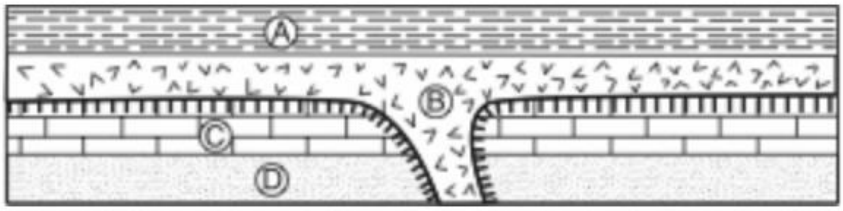
c. The location of large areas of freshwater d. None of the above

9. Minerals, like copper, would most likely be found:
a. In a river b. In the mountains c. In the desert d. In a valley

10. Why is a material like clay helpful in creating an aquifer?
a. Clay lets groundwater run through it easily b. Clay does not let water through easily
c. Clay doesn't help in creating an aquifer d. It is made up of coarse sediments

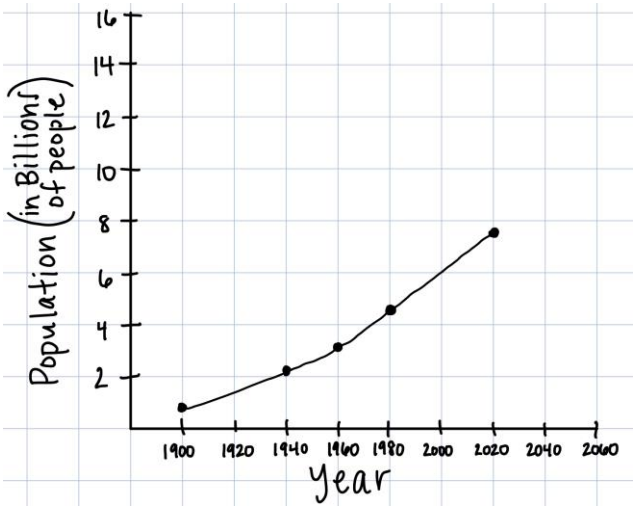
Applying (5 points)

11. This cross section below shows four rock layers A, B, C and D. Which rock layer is the youngest?



a. A b. B
c. C d. D

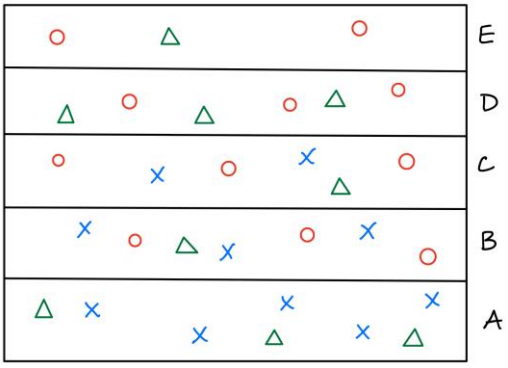
12. Look at the graph of the population below. Predict what the population will look like by the year 2040 by ***drawing a dotted line to continue the graph.*** Assume that there are no wars, or massive diseases that wipe out large amounts of people.



13. A scientist finds a marine seashell fossil at the top of a snowy mountain. What might that tell us about that area's history?
a. That area used to be a marine environment a long time ago
b. Someone left the fossil there after visiting
c. A volcano blew it out recently
d. The marine organism climbed up the mountain and died there many years ago.

14. Look at the diagram of rock layers to the right. Circle the best place a paleontologist would end a time period and begin a new one. Then describe why they would choose that spot (Hint: there may be more than one option! Just choose ONE).

a. Between layers A and B
b. Between layers B and C
c. Between layers C and D
d. Between layers D and E



15. Explain your choice:

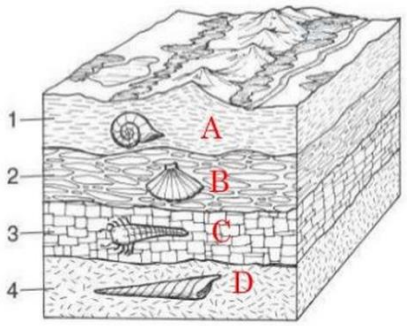
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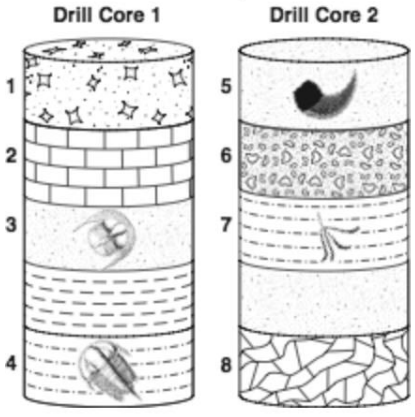
Analyzing (5 points)

16. Information from the diagram to the right can be used to determine:
a. When the last ice age occured
b. The relative, or estimated, age of the fossils found in the rocks.
c. The exact age of the fossils in each layer.
d. This diagram cannot be used to determine any part of earth's history.



17. The drill-core samples below were taken from two locations 1000 kilometers apart. Rock layers 1-8 have been labeled and some fossils are shown in the layers.

Which numbered layers *most likely* formed at the same time?
a. 1 and 6 b. 2 and 8
c. 3 and 6 d. 4 and 7



Please use the same example in questions 18 - 20
18. Provide an example of one way that humans have kept up with increased demand for resources.

_____

_____

_____

19. Based on your example, what is a negative impact on the environment as a result of keeping up with the demand?

_____

_____

_____

20. Finally, name a possible approach to reducing the use of the natural resource in your example.

_____

_____

_____

Evaluating (5 points

20 - 25. Colorado is one of the largest fossil fuel producers, ranking 11th in coal, 6th in oil and 6th in natural gas. Oil and gas companies from Colorado bring in more than $31 billion to the state's economy and provide more than 232,000 jobs to the state.

Tourism and Snow Skiing are also important industries to Colorado. Together, they account for $50 billion in revenue for the state each year. Unfortunately, Tourism and Snow Skiing have now become threatened due to global warming from the burning of fossil fuels.

Currently, oil rigs and drills must be 500 feet from buildings, schools, homes and water sources. Some groups in Colorado are fighting to increase this distance. They feel oil rigs and drills should be 2,500 feet away from these protected areas in order to limit health and safety risks from potential leaks or explosions.

Do you agree with the groups trying to move the distance? Explain your choice using evidence from the information given and then identify a tradeoff. Be specific with your evidence! (5 points)

_____

_____

_____

_____

_____

_____

_____

_____

_____

5 Complete and correct	The student provides • a clear and relevant choice • appropriate evidence • sufficient reasoning • a thorough description of the trade-offs of the decision
4 Almost there	The student is missing <u>one</u> of the following points: • a clear and relevant choice • appropriate evidence • sufficient reasoning • a thorough description of the trade-offs of the decision
3 On the way	The student is missing <u>two</u> of the following points: • a clear and relevant choice • appropriate evidence • sufficient reasoning • a thorough description of the trade-offs of the decision
2 Getting started	The student only addressed one of the following points: • a clear and relevant choice • appropriate evidence • sufficient reasoning • a thorough description of the trade-offs of the decision
1	The student's response is irrelevant and does not answer the question that is asked.