

MODIFIED LECTURE APPROACHES AND THEIR IMPACT TO IMPROVE
STUDENT UNDERSTANDING AND PERFORMANCE IN SCIENCE

by

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ABSTRACT

In this investigation modality strategies were implemented in lectures with the purpose of improving student engagement and learning in their individual work. Lecture activities were differentiated according to three different learning styles, visual, auditory, and kinesthetic. The lectures were divided into two types, which were traditional and lectures including modality strategies. Though performance and summative assessments showed some improvement following the treatment, students demonstrated and expressed more positive attitudes toward both visual and hands on activities.

INTRODUCTION AND BACKGROUND

Introduction to Modified Lectures Approaches and Learning Styles

Introduction

I believe every student can learn. I also think that teachers need to apply methods of differentiated instruction so that each individual student can learn, and teachers can identify, what learning method works best for students. Teachers need to take into account differences in learning styles, instructional strategies, and assessment opportunities. Gayle Gregory (2005) believes we must know the learner, assess the learner, and change instructional strategies and curriculum approaches to empower students to learn.

The No Child Left Behind act mandates that all students will learn. How do students learn? Perhaps teaching students the various learning styles and applying different lecture techniques will facilitate students to be efficient and effective learners.

Therefore, in this research project I structured six lessons for three different learning styles. I hoped to accelerate learning and to keep students engaged so more learning took place.

What causes students to stay engaged, be interactive and learn during a lecture? Do students learning styles really affect what they absorb during a normal classroom lecture? If the traditional lecture format is only good for auditory learners, how do we create lectures for varied learning styles?

My Action Research project is a study on “Modified Lecture Approaches and Their Impact in Improving Student Understanding and Performance in Science.” The

Modified Lecture Approach includes lecture timing, learning styles, and teacher empathy. This Action Research project will discuss the affects the Modified Lecture Approach has on stimulating students and their ability to learn and retain information.

The main reason I started this project was due to a situation that happened as I was teaching academically challenged students in 7/8th grade math classes. The school district decided to change the math program two-thirds of the way through the school year. My students' math skills were so low that most of them were just learning the basics. Most of them could add, subtract, multiply and divide, but anything above those processes was too advanced. These students could not calculate percents, fractions, or decimal based operations. Basic geometry was like a foreign language, and they were also slow readers and struggled with spelling and writing. In addition, my students were not on Individualized Education Programs (IEP).

I think that the school districts "New Math" policy caused my students to go from advancing in their basic math skills, feeling confident and successful, to feeling complete despair and failure. Instead of just answering the problem, the new math required them to write how and why they got their answer. So instead of $2 \times 2 = 4$, they had to write why $2 \times 2 = 4$.

Furthermore, my students struggled with the spelling, the vocabulary, the sentence structure, the thought process, the length, and the amount of writing involved. Their spelling and writing skills were so poor that I could not understand what they were trying to explain. When I went back to the students and asked what they were trying to say they could not even read their own writing. Everybody was frustrated and the students quit working and gave up. The behavior problems escalated.

I fought the district for the students, but the district had adopted the theory that one size fits all. The fact that students have different learning styles or abilities did not matter to the district, as everyone was going to be treated the same.

Another reason I started this Action Research project was in response to an article I read in which the University of Illinois Extension (2009) states over half the population is kinesthetic (hands on) learners, 40% are visual learners while only 10 % are auditory learners .

One article dealt with how breaks in the lecture influenced students' ability to stay on task. Attention span has been defined as the amount of time that a person can concentrate on a task without becoming distracted. Most educators and psychologists agree that the ability to focus one's attention on a task is crucial for the achievement of one's goals.

Several articles believed that attention spans vary with age and are getting shorter and shorter due to the affects of television, video games and the internet. Many children are growing up watching six or seven hours of television a day. Television is broken up into 12-minute segments, and it is possible that people are slowly becoming conditioned to become antsy after doing any single task for greater than 12 minutes. The National Teaching and Learning Forum agreed with these findings (Sullivan, 1996).

I found this article intriguing and I thought that a "change-up" could be beneficial to restart students' attention clocks. Thus, how often the change-up is needed is one of my research questions.

The type of change-up used to promote attention could be a creative activity, a lab, a visual aid, or a change in lesson direction or a simple change in pace that re-

charges the student's attention span. Maybe a change-up is nothing more than having the student explain their new knowledge to other students using a collaborative learning technique. In practice, these activities would last for two to five minutes and start as the students became disengaged. I expected the disengagement to happen around 15 minutes after the start of the lecture. The change of direction would "re-energize" them for the next 15 to 20 minutes and would be repeated as needed throughout the lecture.

I became interested in lecture styles and attention deficiencies and how they relate to learning style because I struggle. I struggle with sitting still, I struggle with listening to a lecture and I want to move, to do, to touch. So I started researching learning styles and discovered articles that affected what I wanted to do for my capstone project.

There seems to be disagreements within the articles regarding what percent of the studied populations were kinesthetic, visual or auditory learners. According to the University of Illinois Extension, over half the research population was kinesthetic (hands on), 40% were visual learners, and only 10 % were auditory learners. I wonder if only 10% of secondary students learn best audibly (i.e. lectures), why are we teaching 80% of the instruction in the traditional lecture method (University of Illinois at Urbana Champaign, 2008)?

Carbo, Dunn, and Dunn (1986) stated, "Approximately 20% to 30% of the school-aged population they studied remembered what was heard; 40% of students recalled better visually the things that were seen or read; and many students needed to write or use their fingers in some manipulative way to help them remember basic facts; finally, others could not internalize information or skills unless they used them in real-life activities" (p 13).

Dunn and Dunn (1992) believed that 65% of the population they studied consisted of visual learners, thus when teachers lecture, they reach less than half of the class and many students need learning strategies that accommodate their learning styles. Guild (1994) stated: “Knowing each student and their individual differences is essential to preparation for facilitating, structuring, and validating successful learning in the classroom for all students” (Guild, 1994, p.16).

After reading several articles, I decided to test my own student population to examine their learning styles and learn how their learning styles affect lectures, learning and understanding in science.

The last thing that influenced my decision to start this Action Research project was the student interviews I conducted for another class. The theme that appeared in every interview was that if the teacher had empathy and truly cared about the student, the students would try harder and more learning would take place. The students basically said, “If the teacher doesn’t care about me I don’t try.” My present “picture of teaching” includes not only breaks or a change of direction, (i.e. visual aids, or hands on activities) to prevent the lapse in attention, but also includes the key for learning; empathy for the students.

Research Questions

Primary Question

What is the impact of a Modified Lecture Approach using modalities and lecture time limits in improving understanding and performance in a science classroom?

Secondary Questions

1. What are the effects of lectures using modality strategies on the students' comprehension in the science classroom?
2. What impact does teaching to a student's learning style have on a student's learning and understanding in Science?
3. Do different lecture styles have an impact on keeping the students on task, engaged and focused?
4. What is the impact on a teacher when using the Modified Lecture Approach in a science classroom?

I currently do not have a classroom, but I worked with two different science teachers who let me use/borrow their high school science classrooms. Both classrooms were 9th grade physical science courses. The teachers allowed me to have input in how the material would be delivered but not the academic material. They also wanted to do the majority of the teaching, and I could observe. I taught the learning styles lesson and co-taught lessons 12-1 and 12-2. When I co-taught I discovered I could not observe the students and record the needed information. This process was not how I originally had planned my research, however, it worked out great because I could observe and take notes which included a lot of recording of data. I was grateful for the use of the classrooms and the students. I also did my practicum for my Special Education endorsement, and I observed the special education classes and recorded other lecture information.

CONCEPTUAL FRAMEWORK

Introduction

A learning style is a student's consistent way of responding to and using stimuli in the context of learning, and Stewart and Felicetti (1992) define learning styles as those educational conditions under which a student is most likely to learn. Thus, learning styles are not really concerned with "what" students learn, but rather "how" they prefer to learn. The teaching profession has long recognized the need for innovative instructional activities that relate to the diverse learning styles of students, but they question how meaningful they are to the learning environment. Marzano (1998) conducted a large study and found that graphic and tactile presentations of the subject matter had noticeable effects on learning outcomes, regardless of any attempt to match them with learners' modalities.

Learning styles cannot easily be changed. It is not enough to develop an awareness of the students learning style but also awareness of the classroom population learning style. This awareness must be translated into a zone of comfort for learning and teaching strategies. Robert P. Ouellette (2000) suggested that an astute learner will develop a repertoire of strategies that favor their preferred learning style, but allow them to deal with situations where the preferred learning style is not effective.

I developed my theoretical framework after reading several articles that investigated topics on learning styles and various lecture formats. Studies on the attention span and learning styles shed light on why students have difficulty with the traditional lecture presentations. Though there are many types of learning styles, I used Fleming's

VAK/VARK model (Fleming and Mills, 1992, p. 137), one of the most common and widely-used categorizations of the various types of learning styles. Therefore I investigated the use of three of Fleming's learning styles: visual learners, auditory learners and kinesthetic learners.

Visual learners have a preference for seeing, they think in pictures; use visual aids such as overhead slides, diagrams, handouts, etc. Auditory learners' best learn through listening to lectures, discussions, tapes, etc. Tactile/kinesthetic learners' prefer to learn via experience by moving, touching, and doing active exploration of the world; science projects; experiments, etc. Its use in pedagogy allows teachers to prepare classes that address each of these areas. Students can also use the model to identify their preferred learning style and maximize their educational experience by focusing on what benefits them the most. Research by child development theorist Linda Kreger Silverman (2002) suggested that less than 30% of the studied population used visual thinking; another 45% used both visual/spatial thinking and thinking in the form of words, and 25% thought exclusively in words.

With the help of two grants from the Morris S. Smith Foundation, the two instruments were validated on 750 fourth, fifth and sixth graders. In this research, one-third of the school population emerged as strongly visual-spatial. An additional 30% showed a slight preference for the visual-spatial learning style. Only 23% were strongly auditory-sequential. This suggests that a substantial percentage of the school population would learn better using visual-spatial methods.

Maryann K. Lovelace (2005) performed a quantitative synthesis of experimental research conducted between 1980 and 2000, in which the Dunn and Dunn Learning-Style

Model was used. The results overwhelmingly supported the position that matching students' learning-style preferences with complementary differentiated instruction improved academic achievement and students' attitudes toward learning (Lovelace, 2005).

Attention Span

The timing and presentation are the next two important parts of delivering a lecture. Some authors believe adult learners pay attention to a lecture for no more than 15 to 20 minutes at a time, starting from the beginning of the class. Two researchers, Middendorf and Kalish (1996), observed students in over 90 lectures, with 12 different lecturers and recorded breaks in student attention. They identified a general pattern: After three to five minutes of "settling down" at the start of class, they found that the next lapse of attention usually occurred some 10 to 18 minutes later, and as the lecture proceeded the attention span became even shorter. Combining what they knew about attention span and how the mind works, they suggested that lectures should be punctuated with periodic activities (Middendorf & Kalish, 1996).

Are attention spans only 15 to 18 minutes long before our mind wanders or shuts down? "If this is so then the fifty minute to an hour and a half science class lecture are not the ideal learning situations for a student" (Felder and Silverman, 1988, p. 674). Lectures should be in 15 to 20 minute sections spaced with active learning activities to re-energize participants for the next wave of information. Periodic breaks may help relieve student fatigue and restart the attention clock. Some educators recommend using these breaks in attention for relevant demonstrations or activities, including questions at the end to ensure that students get the point.

You can prolong attention spans by periodically giving your audience a change-up. This can be done by telling a story, a joke, giving a demonstration, showing a visual aid, having the students retell the lesson in their own words or doing something else that gives the brain a break. An analogy to what you are doing is running hard for a few minutes, taking a break, and then running hard again. However, just as you usually are not able to run for as long after the break, you cannot expect the renewed attention span to last as long after the pause.

Jeff Davidson (2003) the author of *The Complete Guide to Public Speaking*, states that attention spans are at seven minutes, an all time low. He suggests that if you are in front of a group and you do not have something humorous to say at least once every seven minutes, you are going to have a tough time.

Internet and Video Games

The students' attention spans are becoming shorter due to the student's ability to get immediate gratification when utilizing the computer (internet and video games) and due to the hours children spend watching television.

The Net Generation (Net Geners) ages 12-24 are the first to grow up with digital and cyber technologies. The Net Geners are so inundated with technology that by the time they have reached 21 years of age, the average Net Gener will have spent 250,000 hours playing video games, on e-mail, watching TV, on cell phones, and under 5,000 hours reading (Prensky, 2001).

Net Geners have distinctive ways of thinking, communicating, and learning. Glenn (2000) feels Net Geners need more self-directed learning opportunities, interactive environments, and assignment choices that use different resources to create personal

meaningful learning experiences. Digital Age students need more varied forms of communication and become easily bored with traditional learning methods.

The Net Geners are of the now generation. The Net Geners want everything now; information, food, answers, things. Anything they want is at their fingers tips. Computers are guilty of giving information on demand. The students are more aggressive in seeking information and desire more active, engaged learning experiences (Oblinger & Hagner 2005). Hay (2000) suggested that Net Geners want more hands-on, inquiry-based approaches to learning.

Television

Many children are growing up watching six or seven hours of television a day. Television is broken up into 12-minute segments, and it is possible that people are slowly becoming conditioned to become antsy after doing any single task for greater than 12 minutes. The National Teaching and Learning Forum agreed with these findings (Sullivan, 1996).

Dimitri Christakis, a pediatrician at Children's Hospital and Regional Medical Center in Seattle indicated that the possible link between watching TV and attention problems is of great concern because so many infants and toddlers are frequent viewers. Frequent TV viewers in early childhood were most likely to score in the highest 10% for concentration problems, impulsiveness and restlessness (Christakis, Zimmerman, DiGiuseppe & McCarty, 2004).

Because the internet and television are possibly creating shorter attention spans, we need to evaluate how we have been teaching and how are we going to address future lectures and examine learning styles. If the students are to be excited about what they are

learning, and it is to be presented in a method they understand, teachers will have to teach to the students learning style. This will require more prep work for teachers but it will benefit all students.

Clearly, it has been observed that attention spans vary, but in general, people are capable of longer attention spans when they are doing something they find enjoyable or motivating. According to Cornish and Dukeette, (2009), “attention is also increased if the person is able to perform the task fluently, compared to a person who has difficulty performing the task or to the same person when he or she is just learning the task. Fatigue, hunger, noise, and emotional stress can also reduce time on task” (p. 73). In their study, because the students found the task difficult while doing Treatment # 6 Boyle’s Law, the students became frustrated and basically quit working. However, after losing attention from a topic, a person may restore it by taking a rest, doing a different kind of activity, changing mental focus, or deliberately choosing to re-focus on the first topic.

Dividing the lessons into smaller active parts obviously plays an important part when teaching science to this new generation of students. Before reading the articles on attention spans, I thought I only had to teach to different modalities and learning would take place, yet after reading the articles it seems the Net Geners need even more creative visuals and active hands-on activities than I realized.

I think I need to change my teaching methods by utilizing creative activities and developing “change-up lessons” to restart the student’s attention clocks in the daily lessons. My lectures format must not only deal with the students’ shortened attention spans, but also the individual student’s learning style.

Learning Styles

Does teaching with different modalities affect the learning process? Do different teaching styles have an impact on keeping the students on task, engaged and focused? I want to examine personal learning styles; auditory, visual and kinesthetic and how it affects learning in the science classroom. “Your learning style may be the single most important key to improving your grades. Research shows that students perform better on tests if they change their study habits to fit their own personal learning styles” (Fleming, 2010, p.1).

Learning styles classify different ways people learn and how they approach information. If students have trouble learning something important, it might be because they need it taught in a way that addresses the individuals learning style. We all learn and process information in our own special ways. We share some learning patterns, preferences, and approaches, but knowing the student learning styles can help approach the same information in a way that’s different and useful to that particular learning style.

Learning styles are important throughout a student’s education, from pre-kindergarten through college and beyond. Learning styles affect how we learn our entire life.

Many in-coming freshmen enroll in community colleges with a strong desire to improve their standard of living. However, less than 63 % of these students return for a second year. To understand this problem, the learning-styles of two distinct community college populations, education majors and remedial students, were examined. Although the two groups evidenced no significant differences in their perceptual strengths and

hemispheric processing styles, comparative analyses revealed significant differences for specific learning-style elements (Rochford & Mangino, 2006, p. 1).

Learning styles are becoming a widely talked about topic in college. The traditional straight lecture to the students is not working for everyone, and “Research has demonstrated that the less academically successful college students are, the more important it is to accommodate their learning-style preferences” (Dunn, 2003, pp. 1-6).

Rochford and Mangino (2006) researched several different authors and found: Despite prior research that has demonstrated improvements in academic achievement and retention when college students are taught with methods that address their individual learning styles, many college educators continue to rely on traditional methods because they believe it produces achievement as long as the students are motivated and apply themselves (pp.23-36).

Most instructors are not cognizant of the fact that less than a third of their pupils can recall what they hear during a classroom lecture (Dunn, 2003). However, many of these same learners remember well when they learn tactually by using their hands, or kinesthetically through whole body movement. “Nonetheless, many tactual and kinesthetic students cannot achieve success in college because they are expected to sit and listen passively in class when they, instead, crave active engagement to learn effectively” (Rochford, 2004, p.23).

Mangino and Griggs (2003) examined experimental research conducted in various undergraduate courses, and discovered that when instruction was congruent with college students’ learning-style preferences, they achieved significantly higher scores than when mismatched.

Rochford (2004) replicated these findings and she confirmed that preparing under-achieving remedial writing students at an urban community college with learning-style responsive materials resulted in significantly higher achievement and levels of curiosity than the use of a traditional classroom chalk and talk method.

Pashler, McDaniel, Rohrer and Bjork (2009) disagree and believe learning styles have "enormous popularity" and both children and adults express personal preferences, but there is no evidence that identifying a student's learning style produces better outcomes, and there is significant evidence that the widespread "meshing hypothesis" (that a student will learn best if taught in a method deemed appropriate for the student's learning style) is invalid. In my own Action Research, I decided to challenge that statement and evaluate its validity with my own research on students and classrooms.

Pashler et al., (2009) seem to contradict themselves because they conducted a study entitled "Graphic Organizers: A Review of Scientifically Based Research". They evaluated a total of 29 studies on visual aids and concluded that visual learning improved student performance in the following areas: Critical Thinking, Retention, Comprehension, and Organization. After reading this article, I realized not only do I need to lecture less and change the routine quickly; I also need to incorporate more visual aids and more hands on methods in my teaching style.

"Learning only happens when students 'do', not when they listen passively to a lecture" (Howell, 2001, p. 88). It is argued that students achieve best when their learning preferences are matched to teaching methods (Carbo, Dunn & Dunn, 1986).

The lessons were presented in the student's preferred learning styles to see how it affected motivation and cognition in the science classroom. To find the student's learning style the student's were given three different surveys. The results of the survey showed 37% of the students having one preferred style. The primary goal in the lecture formats was to insure that the students remained focused and engaged and learning takes place.

Lecture Format

What is the impact on the teacher if they use the modified lecture approach in a science classroom? School districts now have the mandated "no child left behind" policy. With the budget cuts and class sizes growing and the demands on the teachers increasing, how can teachers make sure no student is left behind?

We need to look at each student as an individual, unique, with their own style of learning. As class sizes grow and the pressure of guaranteeing the success of each student, how can science teachers create 30 plus different lessons so each student has their own individualized education program? I think that a teacher cannot and does not have enough time in a day to do that.

A key component in trying to individualize instruction in the science classroom might be to insure we teach to the students learning styles. Instead of teaching 25 plus different science lessons, the teacher can change their lecture style, for example, by simply adding visuals and hands-on items to create independent and unique learning situations. Instead of creating thirty individualized lessons I can teach to the whole class while treating each student as an individual through modified lectures using modalities to encourage learning.

I predict I will find the answers by using modified lectures and teaching with modalities. The students will be engaged, on task, and there will be an improvement in what the students learn and want to learn. I predict I will find students that, if they are taught by the traditional lecture styles, will become frustrated, bored or off task. I believe student-centered activities allow for more freedom within the lessons and will result in less chance for the student to be off-task.

The articles I reviewed concerning the length of the lectures and learning styles helped me establish my research questions and treatments. During my research, observations were my primary assessment technique for the data collection on lecture lengths and engagement. The students learning was measured by worksheets, One Minute Papers, a modified Classroom Assessment Technique # 38 (Angelo & Cross, 1994, p. 308), a quiz and a test on chapters 12 and 13 in the textbook, *Foundations of Physical Science* by Tom Hsu (2009).

I also addressed the questions: Do the teachers have time to spend creating lectures with special lengths, breaks and strategies? Do the benefits outweigh the time involved?

METHODOLOGY

Demographics

Community

The high school where I conducted my research is in a small rural town located in Douglas County, in southern Oregon. . The population of the town is approximately 5,500, and the surrounding population totals about 33,000, with two high schools. Most residents are low income due to massive mill lay-offs and lack of jobs. Due to the lack of

employment, many families are moving away to find jobs and the school where I worked experienced a major drop in attendance. The unemployment rate is nearly 20%. The only big industry still in business is a lumber mill that has gone from having three shifts running 24/7 down to having only one shift.

District

The school district manages five schools and 1,595 students. The district revenue per student is \$8,193 while the state average is \$10,560. The district expenditure is \$8,099 per student and the state average is \$10,617. Breaking the budget down by expenditures: 56% of the money goes for instruction, 8% Student and Staff support, 16% Administration, and 19% for other expenditures. It has received a Great Schools Rating of 6 out of 10, based on its performance on state standardized tests.

School

Douglas High School is a public high school. The building is over 50 years old and in need of repair. It serves grades 9-12. This school has an average Community rating of four out of five stars, based on reviews from 11 school community members.

The high school has a total of 492 students in grades 9th-12th. It is composed of 45% males and 55% females. Students by grade: Grade 9 - 122 students, Grade 10 - 130 students, Grade 11 - 113 students, and Grade 12 - 127 students. There are a total of 21 classroom teachers. The teacher to student ratio is 1:23. The Oregon state average is 1:23. Over 49% of the students are on the state's Free and Reduced Lunch

Program. Even through the economic struggles that the families are facing, the students are still learning and achieving the state requirements and goals.

The school district runs a four day week. They usually take Friday off unless Monday is a holiday. The school begins each day at 7:25 and ends at 3:28. The daily schedule consists of seven periods with a nutrition break at 9:30. It has an open campus policy for lunch, and lunch is thirty minutes. The school encourages the students to stay on campus by having tournaments and other fun activities during lunch.

The high school is ancient when it comes to technology. There are no laptop computers, Smart boards, document cameras, or even ways to bring your own personal laptop; and the list goes on.

High School Students

Ethnicity

The most common ethnic group at the high school was White-non-Hispanic (80%), 2% were Hispanic, 2% Asian/Pacific Islander, 2% American Indian, 14% Unknown and no students were African American. The percent of migrant students enrolled was 2%.

Academics

In 2010, 65% of the school's seniors received a modified high school diploma. To receive this diploma the students' educational plan had been modified in some form, vocational studies or fewer requirements. Of 127 students, 82 graduated, 32 dropped out, one received a transitional diploma, and 12 are still in high school.

The district uses the Oregon Assessment of Knowledge and Skills (OAKS) to determine knowledge proficiency. The OAKS is a standards-based test, which means it measures how well students are mastering specific skills defined for each grade by the state of Oregon. The goal is for all students to score at or above the state standard. In 2008-2009 Oregon used OAKS to test students in grades three through eight, and ten, in reading and math; in grades four, seven, and ten in writing; and in grades five, eight, and ten in science.

In the past three years the scores for the students at the high school in Reading Grade 10 were 67% (2009), 76% (2008), and 67% (2007). The state average for Reading was 66% in 2009. The Science OAKS Test Results were 49% (2009), 65% (2008) and the state average for Science was 58% in 2009. The writing scores in 2009 dropped greatly compared to 2008. In 2009 the writing scores were 52%, 70% in 2008 and 51% in 2007. The state average for Writing was 55% in 2009. Math scores remain around the state average of 54%. In 2009 the math results for the OAKS tests were right at the state average with 55%. They saw an increase in 2008 of 63% and a below average score in 2007 of 52%.

Classroom

I chose my research school due to a job interview for a teaching position. During an off campus conversation with the high school science teacher he told me he would desire a student teacher in his classroom. After discussing my research project with him, he thought it would be best if I used one of his classes, and suggested I also use another class with a different ninth grade science teacher. The research sample was a mix of

young men and women in grades nine through eleven. The students came from a very diverse population and various levels of aptitude.

Classroom C1 was a ninth grade Physical Science classroom. She is a first year teacher. The teacher had 28 students in the classroom, four females and 23 males. All students were in ninth grade except for one 11th grades female and one 10th grade male who were repeating the class. This was the fifth period class and it ran from 12:24 to 1:22 pm. The teacher had an instructional assistant.

Classroom C2 was a ninth grade physical science classroom. He has been teaching for almost thirty years. This teacher had 30 students in the classroom, 12 females and 18 males. One 10th grade girl was repeating the class. It was the teacher's seventh period class and it ran from 2:30 to 3:28pm, and they had an instructional assistant.

The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained.

Treatment

The Action Research project was conducted for three weeks during the winter semester. I did not have a class of my own, but was allowed to conduct my classroom work in the classes of the two different ninth grade physical science teachers I previously described (see the Classroom section above).

The two teachers were very specific as to what would be taught. I explained that the material needed to be presented in either the traditional lecture method or a lecture

using different modality strategies and breaks. Time was a major component as to what, when and how the lessons would be taught. They were a little apprehensive and reluctant to let me in their classrooms. The curriculum was new to both teachers. Their classrooms were large, they had new textbooks, and the pressure of regulations of the Oregon State assessment test dictating what material was to be covered.

The two different classrooms were called classroom C1 and C2 and both classrooms had similar class size and student abilities. There were six treatments and a video lesson presented to both classes. Each classroom had three treatments of traditional and three modality strategies style lectures. The teachers took three turns presenting the traditional auditory lesson or the lecture using modality strategies.

I either taught the lesson or helped C1 in the first three treatments. We used the modality strategies lectures. Due to my lack of experience collecting data, I did not collect adequate data on the attention spans during the lectures. Realizing after the third lecture I could not do both parts (i.e., teach and observe) I took on the role as observer so I could watch the students carefully during the lectures. The classroom teachers now did all the lecturing and delivered the new material. Thus I was able to observe the students and collect data addressing my primary and secondary research questions. I recorded the times of disengagement verses the times of engagement. I also compared how modalities not only dealt with students' attention spans, but also how lecture styles helped or hurt a students learning ability.

Table 1.

*Treatment lecture/ Classroom description. *Team taught, no observational data was collected.*

| Lecture / Classroom Description | | |
|---------------------------------|--------------|--------------|
| Lecture | Classroom C1 | Classroom C2 |
| Learning Styles | Modality * | Traditional |
| Reading Guide 12-1 | Modality * | Traditional |
| Reading Guide 12-2 | Modality * | Traditional |
| Diver | Traditional | Modality |
| Hemisphere/ Demo Day | Traditional | Modality |
| Boyle's Law/ chemistry | Traditional | Modality |

The traditional lecture classes were taught using little or no modality strategies with little or no breaks in speaking; this was geared toward the auditory learners. The modality strategies lecture used and incorporated breaks, visual aids, hands on activities and interacted with the students. The modified lectures were geared towards the visual and kinesthetic learners, and used modality strategies and breaks to keep the students engaged.

Both classrooms followed the same format, where each day class was started by writing the daily outline in their science journals, then a short lesson review of previous lessons, and then presentation of new material. The lecture length varied throughout the treatments depending on a variety of factors, the length of the review, the reading of the textbook material, and whether there were questions from the students.

The lecture content was taken from the material in the student's textbook, *Foundations of Physical Science* by Tom Hsu (2009). There was only one set of books in

the whole school and it was shared between all the ninth grade science classrooms; therefore there could not be any homework with the text. In the course of the treatment, Chapter 12 Properties of Matter and Chapter 13 Behaviors of Gases were completed.

For my question, does the traditional lecture teach all the students, or only the auditory learners? I addressed this question by observing the classes during the lectures, and I also hoped to determine when and why the students became disengaged and off task. For my question:

Pre-Treatment

A pre-treatment was given to both classes and consisted of three different learning style surveys. First, I gave a short five minute lesson describing the three learning styles; visual, auditory and kinesthetic. I briefly explained the learning styles and passed out the first of three learning style surveys. The students received the surveys one at a time.

Learning Style

Survey # 3 was handed out first because it was the longest and I felt the most accurate of the three tests. The rest of the class period was spent completing the three surveys (Appendix A, B, C).

The surveys were collected as they finished but not every student completed all three surveys. The surveys were not allowed to go home with the students. I struggled for the next week trying to get all surveys completed. Both classes had many students absent. Absenteeism played a big part in my entire project.

Learning Style Surveys

Each student was given three surveys during the pre-test. I used these surveys to determine the students learning style. The essay survey called, the Learning Styles Survey, consisted of nine fill in questions that I created. The essay survey was divided into four parts: Question #1, asked the students if they knew their style of learning. Question # 2, asked what they thought made a good teacher, Questions # 3-6 asked the students what helps them learn and the last three questions asked the students how they thought they learned best. I created this survey to determine the learning style of each student and to ascertain the importance teacher empathy in the classroom.

Surveys two and three are Likert style questionnaires. The students were to circle or put a check mark on the one answer that best suits them. I found the surveys on the internet. A few questions had to be rewritten because they were irrelevant to ninth grade students. For example, question # 4 was changed from, a travel book with a lot of pictures; to a book with a lot of pictures, how many 9th graders read a travel book? Another change was made to a questions which asked if when they get angry they break things, I changed it to another physical activity like...“I go for a walk, exercise, go shopping or do some form of physical activity.”

Survey two, “What’s Your Learning Style”, had 16 questions and each question had three choices. Totaling at the end how many questions were marked in each area determined the students’ predominant learning style.

Learning Style Test # 3 had 30 questions. Each column represented each type of learner: column one, visual, column two auditory, and column three kinesthetic learners.

To find the students learning style I had to total the numbers marked in each column. (Appendix A, B, C).

A table was made of the results from all three surveys. After reading the table the student's learning style was determined according to the dominate style (two out of three, three out of three). If the student did not have a dominating learning style, I labeled the students V/K, A/K or A/V (V/Visual, K/ Kinesthetic, A/Audio) to show that a student had a compound learning style.

I used the data from the three surveys not only to determine the students' learning style but also each class's predominant learning styles. I then prepared a pie chart to reflect the results of the data analysis.

Treatment Lectures

Combining what I learned about attention spans and learning styles, I wanted to confirm that the treatment lectures punctuated with periodic activities using varying modality strategies to not only keep the students on task and engaged, but create a better learning environment. This helped me address my questions: do students learn more during a lecture when the lessons are taught to the student's personal learning style? And do the change-ups re-energize students and create a better learning environment?

There is an old idea that, "School is for learning"; and although interrupting a lecture every ten minutes might keep a student engaged, it certainly might not increase knowledge transfer. I wanted to engage the students and continue to increase their knowledge. Therefore change-ups needed to be related to the material being taught and add to the students' learning. My research project used a variety of activities to keep students guessing and wondering what will come next. I think they kept the students

engaged in the lecture, but did change-ups help them learn more? To address this, I recorded formative learning by using the One Minute Paper (CAT 6) approach, the classroom learning assessment (Modified CAT 38), a quiz, and Guided Reading worksheet and a post test.

Treatment # 1- Learning Style Lesson

Description - Both classes received a 20 minute lecture on the three learning styles (auditory, visual and kinesthetic). I explained why I was doing my action research project and why determining their dominate learning style was important not only for comprehension but everyday life. The content included the definitions and the characteristics of each type of learner, test taking strategies and study methods for each learning style. I also talked about possible job professions for learning style.

C1 Modality Strategies Lecture -The material was presented using modality strategies. The students in C1 were shown visuals aids and allowed to touch different items when I presented the lesson on learning styles. They also were asked different questions and were encouraged to participate in the discussion.

Hands-on items and visual aids that emphasized student interaction were used during the lecture. For example, for the three learning styles I had bizarre pictures of an ear, eyes and a collage of active movement for the kinesthetic learners. I brought in a skateboard to represent movement. I threw ping pong balls to the students to represent that kinesthetic learners are good at sports. This was a mistake because I had to ask them to stop bouncing the balls while I tried to talk. I had a shovel and pretended to plant a garden because gardening is something kinesthetic learners enjoy. I had the students

stand up if they enjoyed certain activities. I had them run in place. I had two students see who could do the most push ups.

I presented visual aids of different activities that the visual learners enjoy. I had an art easel, legos, a map, etc. I moved around the room and was very animated throughout the presentation. When I talked about auditory learners I did not have visual aids or hands on items. The only visual I had for them was an ear when I was describing the three learning styles.

C2 Traditional Lecture - From my notes, I read the definitions and the characteristics of each type of learner, test taking strategies and study methods for each learning style. I talked about possible job professions for each person's learning style, and no modality strategies were included. I read the descriptions of all three learning styles.

The students were to listen and take notes. I was strictly focusing on the auditory components of the lecture (Appendix D, E, and F). Could the students remember what they just heard in a fifteen minute lecture? Following the completion of the lesson I handed out a blank sheet of paper and they were asked to write down everything they had learned in the short lesson. I used a modified CAT 38 to collect data after the lecture.

Treatment 2- Chapter12-1 Characteristics of Matter

Description -The same material on characteristics of matter was delivered to both classrooms. The classroom read the chapter material from the text book and then completed Guided Reading worksheet 12-1 Characteristics of Matter (Appendix G). Chapter 12-1 covered physical and chemical properties. We used the Guided Reading

worksheet as our template for what was covered in the lecture. The lecture was to cover the vocabulary and content of the reading material.

C1 Modality Strategies Lecture - This lecture used different modality strategies. We presented the new material to the class. Breaks were incorporated along with different modality strategies. C1 delivered the lecture covering the reading and each question from the Guided Reading worksheets 12-1. As we went over each question, I interjected the lecture with either a visual aid or hands on objects for each question.

For example, Question 1 on the worksheet: Physical properties of matter are those you can 1) change 2) observe 3) touch. I had a picture of a huge eye, so the class would remember, you observe physical changes.

Question 2: Physical properties of matter include, color, texture, density, brittleness and state of matter. I interjected with a different item for each property. For example for color I had a paper with a rainbow of colors, texture was demonstrated with a rubber shower scrubber that had large soft rubbery bumps all over it; I walked around the room allowing the students to touch these items.

Before handing out the Guided Reading worksheets we reviewed each question on the worksheet using the hands on or visual aids items. The rest of the period was spent completing the worksheet. The class did not have enough time to complete the worksheet because of the length of the lecture, but would have a few minutes the following day to finish up.

C2 Traditional Lecture - The same lesson material was presented appealing to the auditory learner. C2 did not pause for a break or a change-up. Section 12-1 was read aloud as a class. C2's lecture covered the material in the textbook and the questions on

worksheet 12-1. After the lecture the class was given the Guided Reading worksheets and the class worked on completing the worksheet for the rest of the period. I took observation notes during the lecture and as the students completed the worksheet (Appendix G). Formative data for both classes was collected using the One Minute Paper and the Guided Reading worksheet.

Treatment 3 - Chapter 12-2 Viscosity

Description- Students read (Chapter 12-2) out of the Science textbook - a lesson on viscosity and buoyancy. The teachers reviewed the new vocabulary words; Bernoulli's Principle, density and viscosity. The students completed worksheet 12-2 and data was collected the One Minute Paper. C1 added several demonstrations.

C1 Modality Strategies Lecture - C1's students read silently out of the science textbook (Chapter 12-2) and those who needed extra help were read to by the instructional assistant in another room. After 10 minutes all students returned to the room. Together C1 and I answered each question on the 12-2 Guided Reading worksheets and the chapter material using hands on objects and visual aids (Appendix H).

For example: To explain density each student was given a set of six flat glass marbles. The students arranged the marbles into tight organized rows, representing a density of a solid. Then they spread them out in disarray, representing a less dense object (liquids and gases). Note: As I collected written data and did the interviews this was the most remembered demonstration.

C1 inflated a balloon and talked about the pressure acting in all directions. Next a bucket with a hose attached was filled with water to explain Bernoulli's Principle. A

picture of a bike tire was drawn on the board. It explained the pressure involved with the tire. We performed a demonstration using corn oil and water to explain viscosity. To involve the students' five senses the students were asked to picture a pan of fudge - when it is warm it flows but as it cools it thickens and solidifies. The combustibility demonstration compared a thin wood stick and magnesium. After the demonstrations the students worked on the Guided Reading worksheets 12-2. This class did not have as long to work on the worksheet as C2 because of the demonstrations. I used a One Minute Paper and the worksheet to collect data.

Traditional Lecture C2 - students read aloud Chapter 12-2 as a class. C2 gave all instructions audibly and reviewed the reading lesson orally. Even though this lecture is geared towards the auditory learner to demonstrate the vocabulary word viscosity, he showed the class a quart container of oil and explained what the numbers on a quart of oil represented. He continued to lecture for approximately 40 minutes before they were instructed to do worksheet 12-2. I used a One Minute Paper to collect data.

Treatment 4 – Fluids - Cartesian Diver

Description- students read silently pages 295-300 on fluids in the science textbook for ten minutes and those who needed help reading left the room and received help from the instructional assistant. After ten minutes all students returned to their desks and teachers reviewed worksheet 12-2. Both classes reviewed how to build the Cartesian diver, they received supplies and completed the diver and recorded their observations. The Cartesian Diver was a lab to explain pressure. The students performed this lab later in the class period. During the construction of the diver I did class interviews. I

interviewed all students in both classes. Data was collected through classroom observation, individual interviews and the One Minute Paper.

C1 Traditional Lecture - This lecture is an auditory traditional lecture. During the review no visual aids or other props were used. After the review the class was given a worksheet. The new material and the answers to the overhead were presented to the students without any visuals except the blank copy of the worksheet - Characteristics of Matter which was shown on the overhead. The students were to fill in their copy of the overhead at their desk. C1 explained the overhead and then filled in the overhead from her computer.

After completing the worksheet the students were to turn the paper over and write down C1's explanation of how to build their Cartesian Diver. The students were only given stepwise verbal instructions on how to assemble the Cartesian Diver. The students were expected to write down each direction for building the diver as she discussed the different steps. They did not have breaks or change-ups in this lecture.

The students did not have any lab equipment on their desk as she lectured. She explained audibly to the students what she expected them to write down on the paper for their observations and procedures. C1 spoke continuously for the duration of the lecture. The lecture lasted 25 minutes without breaks or change-ups.

Each table group of two had to share a diver. We did not want to appeal to the kinesthetic learners by allowing them each to have a diver and they were not allowed out of their seats to get the materials, the aid passed out the materials for the students to start the lab.

Because the students had not been paying attention and did not write down the directions as directed in the lecture, when the students were told to begin their experiment, questions immediately arose throughout the room. The students tried to talk over one another, shouting out their questions. The classroom was in chaos. No one knew what to do even though C1 explained everything step by step twice.

C2 Modality Strategies Lecture - This lecture used different modality strategies geared towards the visual and kinesthetic learners. C2's students read silently pages 295-300 of the science textbook. C2 reviewed the reading lesson using a pre-made visual of the Cartesian Diver. He manipulated the diver by squeezing the bottle until everyone was watching and engaged; he encouraged the students, "What do you think is happening to the diver". He held it high and came in front of the table with the visual. Immediately there were six hands up. He showed another visual aid and asked, "Are the bubbles bigger or smaller as they go up?" four students spoke out at once. The questions continued and the students were engaged.

C2 changed direction and asked the students if they had seen a movie called a *Man of Honor*. He used the movie to help define a science term and reengage the students. As another change-up, C2 appealed to the kinesthetic learner by allowing them out of their seats to get their equipment for the lab, and had students perform their own experiment. When all the students had the equipment at their desks, he explained the apparatus and its purpose. C2 demonstrated as he explained how to assemble the diver step by step. He would explain; complete a step and the students would follow. When the Cartesian Diver Lab was completed the students wrote up what happened and why. Data

was collected from their observation papers and graded with a rubric. Student interviews and observations were also used to collect data.

Treatment 5- Hemispheres-Demonstration Day

Description- In this treatment both classes used modality strategies but the lecture styles were completely different. C1 used a traditional lecture. Both classrooms ran a set of five experiments on Gas Laws: The demonstrations used in the lectures: # 1 - Candle, # 2 - Hemispheres, # 3 - Marshmallow, # 4 - Balloon and # 5 - Plastic Bottle.

C1 Traditional Lecture - used continuous talking with little or no class interaction. The teacher did not use visual aids except for the experiment itself. C1 did not pause to interact with the students nor did she try to involve the visual or kinesthetic learners. She read the directions to the students without pausing and demonstrated the experiments one after another until the period ended. Throughout the experiments she lectured and continued to talk 'at' the students. All the experiments were done at the front counter or behind it.

C2 Modality Strategies Lecture - C2's lecture style involved interacting with the class and breaking the lecture up into smaller increments that appealed to both the visual and kinesthetic learning styles. The students were asked questions that involved their five senses; he drew on the board, told jokes and stories about science related events. He also played guessing games with the students. He had them draw or write what they saw and describe it.

Demonstration Day – Both classrooms had directions for what was expected on the whiteboard as the students entered the classroom. Each student was expected to write them down in their science journal. Both teachers are teaching the same content and vocabulary in each class. This particular lesson involves modalities in both classes so we concentrated on the lectures. I addressed the questions; will the use of modalities affect the traditional style lecture? Will the students stay engaged because of the modalities or the lecture? What is it exactly that keeps students on task?

The next section of my paper describes the five demonstrations used in Hemisphere/Demo Days and how each teacher presented the material.

Experiment # 1- A lit candle in a pan of water.

Description- The demonstration included a small candle in a pan of water filled so half the candle shaft was in the water. The candle is lit and a small glass cylinder is put over the lit candle. The candle goes out and the water rises.

C1 Traditional Lecture - Each step of the procedure was described as she lit the candle and covered the flame with a glass cylinder. C1's lecture included defining vocabulary words and reviewing the vocabulary from the textbook. She continued her lecture by narrating the next series of events, while placing the tall narrow cylinder over the lit candle causing the candle to go out and water to rise up the cylinder. C1 discussed why the water went up the cylinder and made sure to use the vocabulary words. Every student watched and drew pictures.

C2 Modality Strategies Lecture – The demonstration was started with an explanation of the different equipment and its purpose. He drew pictures on the board

that explained the demonstration. He defined all unknown vocabulary and reviewed the vocabulary from the textbook. He told the students what to draw on their papers and demonstrated an easy way to draw it.

He explained each step of the experiment. For example: “As the oxygen from the cylinder is used up the candle goes out and....” He paused (a break) his lecture and let the students absorb the information. As the experiment took place C2 engaged the students by asking questions such as, “What pulled the water into the cylinder?”, “Was it pulled or pushed?” Several different students answered his questions. Several others are chomping at the bit to answer his questions. All students are engaged.

Experiment # 2 - Hemispheres with vacuum

Description - This demonstration involved the two hemispheres and a vacuum. The hemispheres were stuck together and pulled apart easily. The vacuum pump was then attached and started. It continues to run until all the air is sucked from the inside of the hemisphere.

C1 Traditional Lecture – The teacher’s lecture began as she described the function of the hemispheres, and hooked the hemispheres together and showed the students how easy it was to pull them apart. She described what was happening as the vacuum pump was hooked up to the hemispheres and she pumped the air out of the hemispheres. She talked about pressure and the forces of pressure.

When the vacuum was sufficient, a student was asked to try to pull the hemispheres apart. The first time the student did pull them apart so the teacher redid the vacuum. The students were engaged and interested. The hemispheres are reattached to the

vacuum pump and C1 continued to lecture about vacuum safety. The hemispheres were ready and the volunteer student could not pull them apart. C1 and the student could not separate the hemispheres no matter how hard they tried. The lecture continued without any breaks. All students wrote or drew their explanation and completed the assignment.

C2 Modality Strategies Lecture - Between experiments he prepped and lectured holding the students attention. Instead of telling the students what a hemisphere is, C2 asked the students to describe the hemisphere. Then he described in detail, the parts of the hemispheres and how they fit together. C2 used “change-ups” to break up the lecture. He told jokes and teased the students by creating stories about what would happen, the students reacted and offered their own predictions. The students followed his every move. As he prepared the vacuum pump, he described each part and what it does. He drew on the board and told real life stories. C2 got their five senses involved. When he first turned on the vacuum pump he asked the students to be quiet for a moment and just listen. He asked, “What do you hear?”, “What do you smell?” C2 made the students listen as the air escaped from the hemispheres and then asked the class to describe the sound of the escaping air.

Experiment # 3 Marshmallow and Vacuum

Description- A regular marshmallow was placed in the middle of a board under a large bell jar. The vacuum pump is attached and the marshmallow expands to four times its normal size then completely shrinks into a dried up flat marshmallow.

C1 Traditional Lecture - C1 sets up the next experiment and explained what she was doing as she placed the marshmallow under the bell jar. The students were curious and engaged. The vacuum pump was applied to the bell jar. She continued lecturing as the marshmallow expanded and then shrank down into rubber like substance. C1 continues to lecture about pressure. The students watched the experiment but started to talk to other students, drew picture or put their heads down. Due to the continuous talking and talking she lost the attention of her entire class by the end of this demonstration. She continued talking with out breaks, interaction, or sensitivity to the kinesthetic learner and this caused her to lose most of the student's attention by the end of this demonstration.

C2 Modality Strategies Lecture - Before the demonstration, C2 explained what would happen and why it occurred as he drew on the board. He lectured about pressure as the marshmallow grew. C2 played with the marshmallow and asked the students to describe what the marshmallow felt like. After the marshmallow had expanded and then shrunk, he passed the marshmallow around for the students to touch. Students were engaged the entire time. C2's students were quiet and attentive; all but one student took notes. C2's students continued to be engaged and focused.

Experiment # 4 Balloon and Vacuum

Description- A balloon is placed on a cylinder inside the bell jar, the vacuum pump is applied and the balloon expands and pops.

C1 Traditional Lecture - C1 prepared a small partially blown up balloon, placed it into the bell jar, and applied the vacuum pump C1 described what happened and why as the vacuum pump is attached to the bell jar. The vacuum pump ran and the balloon

expands. As the balloon expands, C1 continued to lecture about Boyle's Law without any diagrams or breaks in her lecture. She stopped the vacuum pump, the balloon did not pop. The students became bored and disinterested; they were no longer engaged and did not write down what happened. I addressed the research question, is it possible teacher interaction in a lecture might be the key to students loss of interest? C1 stopped the vacuum pump and continued to talk to the students about the process.

C2 Modality Strategies Lecture - For the visual learners C2 drew on the board describing what would happen to the balloon. As he drew on the board he explained what, why and how it would happen; he also explained the textbook terminology. The balloon expanded and C2 asked the students to be very quiet and listen, asking what they heard. The balloon popped and took everyone by surprise, there was no sound related to the pop. He appealed to the kinesthetic learner by passing the popped balloon around the room so they could touch it. He asked the students to describe what they saw, heard and felt. The students remained focused the entire time.

Experiment # 5 - Plastic Bottle and Vacuum

Description- A small hand vacuum pump was applied to the top of a soda bottle. The inside air inside the bottle is removed and the bottle collapsed inward until it was a crumbled up piece of plastic.

C1 Traditional Lecture - As C1 prepared the experiment she continued to describe what was going to happen. The students talked to each other and were not engaged. The vacuum pump was then applied to the top of a plastic water bottle and the bottle collapsed. C1 lectured but the class did not pay attention. C1 continued the experiment and continued the lecture explaining the textbook terminology, but only a few students in

the front row were engaged; the rest of the class was disengaged and starred off at nothing, talked, slept, or played with different items.

C2 Modality Strategies Lecture - C2 performed the demonstration and continually interrupted his lecture with change-ups. As he lectured he would joke or tease the students. He explained the hand pump and showed the students how it physically worked. He had some of the students pump the handle. As he did the experiment he continued to lecture and describe what was happening. He explained how it relates to the textbook information. He drew on the board and allowed a break in his lecture as he told a real life story about himself and the pressure in a soda bottle. The students remained captivated until the bell rang. Both classes ran out of time so the quiz on the lesson was administered the following Monday. I collected data on the students through observation.

Treatment # 6 - Boyles Law - Chemistry Paper

Description- C2 explained Boyle's Law and the formula. The students drew the chart from the board in their journals and are given numbers to plug into the formula. The students use calculators to complete the chart on the board. They are handed the Guided Reading worksheet labeled Chemistry.

C1 Traditional Lecture- The lecture described the principles of Boyle's Law. C1 began the class with a glass cylinder demonstration. It was a quick experiment with a long explanation. I would describe the demonstration as a look, see, and complete.

Next C1 began the lecture reading from notes. The students were expected to take notes on the lecture. C1 continued to read from the notes. The students were told to draw the chart that was shown via the projector. The explanation of how to fill in the chart was given audibly. The formula for Boyle's law was written on the board. The students were

given calculators and told how to use the formula audibly step by step. The students were to write down the steps in their journals.

C1 continued the lecture on Boyle's Law and audibly gave the numbers to be used in the formula and repeated the directions for using the formula. The students were expected to figure out the answer to the problem and place in the right column on the chart. A majority of the students immediately put their pencils down and became disengaged. When the teacher asked the students for the answers to the chart, the same seven students answered the 14 questions on the chart. C1 explained the chart and all but seven students were disengaged.

The lecture was completed and worksheet and calculators handed out to the students so they could complete the worksheet Boyle's Law. The worksheet contained the same type formulas that they had just done on the chart from the board. C1 discussed the first problem on the worksheet and went over it step by step. As the students started the worksheet only nine students were on task and within five minutes only three students were on task. I interviewed some of the off task-students; eight said it was too hard for them and most of the rest of the class did not understand the explanation on how to do the worksheet.

C2 Modality Strategies - C2 began the class presentation by reviewing yesterday's lesson, using the student's worksheets from the day before. He used a barometer as a visual aid to explain pressure. He engaged the students by asking the students questions about the weather. Liquid Mercury pictures were drawn on the board. As he continued to talk four students were off task, two minutes later eight people had their heads down, were fidgeting, drawing or writing notes.

C2 does a change-up; everyone must get out of their seats and get a calculator. When the students get back to their seats he gave them a moment to play with their calculators. C2 then discussed what to do with the formula on the board and time was allowed for students to experiment and try the formula on their own before they completed the chart together as a class, step by step.

Problem number one was explained and the numbers to the formula were written on the board. The students tried to complete the problem on their own. C2 paused and let the students try to work the problem before he gave the answer. Students raised their hand as they finished. He explained the problem once more and when most of the students had their hands up; he called on a student and received the correct answer.

He went over the steps to the formula one more time on the board pausing so the students could write them down. The students understood how to work the formula and everyone was on task and worked on the next problem. C2 called on a different student to answer each different problem. Every student answered correctly. Everyone got them right. This activity kept the students on task and everyone finished at the same time.

C2 asked the students to predict the slope for the chart and all students were involved. The class completed the chart together. C2 challenged the students to look for patterns in the chart. C2 started a new demonstration, describing Boyle's Law, in which he used more visuals and a protractor. He described the equipment and he discussed each step of the procedure. All students were watching. C2 had the students write a conclusion in their journals and all students complied.

C2 handed out the Chemistry worksheet and explained exactly what to do and where to find the answers in their notes. He told a science history story and then read

question # 1 on the worksheet to the class; the class answered problem # 1 together. All students concentrated on the worksheet the rest of the period. Why did C2's whole class start working on the worksheet and C1's class found it too hard and irrelevant?

Pre - Treatment 7: Video-Buoyancy

Do videos address all learning styles? Students watched a video on buoyancy and displacement. Data was collected using the CAT 38 about what they learned from the video. The students were to write or draw pictures of what they learned using two different types of data collection sheets. C1 used a pre-numbered (1-10) sheet of paper and C2 used a bright orange sheet of paper which had 10 different geometric shapes printed on it.

I used the geometric sheet for the collection of data because visual learners remember best what they see (pictures, diagrams, graphs, schematics, flow charts, time lines, films, and demonstrations). They find maps, graphs, charts, and other visual learning tools to be extremely effective. Kinesthetic learners like brightly colored paper under worksheets or study materials to help them focus.

Research Design

To insure validity and reliability in my instruments I used published Learning Styles and repeated two of the three surveys seven weeks later. The One Minute Paper and CAT 38 were assessment samples taken from a college textbook. The scoring rubric was created from an idea from my professor, and I analyzed the information by evaluating and totaling the information from the different questions and categories.

Validity was established by showing my instruments to a fellow teacher, a microbiologist and two professors at Montana State University.

There were six treatments and a video presented to both classes. Each classroom used one of the two different lecture styles (Traditional or Modality Strategies) for each lesson. The traditional lecture had little or no interaction with the students and delivered the straight auditory lecture. The modality strategies lecture used and incorporated breaks, visual aids, hands on activities and interacted with the students.

C2 had 30 years experience and C1 was a brand new teacher. I taught the learning style lesson to both classrooms. Secondly, C1 and I team taught the modality strategies lectures, Chapters 12-1 and 12-2. C2 taught the same lessons using the traditional lecture method. Finally, we C1 and C2 switched roles- C2 became the modality strategies lecturer and C1 did the traditional lecture.

Does learning take place just by hearing a lecture or do we acquire more knowledge using modality strategies in lectures? Maybe good class management skills are part of what is necessary for generating accomplished students.

I utilized the following formative assessments for data collection methods: One Minute paper, quiz, lectures, classroom observations, guided readings, CAT 38(Punctuated Lectures), post- test and my teacher's journal.

Table 2
Research Questions and Formative Data Collection Methods

| Focus Questions | Data Source 1 | Data Source 2 | Data Source 3 |
|---|--|--|---|
| <i>Primary Question:</i> | | | |
| What is the impact of a Modified Lecture Approach using modalities and lecture time limits in improving understanding and performance in a science classroom? | Observations and journaling | Post treatment unit test, Quiz | Modified Cat 38, One Minutes, Guided Reading worksheets, Exit student interviews, Compare non-treatment classes |
| <i>Secondary Question:</i> | | | |
| 1. What are the effects of lectures using modality strategies on the learning of high school science students? | Observations and journaling | Post treatment unit test, Quiz | Modified Cat 38, One Minutes, Guided Reading worksheets, Exit student interviews, Compare non-treatment classes |
| 2. What impact does teaching to students learning style have on a student's learning and understanding in Science? | Surveys, Observations, Teacher Journal | Post treatment unit test Mid-way student interview ,Quiz | Modified Cat 38, One Minutes, Guided Reading worksheets, , Exit student interviews, Compare non-treatment classes |
| 3. Do different lecture styles have an impact on keeping the students on task, engaged and focused? | Observations, Teacher Journal | Mid-way student interview | Exit student interviews, Compare non-treatment classes |
| 4. What is the impact on a teacher when using the Modified Lecture Approach in a science classroom? | Observations, Teacher Journal | Post treatment unit test Mid-way student interview | Modified Cat 38, One Minutes, Guided Reading worksheets, , Exit student interviews, Compare |

Pretest

No pretest was performed. Both high school science teachers I worked with did not want to spend the time giving a pretest. They believed this material was new to all students and requested that I start each student with a zero as the baseline for instruction. We did not review previous taught material on physical and chemical properties, but rather introduced it as if learning the information for the first time.

Learning Style Surveys

The essay survey consisted of nine fill in questions. They were divided into three parts: Do they know their learning style, what makes a good teacher and what helps them learn.

Surveys two and three are Likert style questionnaires. I found the surveys on the internet and have made some corrections to prevent influencing the kinesthetic learner.

Survey two, "What's Your Learning Style", has 16 questions. Each question had three choices. Totaling how many questions were marked in each area determined the students' dominant learning style.

Survey three, Learning Style Test # 3, had 30 questions. Each column represents each type of learner; column one, visual, column two auditory, and column three kinesthetic learners. To find the students learning style you must total the numbers marked in each column. (Appendix A, B, C).

The two Likert style surveys and the essay survey were analyzed together. I added up the scores and placed them in a table. the student's learning style was determined according to the dominate style and if the student didn't have a dominate learning style, I

labeled the students V/K, A/K or A/V (V/Visual, K/ Kinesthetic, A/Audio) to show that students had a compound learning style. I then prepared a pie chart to reflect this data.

Lectures

The traditional lecture used little or no visual aids, hands on activities, and did not use any change-up activities. They did not try to interact with the students in presenting the material. The material was to be presented as if the students were in a college style lecture.

Lectures using the modality strategies used visual aids, hands on activities, change-up activities and tried to break the lecture into small pieces while trying to hold the students' attention. In these lectures the teachers were to interact and have empathy for the students

Treatment # 5 Hemispheres was unique; modalities were used in both lectures. Demonstrations, visuals aids and hands on objects were utilized in both classes. I wondered if it was the modalities that kept the students on task or was it truly the lecture style.

Observation rubric

During the observations on the lectures, I kept time and recorded the students' activities during the lectures. I recorded the number of students off task, their behavior and wrote down what the teacher was doing at that specific time. (Appendix K).

The material presented in both classrooms was the same in content yet they were taught in two different styles. My intent was to collect data by observing students having lapses of attention during lectures, when in the lecture did lapses appear, and how many

students were affected and how/if they were brought back on task. When students have lapses in attention, does a change-up bring them back on task? I wanted to know if breaking the lectures into smaller blocks kept the students engaged. If those smaller blocks were taught in the students learning style would the students learn more? Do students learn more from the traditional lecture methods or are modality lectures better for the student's ability to gain knowledge. If you keep their attention do they learn more?

When I was involved in the delivery of the lecture material I found it was difficult to observe and write down the information I needed on individual students. I would try to remember the information and write it down later in my teacher's journal; however I could not remember the information in great detail. My original observation data collection method was changed, the teachers delivered the rest of the lectures, and I recorded the information on the observation rubric. Having the teacher do the lectures allowed me more time to observe.

I assumed I would know the students by name, however, it took too much time to find out who was who and record when each individual was off task or lost interests. So instead I totaled the number of students off task at a given time. Once the students got off task I tried to record information every two to three minutes and continued until they were on task again. I would move around the room so I could watch the students and record what I observed during each treatment.

Analyzing the information took place through an observation rubric. On the rubric I recorded the time, the number of students off task, the on or off task behavior and what event or task causes the on or off task behavior. I started recording the time when I first

noticed a student off task and then continued about every two to three minutes after that for the rest of the class period. The lectures were then graphed and the facts stated.

I analyzed the observation rubric from three of the six treatments plus Chapter 13-2 lesson, which was not listed as a treatment. In 13-2, C1 delivered the traditional and C2 the modality strategies lecture. Line graphs were made for only three of the six lectures due to inadvertent non-collection of data. I did not have enough data in the first two science lectures because I found it hard to teach and observe so I wasn't able to record enough information. I also placed the two extra observations from (Chapter 13-2) in a graph (Figure 10).

One Minute Paper

Both classes did a One Minute paper after the class lecture. I gathered information on the lecture styles and collected information on how much knowledge was gained or if facts given were not clear. I stopped class four minutes early and asked the students to write down the most important things they learned in class and what questions remain unanswered?

I compared the traditional lecture class to the modality strategies class as to the total number of items learned or remembered. I also compared the results learned from CAT 38 and the One Minute Papers. I wanted to know which lecture format taught the students more: lecture with breaks, visual aids and activities or the traditional lecture. The learned material was analyzed using a rubric, "5" relevant, a "3" a little relevant, and a "1" no relevance. I then totaled the points and compared the two classes.

Classroom Learning Assessment CAT 38

This was a modified form of CAT 38. It is a lot like the One Minute except it evaluated one section of the class time instead of the entire period. The students were to complete 4 Steps: Listen, Stop, Reflect, and Write. Students listened to the lecture. After the lecture was over the students were given a sheet of paper. The students reflected on the presentation and described either with a picture or words what they remembered or understood about the lecture (Angelo & Cross, 1994).

I wanted to know which lecture method taught the students more: breaks, visual aid and actives or the traditional method. The learned material was analyzed using a rubric, “5” relevant information, a “3” information of little relevant, and a “1” no relevance. I then totaled the points and compared the two classes.

When asked what lecture style the students liked best, I repeatedly got remarks such as “Hands on helps you remember” or “I like hands on better than listening.”

Quiz

The quiz was a six question fill in the blank type test. The test was made up using the textbook Chapter 13-2; (Identify and Evaluate Properties of Gas), the guided reading 13-2, and the Demo day labs. It was given to both classes the following Monday after the students had completed all three surveys.

I analyzed each student’s data by using a scoring rubric (Appendix I). The learned material was analyzed using a rubric, “5” relevant, a “3” a little relevant, and a “1” no relevance. I then totaled the points and compared the two classes to see which learning style created a better learning environment in science.

Post Test

I used a summative assessment to check for student competency after the instructional phase was complete. The best types of tests for visual learners are diagrams, maps, and essays. The worst type for a visual learner is a listen and respond, because they can't recall test material that was "heard" in a lecture. The best test type for kinesthetic learners are short definitions, fill-ins, multiple choice and the worse are the listen and respond tests. Auditory learners do not like reading passages and writing answers about them in a timed test. The post test had a variety question types.

The test was premade from the teacher's edition guide workbook and covered chapters 12 and 13, Properties of Matter/ Behavior of Gases. It had 25 multiple choice, four true/false and eight fill in the blanks for a total of 37 questions. It was the unit test for both chapters and was given to both classrooms. The students had the entire period to finish the test. There were many absent in C1- 19 out of 29 took the test. C2- 29 out of 30 took the test. This test was used to give me the final knowledge gain assessment covering the presented material over the past three weeks.

I analyzed this data by totaling the number of problems correct out of 37 and calculated each student's scores as a percent value. I averaged the class totals and compared the two classes to see which learning style created a better learning environment in science.

Interview questions

The data I collected was used to verify learning styles and whether the students gain and retained knowledge. I did two different interviews, mid interview and exit

interview. During the Cartesian Diver lab I interviewed all the students at their desks. I asked three questions, one auditory and two learning style questions. The three questions were: Do you like to read science material silently or aloud as a group in the science classroom? Do you like doing hands on activities or worksheets? Do you learn better from hands-on activities or worksheets?

After all treatments were completed I interviewed groups of students in both classrooms. I interviewed three groups of four or five students and one set of doubles in each class. I had planned on interviewing every student in the class but the interviews went longer than I expected. I had about 35 minutes in each classroom. The interviews took much longer than I had hoped and therefore was not able to interview the entire class.

The responses were tallied and assessed for differences in learning style preference. I analyzed the interviews by sorting the information into groups. Group one were quotes on what and how they learned. Group two: scientific terms and correlations to modality strategies. Finally group three contained things that pertained to the two different lecture styles.

DATA AND ANALYSIS

Data Collection

Are we using lecture methods that teach to only 20% of the student population? Students learn in many ways, seeing, hearing, and experiencing things first hand. But for most students, one of these methods stands out. We all have a visual image of the traditional science high school classroom: The teacher talks (lectures); the students usually listen and occasionally write something in their notes.

My treatments were designed to test whether traditional lectures addressed the three different learning styles auditory, visual, and kinesthetic or only the auditory learners. By nature our attention spans are only so long. Is it possible to take the lapse of attention and use that time to insert an activity that will benefit the student? Will this break re-charge the students' attention clocks and solve two problems at once; create lectures that teach to different learning styles and hold the students attention? By having breaks in the traditional lecture and adding activities for the visual and kinesthetic learners is it possible to keep all students focused, engaged and learning?

I did six different treatments, collected data on a video and observed two other classrooms. The two classrooms had an average of 29 students. The students varied in cognitive abilities and learning styles. The treatments spanned over a three week period. Seven weeks later I returned to the two classrooms to see if the previous information I gathered on their learning styles was reliable. The students redid learning style surveys #2 and #3. Each classroom conducted six treatments, three modality and three traditional. The three modality strategy lectures used Classroom C1 were learning styles, Chapter 12-1 and Chapter 12-2. I did not collect enough information through observation on these three lectures to graph, I did however collect information on the amount of information they learned. When C1 did modality strategy lectures C2 used traditional lectures. After three treatments they switched and C2 used modality strategy lectures with the Diver, Hemispheres, and Chemistry, C1 would do the traditional.

In order to track attention spans and the amount of learning taking place, my main form of data collection on lecture styles came from observation and interviews. I used the

One Minute Paper, revised CAT38, Guided Reading worksheets, a quiz, observation rubric, and a post test to see which lecture style created a better learning environment.

Learning Styles - The students were given three pre-treatment learning style surveys and two post surveys. Research can't agree as to the numbers of auditory learners in a classroom, the average number varies between 10% and 60%, and in my findings, based on the results of the surveys, I found it to be only 7 % in one class and 18% in the other. For the two classes the average number of auditory learners was 12%.

Visual learners made up 22% and 41% in the two classrooms, and kinesthetic learners made up the greater population with 45% and 37%. I combined the visual and the kinesthetic learners together because I wanted to single out the auditory learner and the traditional lecture style. There was a mix of visual/kinesthetic learners and a mix of auditory/visual learners because I was unable to determine their classification. Together the two classes had an average of 86% visual or kinesthetic learners and an average of 13% auditory learners.

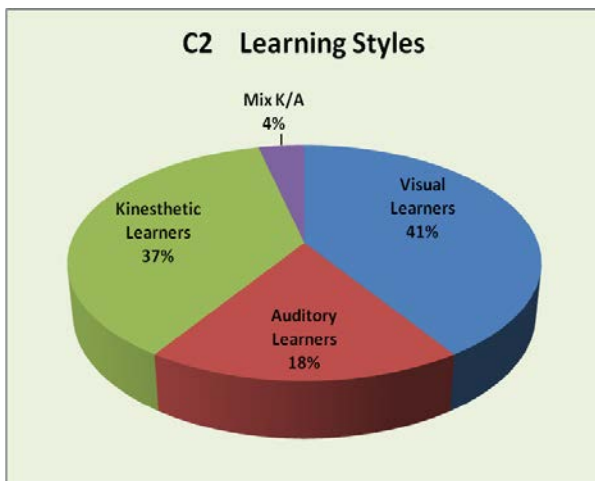
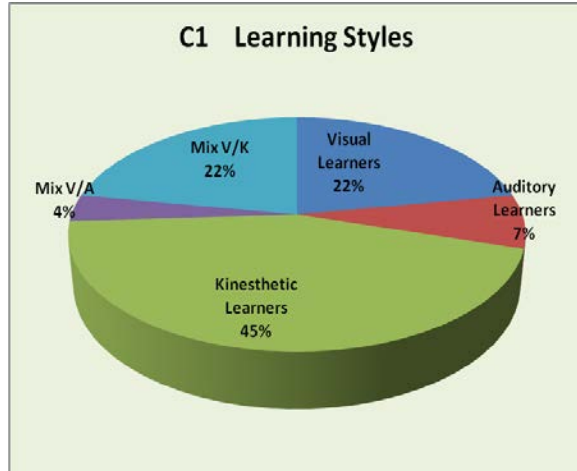


Figure 1 & 2. C1 & C2 Percent of Students in their various Learning Styles after Survey Set # 1.

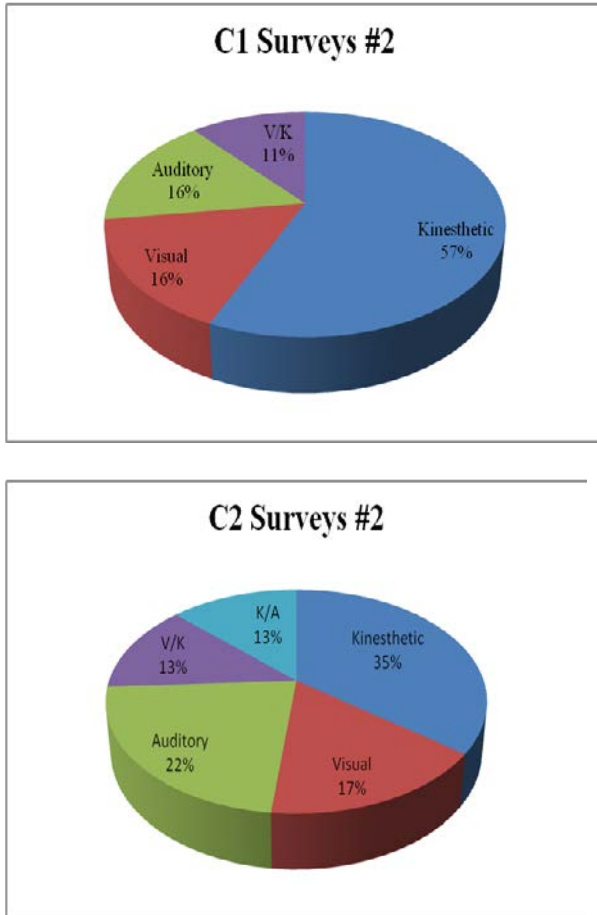


Figure 3 & 4. C1 & C2 Percent of Students in their various Learning Styles after Survey Set # 2

Interviews

Mid- Interviews-After talking with 27 students in C1 during the mid point interviews the data revealed 85% ($N=23$) of the students in both classes would rather do hands-on activities. Seventy percent ($N=19$) said they learned more doing hands on activities such as labs. C2 revealed 77% ($N=21$) out of 27 students would rather do hands-on activities and 77% ($N=21$) learned more from hands on activities. One student mentioned that he liked lectures that were “interactive.” Another student remarked, “Today was her favorite because it was hands on.” This resonates with the idea that students “Learning only happens when students ‘do,’ not when they listen passively to a

lecture” (Howell, 2001, p. 88). I interviewed three to four groups with four to five students in them. I also interviewed one smaller group consisting of only two students per class.

During the exit interviews each group of students said their favorite lectures had the visuals and hands on items. The marbles, which represented molecules and formed solids, liquids and gases when manipulated, and this was a favorite with the students. When asked to list the things they learned during the lectures, 85% ($N= 23$) of the students drew the six marbles, in both solid and liquid forms. During the exit interviews the marbles were the number one activity each group remembered. When asked what caused them to remember manipulating the marbles one student said “hands on helps you remember” and another said, “I saw it for myself.”

The groups expressed common themes about things they saw and touched but the only thing they told me they heard was the vacuum pump, which was encouraged by a prompting from the teacher. One student said he did not like reading it out of a book; he needed to see it, to do it. Less than 1% of the students said they liked it when we read aloud as a class. Honigsfeld & Dunn (2003) made the statement, “Most instructors are not cognizant of the fact that less than a third of their pupils can recall what they hear during a classroom lecture” (pp. 195-206).

Another student said, “If I do not like lectures I tap my feet cause its just words”. One group of students summarized what they learned in the modality strategies lectures on characteristics by defining density, as how they moved the glass marbles they were given to form solids and gas. The students were also able to characterize phases of matter: solids, gases and liquids.

The students used the diver lab to describe buoyancy, pressure and water displacement. They remembered combustibility from the wood and magnesium demonstration. They remembered characterizes of matter by things they saw and touched. Several interviewed groups remembered seeing the marshmallow grow and then shrink but they didn't remember why it grew.

Several groups mentioned things they saw in the video. They remembered the definition of buoyancy, density and the ability to float. They talked about the hemispheres and knew it had to do with pressure yet couldn't explain why, how or what.

When asked what the teacher could do to increase their participation, one student said he liked teachers who "cared enough to understand how I learn, who takes the time to understand me." Another felt that "The best teachers are those who show us demonstrations." One reflected, "A good teacher is one that teaches in the way I learn best. I am a hands-on learner."

The students said in learning style survey #1 the things that make a good teacher are those that: show and explain things, show you things on the board and ask for feedback. The students said they learn best when, "I see what is happening", "When I can try things out", or "When a teacher shows us what to do." One student remarked, "I learn best when I actually do it instead of reading about it".

The observation rubric- raised many of the themes already discussed above, but I was surprised how quickly the students got off task.

Observations

Observations were performed on the six treatment lectures and three non treatment lectures. The Observation rubric was used to record the time of disengagement, the number of students off task, the students' behaviors, and what was happening during that event (Appendix K).

The following graphs depict the sudden rise and fall in the students' attention span. The graphs show periods of engagement with the base line zero. In every treatment, the traditional role had a high number of students off task more often, than the modalities strategies lectures where the students stayed on task for longer periods of time. The students were brought back on task using a break and a change-up activity.

Once the students were off task the information was recorded in two minute segments. The students remained on task for the first five minutes in most cases, after that the students in the traditional lectures were off and on task throughout the lecture. The modality lecture had fewer periods of disengagement, but remained relatively constant through the lectures. Both classrooms showed severe lapses in attention 15 to 20 minutes into a lecture.

Line graphs were used to compare the two different lecture styles and the number of students off task at a given time. Due to the lack of information in regards to my inexperience, I was unable to graph the students off task in the first three modality style lectures in classroom C1. This is a limitation to my study. The information I did collect came from my teacher's journal in which I recorded the following observations for each treatment:

Lesson one Learning Styles- C1 Students were engaged and involved in the discussions and activities. The students actively got out their seats and jogged in place, did pushups, and called out the answers. C2 students were quiet-as I read, and I did not notice any off task behavior.

Lesson 12-1- C1 Students were engaged and focused as we started the lecture on Characteristics of Matter (12-1). C1 provided the review for the textbook reading and did the introduction. Together the teacher and students completed the overhead on Characteristics of Matter. All students were on task while actively writing the definitions. As C1 continues to lecture several groups of students were off task but as soon as the slide changed the students stopped talking and wrote the definition. The change-up using modalities; together C1 and I went over each question on the Guided Reading worksheets12-1usingvisual aids, hands-on items or did demonstrations. The students were on task and active in the discussions. The data was collected using two different methods, the Guided Reading sheet provided from the book and also the One Minute Paper at the end of the period.

C2's lecture on Lesson 12-1- began using the visual graphic organizer on the overhead. Students copied the answers off the overhead and are engaged. The traditional lecture began and continued with out breaks or any help from modality instruction. The teacher asked questions and no one answered. Students only pay attention when he changed the slide, otherwise they put their heads down, doodled or passed notes. I was not able to graph the off task behavior for this treatment, which is a limitation to my study.

Lesson 12-2- followed the steps from the lesson. The students were quiet and within five minutes three boys were off task. Once in awhile a student would turn around but for the most part anyone on task during visual aids. C2's lecture is graphed below.

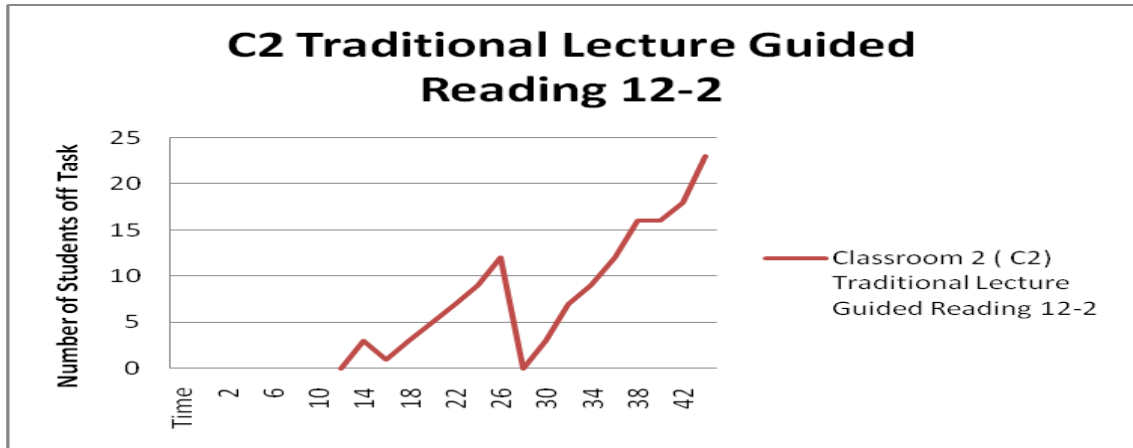


Figure 5. Traditional lecture -Guided Reading12-2 Students off task.

Analyzing the observations I did record, the students in both classes paid attention when the slide changed because they wrote down the next item on their graphic organizer. C1 had students off task while doing the graphic organizer, but when we started with the visual aids and demonstrations the student were engaged and on task. After evaluating the two classes I would say students remain engaged and on task during the modality lectures.

When the traditional lectures started C2 had 3 students off task within two minutes, and this number continued to grow until he did a change up and got the students back on task. But once he continued to talk they were immediately off task.

After the review C2 started the traditional lecture eight minutes into the class period. He started the lecture by reading aloud, within two minutes he had two students off task. The number continues to climb until he did a change up to bring the class back on task, which lasted about a minute and the students went right back to what they were

doing before. The off task behaviors were passive, heads were down, eyes closed, students were looking around, making eye contact with friends, writing notes and doodling.

Changes were made after the first three lectures because I wasn't able to collect enough data while teaching. I created an observation rubric and became the observer. The Observation rubric was used to record the minutes into the lecture, when the students began disengaged, the number of students off task, the students' behaviors, and what was happening during that event. Once the students were off task I recorded the activities every two or three minutes (Appendix K).

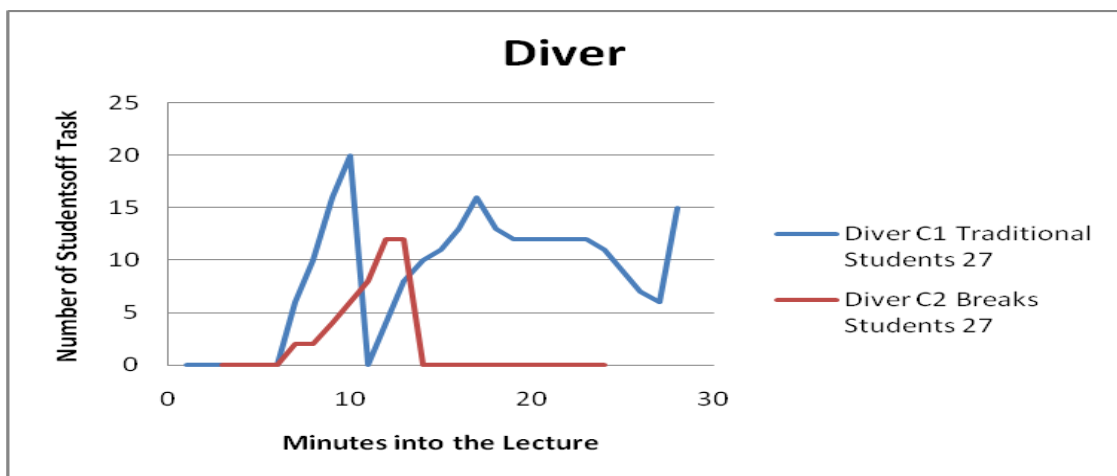


Figure 6. Lecture Stats Cartesian Diver Lecture.

Data for the diver was collected using observations and an interview.

C1 - This line graph shows C1 doing the traditional lecture. The students were off task within 5 minutes. The teacher continued lecturing while explaining the procedure to build the diver. When a change-up occurred every student came back on task. She continued to talk with out breaks or change-ups and the students continued to be off task. Ten minutes into the lecture 20 of the students are off task, C1 does a change-up and the all the student

become engaged for one minute. This continued and finally they were off task the rest of the period.

. When C1 asked the students to start building the diver confusion arose all over the room because the students were off task during the traditional lecture and had not listened to the instructions on how to build the diver even though she repeated them twice. She had to repeat the construction directions a third time.

C2-delivered the modality lecture. The students were off task during the graphic organizer. He did a change-up and started the diver lecture; the rest of the period the students were engaged, on task and built their divers without any problems.

Differences: C1 told the students audibly how to build the diver and the students were to write down the procedure while C2 visually showed the students how to build the diver, and the chaos was eliminated. It was hard to measure if learning took place, but it was easy to observe the differences in classroom behavior and the student ability to stay engaged. When the students became bored with the lecture they completely ignored anything being said.

Table 3. Mid- Interview Results Both Classes.

| Mid-Interviews and The Number of Students Who Responded to Interview Questions | | | | |
|--|----|--|-----------------------------------|-----------------------------------|
| Classroom | C1 | C2 | Students in C1 who preferred Both | Students in C2 who preferred Both |
| Would you rather do hands on | 23 | 21 Total number of hands - on from both classes (82%) | 3 (13%) | 4 |
| Worksheet | 1 | 2 (.5%) | | |
| Do you like to | 6 | 3 | 0 | 5 |

| | | | | |
|----------------------------|----|-------------|---|-----------|
| read out loud as a class | | (17%) | | (.9) |
| Read Silently | 21 | 19 (74%) | | |
| Do you learn more hands on | 19 | 21 (74%) | 3 | 2 (.9) |
| Worksheet | 5 | 4 (17%) | | |

I did an interview as the students worked on their divers. Table 3 shows the preferences of the students, whether they like to read out loud as a class or silently to themselves. Whether they like to do worksheets or hands on activities, and a little twist, which method do they learn more from, hands-on or a worksheet. The total percentage of students in both classes who would rather do hands on activities is 82%, 13% would rather do both and only 0.5% would rather do a worksheet. As for reading, 74% would rather read silently and 17% like to read out loud, while 0.9% would rather do both. I asked the students which method helped them learn more and 74% said hands on activities, 17% said worksheets and 0.9% said both.

When I asked the students why they were off task, the students remarked, “When it’s boring I shut down” and “If you had more hands on stuff you’d get people to understand and want to learn”. When I asked another student if she learned by listening she said, “No I am terrible at that.” Sometimes learners of all ages think they’re dumb or crazy because they can’t understand materials the way the others do (Conner, 2007).

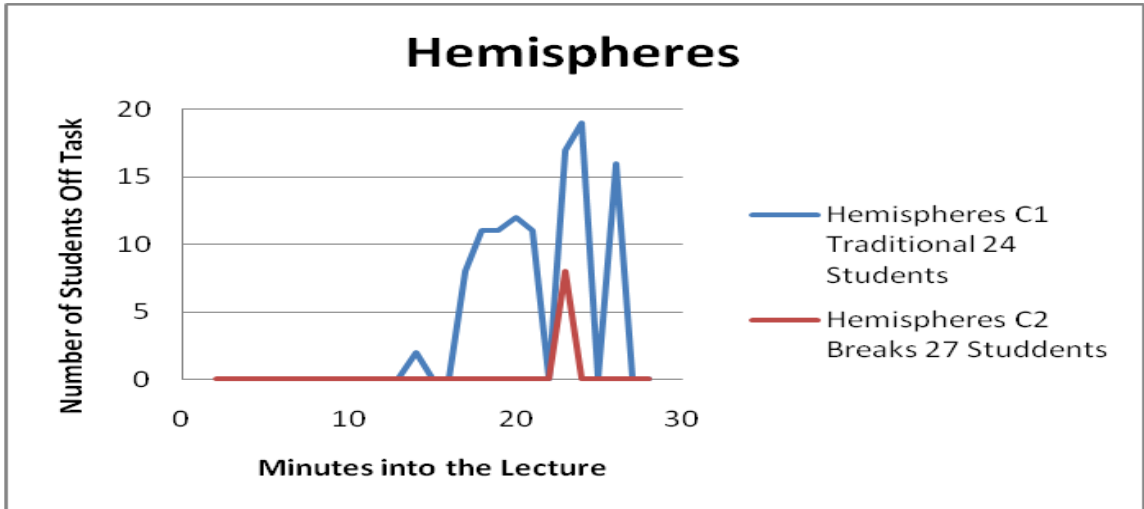


Figure 7. Lecture Stats Hemispheres/Demo Day.

For data gathering in the hemisphere lesson I used the six question quiz (Appendix I), and the observation rubric.

C1- within 20 minutes of starting the hemisphere demonstrations 19 of 24 students were off task. When C1 stopped lecturing and started a demonstration every off task students - repeatedly came back on task. Within two minutes after C1 restarted her lecture, she immediately lost 16 students to off task behaviors.

The observations showed the students in C1's, the traditional lecture, were on task for the first 10 minutes. Large numbers of students were on and off task for the rest of the lecture. C1 was able to draw all students back on task three more times for a very short period of time. C2's classroom was totally different, all students were engaged the whole class period except for one minute and the teacher immediately switched directions and drew the students back on task. The content being taught could be a factor in whether the students were on task or if they retained the information. The learning style lesson instruments showed the largest increase in learning, was it the lecture, the teacher or the content?

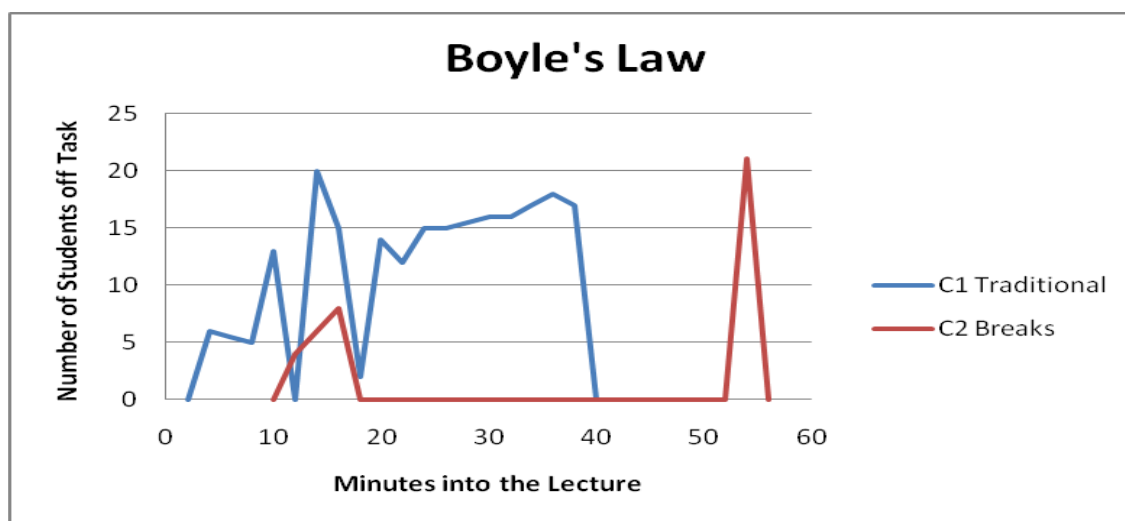


Figure 8. Lecture Stats Chemistry Worksheet.

During the Chemistry/ Boyle's law lecture, C1 used the traditional lecture and C2 the modalities. C1 students had a hard time staying on task. The lecture was 40 minutes long and within two minutes six students were off task. She was able to bring most of the students back on task using change-ups three different times. The students were still off task 99% of the time.

C2 started the class filling in a chart on the overhead; the students immediately lost interest and were passively off task. C2 did a change-up, handed out calculators to each student and from that point he had all students on task for 24 straight minutes. His lecture was 46 minutes long and his students were off task 26% of the time.

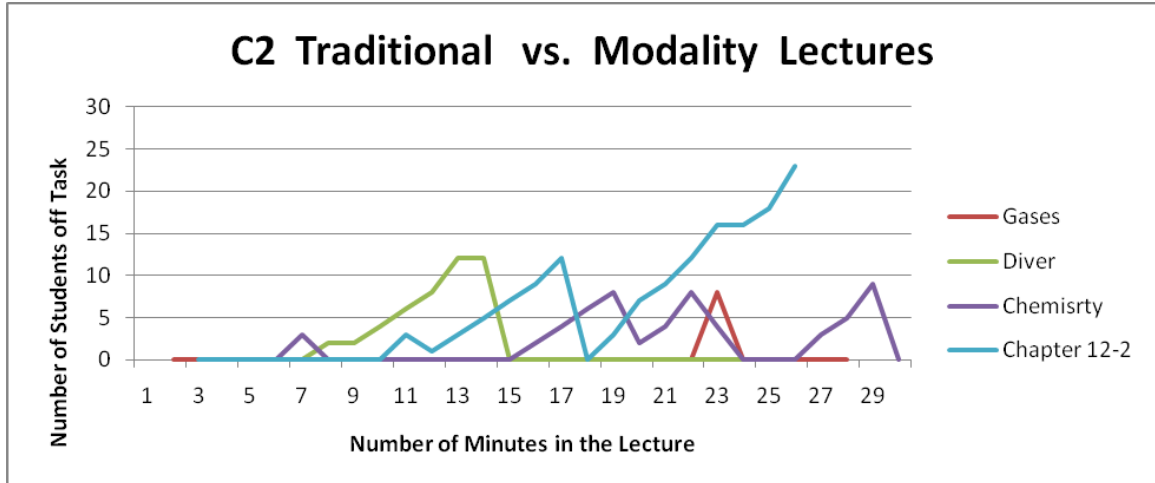


Figure 9. C2's Total Lecture Evaluations.

This graph depicts the modality style vs. traditional style lectures used in my treatments. This graph registers only the information gathered from classroom C2. Chapter 12-2 is the only traditional lecture on the graph. He had trouble keeping the students on task during the traditional lecture. He was able to keep all students on task for 7 minutes and was able to bring most of back on task twice. As the lecture continued the students were off task the rest of the period.

Throughout the observations I noticed a repeating pattern; when the teacher begins talking the students are engaged, the longer the teacher talks without a break or a change-up, the more the students were off task, but if a slide changed, story told, a visual was shown or a demonstration started, the students would stop everything they were doing to watch. Even in the video, if Bill Nye just talked the kids would wander and become disengaged but when there was a change of any kind the students would bounce back.

When analyzing C2's off task behavior vs. time, there is a pattern with the three modality lectures, students are off and on task, but are brought back on task quickly,

unusually with in two minutes. Yet with the traditional lecture C2 is able to bring the students back on task twice and then as the lecture got longer more and more students were disengaged for a longer period of time. Granted, there are some limitations to this insight as teaching experience is another factor. In both the diver and the hemisphere lecture C2 was able to hold the attention of the students for a long period of time.

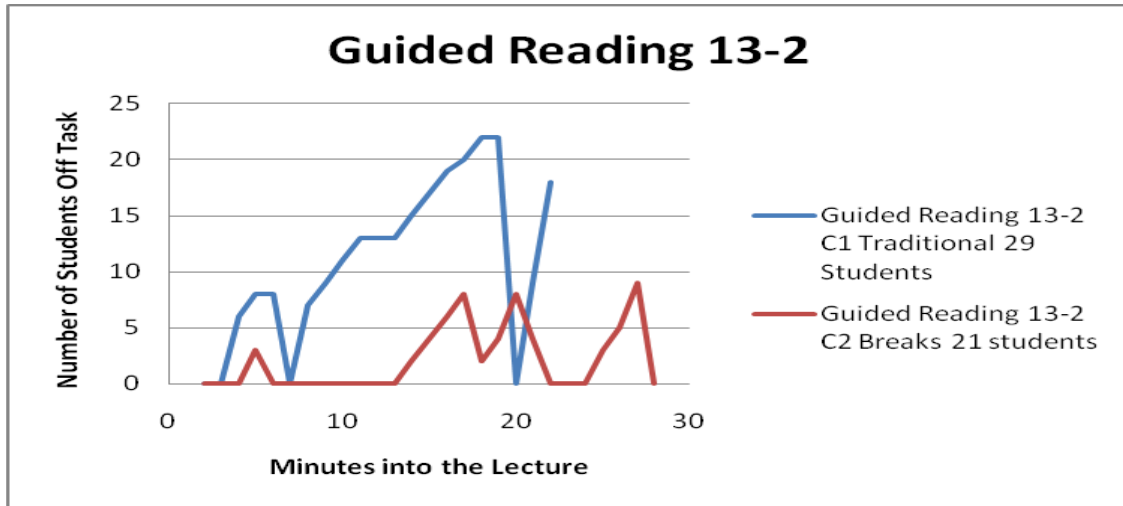


Figure 10. Lecture Stats Guided Reading13-2.

Figure 10 shows C1 using the traditional lecture and C2 the modality lecture. This is the compost of my notes on a non treatment lecture. The material was complicated and difficult for the students to understand yet C2 using modality instruction was able to keep more students on task than the traditional lecture method. This graph shows how the change-ups brought the students back on task.

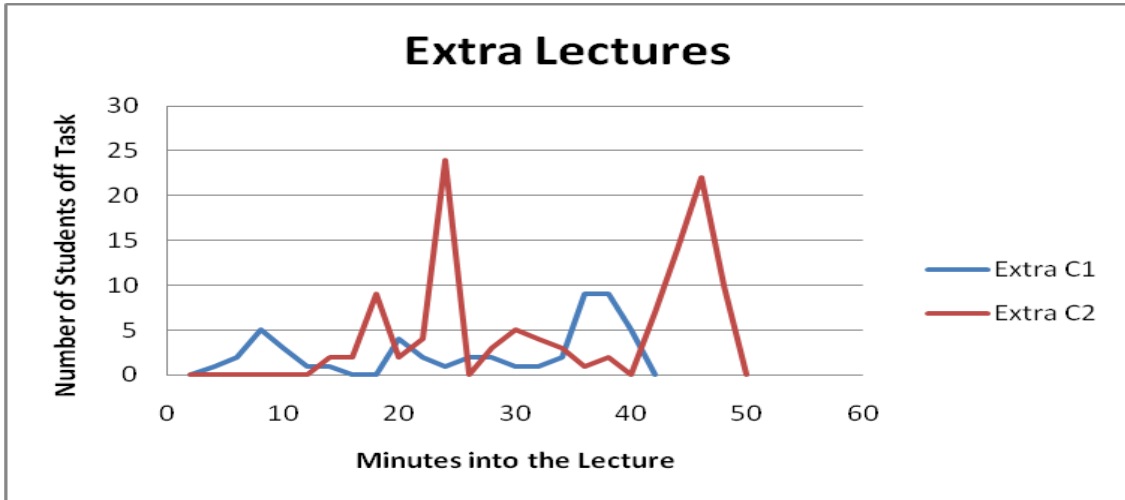


Figure 11. Lecture Stats Extra Lectures Traditional.

I observed two extra classrooms both of these were traditional lectures.

This figure represents two traditional lectures I observed with a different teacher and different students. The teachers using non treatment traditional lectures had trouble keeping the students on task. The changes-ups had a huge impact on bringing the students back on task.

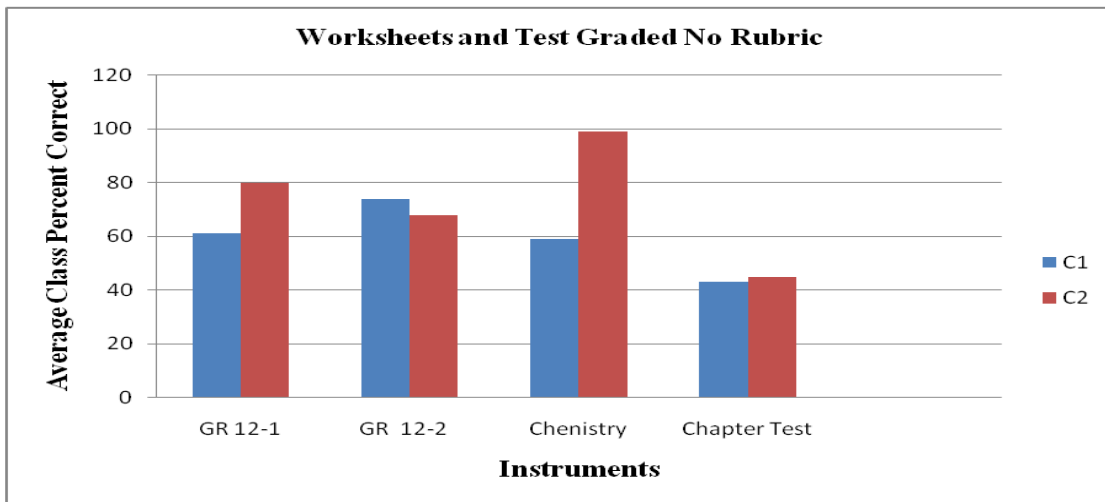


Figure 12. Graded Instruments No Rubric - C1 taught using Modality Strategies and C2 taught Traditional Lecture Methods, (C1 N=29, C2 N=30).

Figure 12 shows the students in C1 earning an average grade of 61 % per student on their Guided Reading worksheets 12-1, even though we went over the answers question by question with visual aids and hands-on items.

Compare that to C2's class who did the traditional lecture earning an average grade of 80% per student. Several things happened that I believe caused this large gap. First, C2 had more time to work on the worksheet because C1's hands- on lecture took longer to deliver. Next, C2 started to review part of the worksheet 12-1 with the students, and before I could stop him, he had given the students several of the answers on the worksheet.

The Guided Reading worksheets 12-2 provided a class average of 74% in classroom C1 while C2 had an average of 68% total points.

On the chemistry paper C2 using the modality lecture scored an average of 99% per student and C1 using the traditional method only scored 59%. Both scores were pretty equal on the chapter test C1 received an average of 43% and C2 45%. The increase of knowledge was in favor of the modality lecture with a growth of 6% over the three Guided Reading papers (12-1, 12-2& Chemistry).

Scoring With a Rubric

I looked for key words, scientific terms used in the lesson or a summary of what was taught to get five points. Five instruments used the scoring rubric, two one minutes papers, two CAT 38's and the video. There were an unlimited amount of points possible, on the One Minutes and the two CAT 38's. The quiz had a total of 30 points possible.

Each teacher taught three traditional lectures and three modality lectures. They each taught the same material each day but presented it in a different lecture method. I graded the One Minute paper for Chapters 12-1 and 12-2 using the scoring rubric. As I graded the One Minute Papers for lesson 12-1, I looked for keywords such as: learning style vocabulary, magnesium or other elements, combustible, oxides, gas, physical or chemical attribute or scientific terms used in the lesson or a summary of what was taught. The keys words I looked for in Chapter 12-2 were Bernoulli and Pascal's principle, density, viscosity and friction. The word magnesium was mentioned 11 times in C1 One Minute Papers. I found this interesting because magnesium was used in the demonstration we performed to show combustibility, and the students seemed to remember because it was a visual aid vs. hearing about it.

The One Minute Papers were graded using the scoring rubric. Lesson 12-1 class C1 used the traditional lecture and scored a total of 217 per class total points while C2 had 195 total points per class.

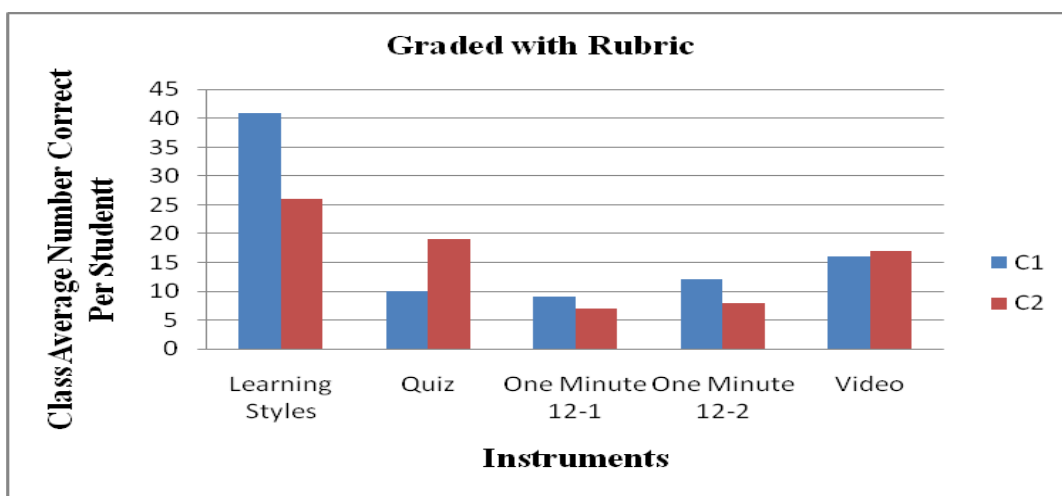


Figure 13. Graded Instruments with Rubric.

One Minute #2 for lesson 12-2 (C1) used the modality lecture and had 314 total class points while C2 taught with the traditional lecture earned a total of 207 total points per class. The modality lecture had a total of 531 points per classroom of learned material from both One Minute Papers and C2 had a total of 402 points per classroom. The modality lectures for 12-1 and 12-2 had an increase of 14% increase of knowledge over the traditional lecture.

The quiz was scored according to the scoring rubric. C1 scored 240 points and had 21 attending class. C2 scored almost twice as many points with 467 with 23 students taking the same quiz. Each of the six fill in the blank questions were five, three, or one point for the correct answer. The modality lectures for the quiz had a 32 % increase in knowledge over the traditional lecture.

The biggest difference in data collected came when I had both classrooms do the Modified CAT 38 the following Monday after the Learning Styles lecture. I taught the lesson on learning styles to the students on both classes. I have 15 plus years of teaching experience. The student's scores were extremely high for this lecture in both the modality and traditional lecture. To score CAT 38, the quiz and the video I used the scoring rubric (Appendix L). C1 completed the Modality Strategies lecture and scored 895 points or an average of 41 points per person (22 students in class) using the scoring rubric. C2 scored 669 points or an average of 26 points per person (26 students in class). The modality lectures for the CAT 38 had a 14 % increase in knowledge over the traditional lecture. What caused this large increase of learned material per class? It was the only lecture that

actually pertained to the students as individuals. Could they absorb more information because they could relate to the information?

I compared the learning styles lecture with the video because both used the CAT 38 to collect data. I found C1 scored 422 points or an average of 16 points per student and C2 scored 411 points or an average of 17 per student. C1 had 26 students in class and C2 had 26.

The third item I compared was the quiz because it too used the scoring rubric. The students in C1 had a total of 240 points earned by 21 students for an average of 11 items per students. C2 presented the modality lecture and his class scored 467 points, 23 students in class which is 20 items per student.

The video scores in both classes were almost equal in average points learned per student. Both classes watched the same video and I used the CAT38 to collect the facts learned and the scoring rubric to total the points. Students receiving the same information in the same lecture style learned the same amount of material.

The four data collections I used showed improvements in learning in favor of lectures using breaks and modality strategies in four of four areas (Guided Readings, One Minute Papers, CAT 38 and the Quiz). During the modality strategies lectures the students remained engaged with an appetite for knowledge. Was this because of breaks, the person teaching, change-ups and the use of modalities or a combination of all four?

Was Marzano (1998) right when he found that graphic and tactile presentations of the subject matter had noticeable effects on learning outcomes, regardless of any attempt to match them with learners' modalities? Or did the students learn more not because of the modalities even though it appears they did, but rather because the lecture pertained to

them as individuals? “Once learning styles have been identified, instructors can estimate the approach(es), method(es), and sequence(s), that are likely to make learning relatively comfortable for each person” (Dunn & Griggs, 2000, p. 19).

Interviews

I completed two sets of interviews, the mid and the exit. The mid interviews were given during the Diver lab as the students worked. I interviewed each individual student and asked three questions (Appendix J). The mid interview confirmed that the students liked and they thought they learned best from visual and hands on activities. A majority of the students in the interview, 42 out of 54 said they would rather do hands on activities instead of a worksheet; six students said they like both worksheets and hands on activities and six said they would rather have only a worksheet.

This figure shows the number of students and their responses to the three questions given in the interview. The graph is divided into three groups and the colors represent the different opinions.

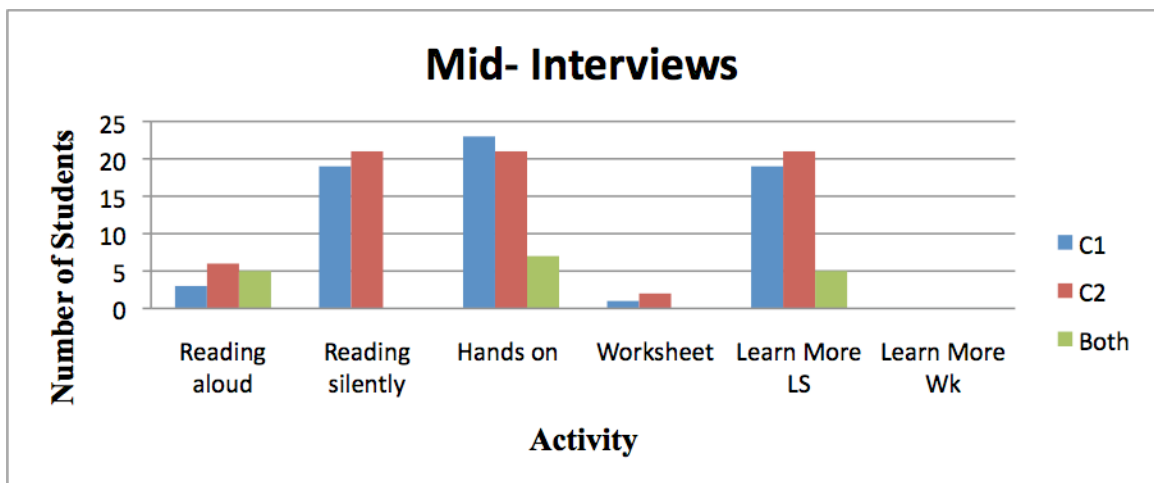


Figure 14. Three question interviews completed during Cartesian dive lab.

Exit Interview

I interviewed three groups of (four or five) students and one set of doubles (2 students) in each classroom. The interviews confirmed the students like visual and hands on learning over traditional methods. When the students were asked what they discussed the last three weeks I heard, “I remember the marbles and we moved them around to make solids and gases”, “Oxidation like that big nail”, “Displacement when the object was put in the bowl of water, Oh yeah and he told the Archimedes story about displacement too.” The eye picture” exclaimed another. They remembered the marshmallows, hemispheres, the diver, the vacuum and the magnesium burning. They remembered the words associated with the activities such as “Solids are packed more tightly like the glass pieces”, “Pressure caused the diver to go up,” “Buoyancy is the ability to float like the diver”. “Density will tell you if it will sink or float, like the wood.”

All the students said Demo Day/Hemisphere day was their favorite day. Not one of them said I remember hearing... in fact when I asked them what they heard, I received blank stares and I had to prompt them and I pulled it out of them that they remembered hearing the vacuum pump. Both teachers tried to involve their five senses. Almost everything the students remembered were things they saw or did, there were very few things they remember hearing like a story.

Chapter Test

The final test for chapters 12 and 13 was graded by the number correct there were 37 possible. C1 had a class average of 43% and C2 had a class average of 45%. Overall, it seems like the teachers flip flop in the results when they switch between traditional and

modality, thus this suggests the teachers are quite similar overall, and it's the treatment that is the main effect, not a teacher interaction. I was disappointed that the test scores weren't higher, and thought it interesting that the teachers said that they were normal. The results in both classes were low with the highest students score being 76%. The material was tough, but I think there are other issues playing a part here. For example, you can't take the text book home to study (there aren't enough), the worksheets are handed back with a point total but no corrections, and the reviews are done audibly. Finally, if you spend the time putting modality strategies into the lectures there isn't time to do the Guided Reading worksheet in class.

Learning Style Stability

To help insure that my instruments were valid and reliable, the students were given two of the three learning style surveys seven weeks later. After the students retook the two surveys, I compared the results with the same two pretreatment surveys. I compared the same individual students to the same students in each class, and I looked for changes and in most cases redoing the surveys show the students were stable learners. In classroom C1, 78% of the students learning styles were stable and for others their learning styles were defined more clearly. In Classroom C2, 85% were stable learners.

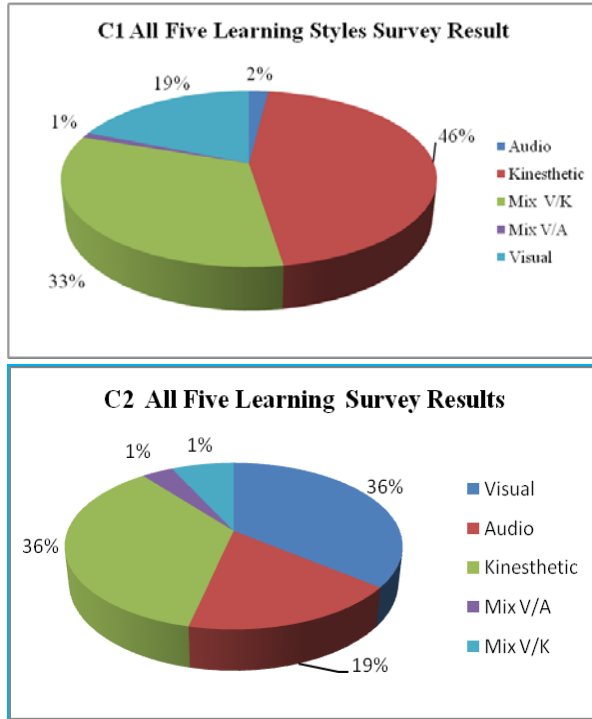


Figure 15. Learning Style Surveys Reliability Verification.

I compared each student from the first set to the results to the second set of surveys. I found C1 had a few changes. The largest change occurred with the visual/kinesthetic learner; they increased from 22 % to 33 %. The kinesthetic learners varied from 45% of the class to 46%. The audio learners remained the same. The visual learners went from 22 % to 19 %. The mixed visual/ audio learners went from 4% to 1%.

The students in C2 showed a big drop in kinesthetic learners 46% to 37% and the auditory learner went from 2% in the first surveys to 13% in the second set. The visual learner stayed close to the same 36% to 41%.

When comparing class to class I found C2 had only one real change and that was in the number of visual learners decreased from 41% to 36 %. The kinesthetic/ audio learner went 4% to zero. Kinesthetic learners went from 37% to 36% and we acquired one visual kinesthetic learner and one visual/audio learner.

For the last comparison I compared the two classes of the first set with the two classes in the second set of surveys. I found that in the two classes the average number of kinesthetic learners out of 58 students was 41%, the visual learners 28% and the auditory learners totaled 10.5 which agrees with the University of Illinois study. In the mixed group visual/kinesthetic learners totaled 22% and Visual/Audio 4%.

Reviewing the scores collected for the One Minutes, CAT 38, the quiz and the observations showed me that students who are actively involved in a modality lecture retains more information and are on task more often. I do think that my testing is far from complete and I have a lot to learn. I think this is the beginning to a life long project and has had a large impact on how I will approach the design of my classroom.

In their book, *Teaching students through their individual learning styles: A practical approach*, Dunn and Dunn (1978) state not only can students identify their preferred learning styles, but that students also score higher on tests, have better attitudes, and are more efficient if they are taught in ways to which they can more easily relate. Therefore, it is to the educator's advantage to teach and test students in their preferred styles.

INTERPRETATION AND CONCLUSION

The purpose of this research project was to determine, if modified lecture approaches and their impact improve student understanding and performance in science. My first question asked, what are the effects of lecture methods and modality strategies in the delivery of a lecture? The purpose of this research project was to determine the

impact of using modified lecture approaches on teachers for the purpose of student academic achievement and positive student attitudes.

What are the effects of lectures using modality strategies on the learning of high school science students? As a result of these lecture treatments I continued to find the same patterns. How long the students remained engaged and focused depended on the presentation of the lecture. Visual aids and hands on material got the students involved and kept them on task for most of the lecture while during the traditional lecture students were off task after five minutes.

I also found if the lecture interested the students or it pertained to them, they gleaned more information, retained more knowledge, and stayed on task. The students compiled higher scores in both learning style lectures than any other data assessment and they had to retain it for a longer period of time over a three day weekend. For C1, the modality lectures had a classroom score of 895 points or 41 facts per student. C2 had 667 points or 26 facts per student. That is an increase of 729 total points over the video, in which C1 had 422 points or 26 facts per student and C2 had 411 or 17 facts per student.

When I compared all the lectures and my notes, students did not return on task without a break or a change-up in a lecture 100% of the time. When there was a change the students checked it out and if they were interested they remained on task, but if it wasn't interesting they returned to the off task behavior. In the traditional lecture the number of students off task increased with lecture length. The longer the lecture the more students were off task.

My second research question dealt with the impact of teaching to students learning style and its effect on students' learning and understanding in Science. The

retention of the material on learning styles was impressive, for example, even after a three day weekend, the students remembered the material presented to them more than another lecture. When I compared that to the One Minutes chapters 12-1 and 12-2, the students did not have to retain the information for a three day weekend, yet their total points scored per class were 314 and 217. The students on the second One Minute scored 194 and 207 facts per class. I also compared it to the video Cat 38; C1 had 422 points and C2 411 points. 12-1 showed an increase of 14% over the traditional style lecture and the modality lecture 12-2 showed an increase in learning of 25% over the traditional lecture and the quiz showed an increase 32%.

Why did the students retain so much more information on the learning styles lecture and retained more over a three day weekend than the One Minute or the CAT38? It appears it wasn't due to the learning styles or the lecture methods because both the traditional and the modality lecture rubric points were higher. Was it the content because it pertained to each student personally? The students who received the modality strategies method lecture also had an increase in knowledge retention over the traditional methods.

My third sub question discussed the different lecture styles and their impact on keeping the students on task, engaged and focused? During the traditional lecture or when the teacher taught without modalities, I found the students repeatedly off task, fidgeting, talking, sleeping and drawing (Figures 3, 4, 5 and 6).

In all the lectures C1 taught the material using the traditional lecture, the students were off task within the first 5 minutes except for during the hemisphere lecture. The line graphs show a repeated pattern of on and off task behavior in the traditional lectures. During the lectures once the student got off task they did not come back on task unless

there was some sort of change-up or break in the lecture. If the change up wasn't important or interesting to the student they quickly became off task again. All four of the line graphs (Figures 3, 4, 5, and 6) show the C1 students are quickly off task off. As the lecture continues more and more students lose interest and are off task.

In all lectures the material presented was the same in content, yet the traditional lectures showed the students with either a definite lack of ability to remain engaged or desire to stay focused. Was this because of the lack of breaks and the use of modalities or because the material was presented in a traditional lecture?

The data provides enough evidence to illustrate that teaching lectures with breaks and modality strategies did improve the student ability to learn compared to the traditional lecture style of 'speaking' at the students. Students that were an active part of the discussion remained on task, engaged and more learning took place based on my research results.

Demo day was the best lecture I observed. During the five experiments both teachers had the same visual aids and hands on activities. It was challenging because there were so many visuals and hands on items, but we focused on the lecture styles. C1 delivered the traditional lecture, and she worked hard strictly delivering the lecture as you would read from a book out loud. She did not interact much with the students.

C2 on the other hand, delivered the lecture appealing to the student's five senses, told jokes and real life stories, and he discussed the vocabulary words and what they meant. He did not talk at the students but actively drew them into the presentation. Most of the students in C1 were off task by the end of the third experiment and C2 had they undivided attention the entire time. Some of this might be due to teaching

experience of the teachers. The teacher in C1 was a first year teacher, and the teacher in C2 was a very experienced teacher.

During the Hemisphere demonstration C1's students were on task for fifteen minutes and then quickly off task. There were visuals and demonstrations yet because the teacher continually lectured at the students with out breaks and with little student involvement the students grew off task.

The same Hemisphere lecture with the demonstrations was taught by C2 yet the presentation was done with breaks and modality strategies, the students remained on task except for one two minute time period. "Nonetheless, many tactual and kinesthetic students cannot achieve success in college because they are expected to sit and listen passively in class when they, instead, crave active engagement to learn effectively" (Rochford 2004, p.23).

What are the effects of lectures using modality strategies on the learning of high school science students? In treatment # 6 Boyle's Law Guided Reading13-2 the formula and problems were difficult to understand. I thought it was the difficulty of the material that disengaged the students and caused them to be frustrated yet C1's classroom struggled and C2 classroom did not. C1 presented the material strictly using an auditory lecture and C2 presented the material by drawing on the board, working through each step together with specific commands directing each step, and using a large Cartesian diver as a visual aid. He pressed the students by asking specific questions which lead them to draw on their own knowledge.

When directed to do the Boyle's Law worksheet on their own all students in C2's class were able to perform the problems on their own. However five students in C1's

classroom were off task within the first two minutes and 10 minutes into the lecture 12 students were off task. A total of 59% of the students were off task during the lecture.

When the students in C1 were asked to do the problems on their own 89% of the students had no idea how to do the problem. The students in the traditional lecture needed to have the directions on how to build the diver repeated a fourth time. Traditional lectures do not meet the needs of the students when giving step by step instruction on lab procedure.

During the observations I saw repeatedly how quickly the students flew off task. When the students were off task the learning stopped. During the traditional diver lecture the students did not pay attention to the step by step directions that had been repeated audibly twice. When the students were asked to build their diver most of the class was confused, and the chaos began. Most instructors are not cognizant of the fact that less than a third of their pupils can recall what they hear during a classroom lecture (Dunn, 2003).

The final chapter test results were close together, yet the scores were still very low. C1 had a class average of 43% points correct and C2 had 45%. This was important to the results because both classrooms had the same amount of modality strategies lectures. The highest grade in both classes was 28 out of 37 or 77%. But why are the scores so low? I think that I need to look at other factors that were affecting the learning of the students.

The interviews confirmed that this generation of students (i.e., the Net Geners) show distinctive ways of thinking, communicating, and learning. After going through the interviews, I tend to agree with Glenn (2000) because he suggested that the Net Geners need more self-directed learning opportunities, interactive environments, and assignment

choices that use different resources to create personal meaningful learning experiences. I observed that my student comments also reflected their preference, “I learn with my hands”. I hate it when the teacher just talks and talks.”; “I get bored easily I like things that are active”.

In the mid-interview C1 had 85% of the students say they learned better though hand-on and visual aids compared to worksheets and lectures. C2 had 78% say they learned better though hands activities.

The traditional lecture methods aren't going to capture this next generation of students. Teachers need to modify their lecture methods to engage the “net generation” of students. The impact on a teacher using the modified lecture approach in a science classroom will require more prep work to change their lecture style and to include more activities. Students respond with, “I don't learn by hearing I learn by seeing.” “I like lectures to be interactive not boring or reading out of a book” and “I have to do it to learn it.” Many of these same learners remember well when they learn tactually by using their hands, or kinesthetically through whole body movement” (Rochford 2004, p.23).

Students are different in terms of intelligence, ability, aptitudes, attitudes and experience. A typical class of 25 to 30 students presents to the instructor a wide range of these qualities as well as a diversity of learning styles and cognitive methods. This means that instructors must incorporate in their class enough material and methods of delivery to address the need of each individual student. This can be achieved by developing a comprehensive knowledge of students learning styles.

My final question was what is the impact on a teacher when using the Modified Lecture Approach in a science classroom? To have a positive effect on the students'

performance and attitude in a classroom the teacher needs to create lectures that teach to all students. They need to be aware of attention spans and place change-ups in the lectures. The teacher needs to be aware of what the students are doing. Just because the students are quiet doesn't mean they are listening. C1 made the comment, "Well that class went well the students listened the entire time." During that class 22 of the 27 students were off task.

It will require prep work for the teacher before giving a lecture. The breaks or change-ups can be anything from a real life story to a demonstration. Even drawing on the board brought many students back on task. Having an overhead was useful but to keep the students on task and together it is better to only put one item up at a time.

Teaching to different learning styles requires more work on the teacher part, but it allows all students to be actively involved in the learning process. It keeps them on task and engaged. It helps eliminate behavior problems.

VALUE

The experience of developing and conducting this capstone project has led to significant changes in my approach to teaching and life. The first area is in collaboration. I could not have completed this project if it had not been for the village that encouraged me. From the peers I met during the MSSE education coursework, my wonderful instructors, and my assistants at work, to my incredible proofreader, I bloomed from an insecure person to Wonder Woman. I now feel I can do anything if I just take it one step at a time.

I hated the feedback I got when I turned my papers over to the proofers. They always told me to do more that it wasn't good enough. My paper is far from great, but it is better than anything I have ever written. They pushed me to become better, the growth hurt, but I am a better writer, teacher and person because of it. I now evaluate all lectures I attend. I analyze what went right or what went wrong. I observe the students and watch to see what keeps them engaged and when they become off task. These observations have and will continue to make me a better teacher. I am hoping to become a presenter and teach others what I have learned.

I am anxious to continue this process of learning more about differentiation and research-based instructional strategies to better meet the needs of my students. Through this process I realized I need to increase my awareness of the importance of knowing my students. Though the interviews the students repeatedly said they learn if the teacher has empathy towards them and if the teacher understands how they learn. I will be aggressive at the beginning of the year to get a grasp on how each student learns. Rather than waiting for this knowledge to unfold, I will do surveys, observations and interviews. I will also evaluate the data on assessments and instruments. I will compile it in a student profile and like to visit with each parent to validate my findings.

My professional goals whether in education or the work force will focus on knowing my students, my peers, my staff and administration. Whether it is how they learn or what makes them a unique individual. I will build my differentiation-oriented instructional strategies, and encourage people to be all they can be. I will ask various questions about their background and interests, students will complete the three learning styles surveys assessments of auditory, visual, and kinesthetic. Through various pre and

formative assessments I plan to evaluate the students' progress. I will continue to record my own observations of students and will develop a more useful observation rubric than I used in my project.

Finally, as I was completing my masters in science education degree I was also completing my masters in special education. I want to take the knowledge I gleamed through my education courses and this research paper to develop curriculum for students with different needs base on lecture and learning styles. I want to create curriculum that reaches all students and not just the auditory learner.

I haven't begun to scratch the surface on learning style and lectures. I hope to find opportunities to continue this research. I see this being the start of a life long project. I will continue implementing modalities and different approaches to lectures, in both the classroom and in speaking engagements.

One area I'd like to research would be in special education and learning styles. Do special education high school students have different learning style characteristics from regular education students? According to Fine, (2003) through teaching to a students learning style the special education students scored statistically higher in achievement and attitude test scores, in addition their behavior improved to the point where they were positively engaged in academic experiences and worked collegially with both their peers and teacher.

I saw a small impact the learning styles had on the academic achievement, but if learning styles and lecture styles do improve learning than this approach will benefit teachers and students for years to come. I want to learn how to teach for a life time not

just to a test. I want to follow the Stewart and Felicetti (1992) example and create “educational conditions under which a student is most likely to learn” (p. 15).

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APPENDICES

APPENDIX A

LEARNING STYLES SURVEY # 1

Learning Styles Survey

Name _____ Date _____

Please answer the questions to the best of your ability

1. Do you know what learning style you are? If so what type are you?
2. What makes a good teacher?
3. I learn best when?
4. Do visual aids help you understand the concept that is being taught?
5. Do lessons where you are active help you learn? Example- touching display items, field trips, playing games or labs help you learn?
6. Does reading the text book aloud help you learn? Or listening to a tapes / CD's?
7. Does listen to a lecture help you learn?

APPENDIX B

LEARNING STYLES SURVEY # 2

WHAT'S YOUR LEARNING STYLE TEST # 2

What's Your Learning Style Test # 2

Name _____ Date _____ Period _____

For these questions, choose the first answer that comes to mind and click on a, b, or c. don't spend too much time thinking about any one question. Only pick one answer.

Question 1

When you study for a test, would you rather

- a) Read notes, read headings in a book, and look at diagrams and illustrations.
- b) Have someone ask you questions, or repeat facts silently to yourself.
- c) Write things out on index cards and make models or diagrams.

Question 2

Which of these do you do when you listen to music?

- A) daydream (see things that go with the music)
- b) hum along
- c) move with the music, tap your foot, etc.

Question 3

When you work at solving a problem do you

- a) make a list, organize the steps, and check them off as they are done
- b) make a few phone calls and talk to friends or experts
- c) make a model of the problem or walk through all the steps in your mind

Question 4

When you read for fun, do you prefer?

- a) Book with a lot of pictures in it
- b) a mystery book with a lot of conversation in it
- c) a book where you answer questions and solve problems

Question 5

To learn how a computer works, would you rather

- A) watch a movie about it
- b) listen to someone explain it
- c) try to figure it out for you

Question 6

You have just entered a science museum, what will you do first?

- a) Look around and find a map showing the locations of the various exhibits
- b) talk to a museum guide and ask about exhibits
- c) go into the first exhibit that looks interesting

Question 7

What kind of restaurant would you rather not go to?

- a) One with the lights too bright
- b) one with the music too loud
- c) one with uncomfortable chairs

Question 8

Would you rather go to?

- a) An art class
- b) a music class
- c) an exercise class

Question 9

When watching an event and something you like happens are you most likely to...? Example sporting event and your team scores point.

- a) Smile
- b) shout
- c) jump, or slap hands or raise an arm in victory or clap for joy

Question 10

If you were at a party, what would you be most likely to remember the next day?

- a) The faces of the people there, but not the names
- b) the names but not the faces
- c) the things you did or said while you were there

Question 11

When you see the word "d - o - g", what do you do first?

- a) Think of a picture of a particular dog
- b) say the word "dog" to you silently
- c) sense the feeling of being with a dog (petting it, running with it, etc.)

Question 12

When you tell a story, would you rather

- a) Write it
- b) tell it out loud
- c) act it out

Question 13

What is most distracting for you when you are trying to concentrate?

- a) Visual distractions
- b) noises
- c) other sensations like thoughts of hunger, problems, or worry

Question 14

What are you most likely to do when you are angry?

- a) Make a face
- b) shout or "blow up"
- c) Get mad a walk away or slam the door

Question 15

When see a word in a book, which of these is you most likely to do? Example

- a) Do you make a picture of what it is in your head?
- b) Sound it out or think of other words that mean the same thing.
- c) Do you think of how it feels, or picture your self doing it?

Question 16

Which are you most likely to do when standing in a long line at the movies?

- a) Look at posters advertising other movies
- b) talk to the person next to you
- c) tap your foot or move around in some other way

APPENDIX C

LEARNING STYLES SURVEY # 3

Learning Style Test # 3

Name _____ Date _____

Male ____ Female ____

Please circle the correct answer.

| | Questions | Answer | Answer | Answer |
|---|---|-----------------------|-------------------------------------|--|
| 1 | When operating new equipment for the first time I prefer to | read the instructions | listen to or ask for an explanation | have a go and learn by 'trial and error' |
| 2 | When seeking travel directions I... | look at a map | ask for spoken directions | Just start driving or walking in the direction you think it is |
| 3 | When cooking a new dish me... | follow a recipe | call a friend for explanation | follow my instinct, tasting as I cook |
| 4 | To teach someone something I... | write instructions | explain verbally | demonstrate and let them have a go |
| 5 | I tend to say... | "I see what you mean" | "I hear what you are saying" | "I know how you feel" |
| 6 | I tend to say... | "show me" | "tell me" | "let me try" |
| 7 | I tend to say... | "watch how I do it" | "listen to me explain" | "you have a go" |
| 8 | When Complaining | write a letter | phone | go back to the store, or send the faulty item to |

| | | | | |
|-----------|---|---|--|--|
| | about faulty goods I tend to... | | | the head office |
| 9 | I prefer these leisure activities | museums or galleries | music or conversation | physical activities or making things |
| 10 | When shopping generally I tend to... | look and decide | discuss with shop staff | try on, handle or test |
| 11 | Choosing a vacation I... | read the brochures, look at the pictures | listen to recommendations | imagine the experience – look at what activities there are to do |
| 12 | Choosing a new car I... | read the reviews | discuss with friends | test-drive what you fancy |
| 13 | Learning a new skill | I watch what the teacher is doing | I talk it through with the teacher exactly what I am supposed to do | I like to give it a try and work it out as I go along by doing it |
| 14 | Choosing from a restaurant menu... | I imagine what the food will look like | I talk through the options in my head | I imagine what the food will taste like |
| 15 | When listening to a band | I sing along to the lyrics (in my head or out loud!) | I listen to the lyrics and the beats | I move in time with the music |

| | | | | |
|----|--|---|--|---|
| 16 | When concentrating me... | focus on the words or pictures in front of me | discuss the problem and possible solutions in my head | move around a lot, doodle or play with items in pocket or on desk |
| 17 | I remember things best by... | writing notes or keeping printed details | saying them aloud or repeating words and key points in my head | doing and practicing the activity, or imagining it being done |
| 18 | My first memory is of | looking at something | being spoken to | doing something |
| 19 | When anxious, I... | visualize the worst-case scenarios | talk over in my head what worries me most | can't sit still, fiddle and move around constantly |
| 20 | I feel especially connected to others because of | how they look | what they say to me | how they make me feel |
| 21 | When I study for a test, I... | Write lots of notes, (using lots of colors! | I talk over my notes to myself or to other people | imagine making the movement or creating the formula or make pictures out of the words or make 3 x 5 cards |
| 22 | When explaining something to someone, I tend to... | show them what I mean | explain to them in different ways until they understand | encourage them to try and talk them through the idea as they try |

| | | | | |
|----|---|---|---|--|
| 23 | My main interests are | photography or watching TV, videos or people-watching | listening to music or listening to the radio or talking to friends | physical/sports activities or fine wines, fine foods or dancing |
| 24 | Most of my free time is spent... | watching television | talking to friends | doing physical activity or making things |
| 25 | When I first contact a new person... | I arrange a face to face meeting | I talk to them on the telephone | I try to get together to share an activity |
| 26 | I first notice how people... | look and dress | sound and speak | stand and move |
| 27 | If I am very angry... | I keep replaying in my mind what it is that has upset me | I shout and tell people how I feel | I exercise, walk away , clean house, go shopping or do something physical |
| 28 | I find it easiest to remember | faces | names | things I have done |
| 29 | I think I can tell someone is lying because... | they avoid looking at you | their voice changes | the vibes I get from them |
| 30 | When I'm | I say "it's | I say "it's great to | I give them a hug or a |

| | | | | |
|--|--|-------------------------------|--------------------------|-----------------------------|
| | meeting with an old friend... | great to see you!" | hear your voice!" | handshake |
| | Totals | Visual | Auditory | Kinesthetic/Physical |

Add up the number in each column of the questionnaire and place the total at the bottom of the page. The total scores for each style indicate your relative preferred learning style or styles. There is no right or wrong answers. Some people have very strong preferences, even to the extent that they have little or no preference in one or two of the styles. Other people have more evenly balanced preferences, with no particularly strong style. The point is simply to try to understand as much as you can about yourself and your strengths (your preferred style or styles), and then make best use of learning methods which suit your strengths (your preferred style or styles).

APPENDIX D

VISUAL LEARNERS

VISUAL LEARNERS

Visual

"Visual learners remember best what they see (pictures, diagrams, graphs, schematics, flow charts, time lines, films, and demonstrations)

If something is simply said and not shown to visual learners (e.g. in a lecture) there is a good chance they will not retain it.

Benefits from seeing information on a chalkboard or in an illustration and may grow impatient listening for long periods of time.

Visual learners remember what they see, but forget what they hear.

Visual learners have a wonderful sense of space, but not necessarily a very good sense of time.

Think in terms of pictures. Prefer to see things written down in a handout, in text, or on an overhead. They find maps, graphs, charts, and other visual learning tools to be extremely effective. They remember things best by seeing them written.

When visual learners are working on reading, memorization is not their strong suit. They need to learn in pictures.

Don't learn by memorizing details and then constructing a whole out of them. They capture information all at once, just like a camera snaps a photo.

Most people are visual learners, which mean that most students do not get nearly as much as they would if more visual presentation were used in class.

Characteristics

Have a wild imagination, are "outside-the-box thinkers" and can think of numerous solutions to a single problem.

Visual-spatial learners excel in spatial tasks but may have difficulty with spelling, math facts and organizational skills.



Spatial visualization, in which males generally have a slight edge, involves the ability to mental rotate objects in three-dimensional space and do well with mechanical reasoning and often excel in certain types of science and engineering. Object visualization, in which women tend to perform somewhat better, involves the ability to clearly recall the vivid colors, details, and images of faces, dreams, or scenes. These individuals often make excellent visual artists.

A strong sense of artistry and are extremely imaginative and creative.

Good at building mental models and manipulating images in their mind.

Have a strong sense of direction and an ease of reading maps.

Enjoys art activities. Draws figures that are advance for age
 Love posters, pictures, movies and other visual presentations.
 Daydreamers, sometimes becoming so engrossed in their own internal "movie" that they don't seem aware of the external environment.
 Have an excellent awareness of space, the orientation of their body and others. This spatial awareness gives them skills in drawing, doing puzzles, mazes, and any task that requires fine-motor manipulation.
 Can visualize pictures in head
 Reads maps, charts, and diagrams more easily than text
 Likes to view movies, slides, or other visual presentations
 Enjoys doing puzzles, mazes, "Where's Waldo?", or similar visual activities
 Builds interesting three-dimensional constructions, such as LEGO buildings
 Likes books with pictures/Gets more out of pictures than words while reading
 Likes to doodle on notebooks and worksheets
 Enjoys geometry in school
 Notices colors and shapes
 Can remember places vividly

How can visual learners help themselves?

- Visual-learning students will sometimes struggle during essay exams, because they can't recall test material that was "heard" in a lecture.
- Uses a visual aids when studying, like a colorful outline of test materials
- Visual tools improve the ability to recall information more completely
- Most classes very little visual information is presented: students mainly listen to lectures and read material written on chalkboards and in textbooks and handouts.
- Making outlines of everything
- Converting any information into diagrams, maybe even numbered bullet points
- Mapping events
- Viewing instructional videos
- If you are a visual learner, try to find diagrams, sketches, schematics, photographs, flow charts, or any other visual representation of course material that is predominantly verbal.
- Ask your instructor, consult reference books, and see if any videotapes or CD-ROM displays of the course material are available
- Prepare a concept map by listing key points, enclosing them in boxes or circles, and drawing lines with arrows between concepts to show connections.
- Color-code your notes with a highlighter so that everything relating to one topic is the same color.
- Write summaries or outlines of course material in your own words.
- Working in groups can be particularly effective: you gain understanding of material by hearing classmates' explanations and you learn even more when you do the explaining.
- Draw pictures and diagrams to help you understand.
- Take notes while studying and/or listening to lectures to reinforce visually what they are hearing.
- Take careful notes during class so you can refer back to them later on.
- Summarize the main points of what you learn using charts.

Careers Ideas

Engineer Surveyor Architect Urban planner Interior decorator
Photographer Art teacher Inventor Pilot Artist Sculptor
Guide Hunter Scout Cartographer Graphic Designer
Fashion Designer

APPENDIX E

AUDITORY LEARNERS

AUDITORY LEARNERS

Auditory

Verbal learners get more out of words--written and spoken explanations.

Sounds, written and spoken words and formulas

Auditory learners' also known as listening learning

Good at absorbing information from spoken words and may understand instructions better if they are read aloud.

Auditory learners learn best by hearing information rather than imagining it.

Characterizes

Good with languages

Remember what is heard

Speak aloud while writing

Learn to read easily with phonics

Read out loud to themselves

Remember information set to music

Notice sounds

Enjoy being read to

Talk a lot

Are distracted by background noise

Distracted by graphic information during lectures

Gain little meaning from written information until it has been heard

Have poor comprehension when reading silently

Have difficulty following written directions

Enjoy talking.

Talk aloud to themselves.

Like explaining things to others.

Remember names.

Recognize variations in a person's tone of voice.

Understand concepts better by talking about them.

Are distracted by background noise.

Have difficulty following written directions.

Read slowly.

Have difficulty being quiet for extended periods of time.

Like being read to.

Memorize things by repeating them aloud.

Enjoy music.

Whisper the words on the page as they read.

Hum or sing often.

Like being around other people.

Enjoy the performing arts.

www.custom-homeschool-curriculum.com/auditory...



How can Auditory learners help themselves?

- Practicing past exam questions and answers by writing them
- Read notes aloud, maybe even reading them to others
- Write down any oral instructions you hear in class right away.
- Consider taping lectures if your professor says it is OK
- Discuss and explain topics with students
- Describe overheads, pictures, and visuals to somebody that was not there.
- Leave space in notes for later recall
- Expand your notes
- Put summarized notes on tape and listen
- During exams listen to your voice and write them down speak your answers

Teachers

- Use rhyming word games.
- Use the phonetic approach.
- Read aloud, even when reading independently.

Use auditory materials to teach lessons, including:

- Video tapes
- Audio tapes
- Books on tape
- Melodies, rhythms and beats to reinforce information

Have Students

- Answer questions orally.
- Give oral reports.
- Repeat facts aloud with their eyes closed.
- Use repetition to memorize.
- Recite information aloud when they're studying (i.e., facts, [spelling](#) words).
- Use tape recorders to record and play back lessons.
- Participate in small and large group discussions before working independently.
- Study in groups.

APPENDIX F

KINESTHETIC LEARNER

KINESTHETIC

Like a "hands-on approach to learning. Learn through moving, doing and touching. Kinesthetic learners move, bounce, and travel around classrooms and homes. They are rarely still, but in their movements are always learning. These individuals will point while giving directions, or only be able to get to a particular place by taking you there.

Kinesthetic Intelligence Body Smart

Actions Speak Louder than Words

Kinesthetic learners best learn by doing.

They process information as their body moves. Because the entire body is involved, this type of student takes longer to process new information.

Kinesthetic Learners are always doing something. They learn best through hands-on activities, in every subject. They are not content to merely observe, but must touch and manipulate everything they encounter. Unit Studies are ideal for these hands-on children because each fact or concept is taught through activities and reinforced in each subject. If unit studies are too labor-intensive for parents, field trips, crafts, activities, projects or whatever else you can imagine will bring any subject to life.

Kinesthetic Learners - kinesthetic, also called tactile, learners are those who learn best through touching, feeling, and experiencing that which they are trying to learn. They remember best by writing or physically manipulating the information.

Characteristics

- Learns better when able to move during learning
- Uses movement to help concentrate
- Likes to take frequent study breaks
- Involves the sense of touch in learning
- Likes to do artwork
- Enjoys putting things together and taking them apart
- Likes to trace words and pictures
- Chews gum while studying
- Often fidgets or finds reasons to move
- Is not very attentive to visual or auditory presentations
- Wants to be "doing" something
- Tries things out
- Enjoys working with hands-on materials, such as clay or finger-paints
- Gestures when speaking. Has a dramatic way of expressing herself/himself
- Is often a poor listener
- Responds to music by physical movement
- Likes to move hands (doodling, tapping,) while learning
- Often likes to work at a standing position
- Uses bright colors to highlight reading material
- Likes to listen to music while studying.
- Likes to skim through reading material to get a rough idea what it is about before settling down to read it in details
- Usually good rhythmic movements and good fine and gross motor skills
- Tracks with finger while reading
- Learn better through emotions, touch, movement and space

- Master skills through practice
- Sits still for 5.2 seconds at a time!
- Retain and understand information best by doing something active with it-- discussing or applying it or explaining it to others.
- Uses fingers to figure out math problems
- Is naturally skilled in physical activities such as sports or riding a bicycle
- Moves, twitches, taps, or fidgets while seated for a long time in one spot
- Doodles while listening
- "Let's try it out and see how it works" is an active learner's phrase.
- Loves to take things apart and put them back together again
- Puts his hands all over something he has just seen.
- Shows good fine-motor coordination in crafts, such as woodworking, sewing, or mechanics

How can you help your self?

Schedule your homework and study sessions so you can take breaks and move around between reading your notes or chapters.

Take good notes during class—this will force you to pay attention and process information even when you feel like you are “getting it”.

Don't sign up for long once-a-week classes—they normally require too much sitting and listening time.

Study in a group in which the members take turns explaining different topics to each other.

Work with others to guess what you will be asked on the next test and figure out how you will answer.

You will always retain information better if you find ways to do something with it.

Using the actual software rather than looking at video's on how to use certain tool's etc.

Take frequent breaks while studying & If you can change the location every time.

Physically manipulate something in order to learn about it.

These learners may have a difficult time remembering the name of each letter and have an especially hard time relating sounds to letter symbols.

It takes a lot of concentrated focus to get through the tasks usually associated with reading. Snippets of information, preferably ingested through visuals and movements, prove most successful

Tips for Studying

1. To help stay focused on class lecture, sit near the front of the room and take notes throughout the class period. Don't worry about correct spelling or writing in complete sentences. Jot down key words and draw pictures or make charts to help remember the information being heard.
2. When studying, walk back and forth with textbook, notes, or flashcards in hand and read the information out loud.
3. Make a model that illustrates a key concept.
4. To learn a sequence of steps, make 3 x 5 flashcards for each step.
5. Copy and paraphrase notes- New information, copy key points onto large writing surface.
6. Learn and practice new material by relying on the sense of touch.
7. Use your computer as much as possible

8. Trace words with finger or the eraser end of a pencil.
9. Arrange the cards on a table top to represent the correct sequence.
10. Put words, symbols, or pictures on flashcards -- anything that helps to remember the information. Use high lighter pens in contrasting colors to emphasize important points. Limit the amount of information per card to aid recall. Practice putting the cards in order until the sequence becomes automatic.
11. Study important information by placing facts on index cards and reading the information aloud while pacing or walking around.
12. Try studying while lying on a bed or the floor, or listening to music.
13. In class, when it is necessary to be still, bounce your foot, twirl a pen, or squeeze a ball. Just be sure you are not distracting those around you.
14. Set a timer for 20-30 minutes. Work for this amount of time, then take a 5- or 10-minute break.
15. Use brightly colored paper under worksheets or study materials to help you focus.
16. Read novels, articles, and texts while pedaling on a stationary bike or climbing a Stairmaster.

Careers

Physical therapist Recreational worker Dancer
 Actor Farmer Mechanic Carpenter Craftsperson
 Physical education teacher Forest ranger Factory worker
 Jeweler Athlete Mime Artistic painter Surgeon

Teaching Strategies Kinesthetic Learners

Construct models (solar system, Egyptian city)
 Experience the topic first hand (field trips, demonstration, plant a garden)
 Touch and examine what she is learning (dissect a flower)
 Work with manipulatives for math, spelling, and writing
 Role-play historic events, math processes, scenes from literature, etc.
 Memorize information (such as math facts) while moving
 Instead of written reports do dramatizations
 Play educational games (fun way to learn grammar, history, math and spelling)
 Use videos and websites
 Take frequent "movement" breaks during seatwork
 Textbook and seatwork-oriented methods are not a good fit
 Painting drawing dancing
 Create a space that allows them to move around freely.
 Stress the shape and structure of a word. Allow student to trace or make from clay etc.
 Allow students to practice writing new words before testing.
 Structure classroom so there are areas student may move to work.
 Do short energizers or other movement activities to channel excess energy.

APPENDIX G

WORKSHEET 12-1

Guided Reading Chapter 12 Section 1

1. Physical properties of matter are those you can
a) change b) observe c) touch
2. Physical properties of matter include color, texture, _____, _____,
and state of matter.
3. _____ properties of matter are those observed when one substance is changed
into another substance.
4. Give a real life example of a physical and chemical change to matter.
5. Describe density of matter. Does the density of a piece of wood change if I chop the
wood in half?
6. Why is a ring made of platinum denser than the same size ring made of silver?
7. Minerals are an example of a(n) _____ solid; having an orderly,
repeated pattern.
a) amorphous b) dense c) crystalline
8. Complete the following table that compares the mechanical properties of solid matter.

Property

Definition

Example

A measure of how much tensional stress a
material can withstand before it breaks.

Wax has a low tensile strength,
steel has a high tensile strength

Hardness

Diamond

Elasticity

The ability of a solid to be stretched and return to its original size.

The tendency of a material to expand or contract due to temperature changes.

Ductility

The ability of a material to be pounded into thin sheets.

Aluminum foil

APPENDIX H
WORKSHEET 12-2

GUIDED READING CHAPTER 12 SECTION 2

1. What is a fluid?
2. Why is liquid silver less dense than solid silver?
3. _____ is the amount of force in a certain area.
4. What is the difference between pounds per square inch (psi) and pascals?
5. Pressure is caused by _____ between molecules.
a) collisions b) density c) bonds
6. Which of Newton's three laws plays a part in creating pressure on objects, and why?
7. Bernoulli's Principle relates the three properties height, _____, and _____.
8. What is Pascal's Principle?
9. Write the equation for pressure in figure 12.13.
10. Write the equation for force in figure 12.14.
11. Viscosity is the property of fluids that causes _____.
a) pressure b) velocity c) friction
12. As the temperature of a liquid is increased, the viscosity _____.
a) increases b) decreases c) remains the same

APPENDIX I

QUIZ

QUIZ FOR DEMO DAY

Name _____ Period _____

- 1, _____ causes food (and wine) to spoil.
2. The pop bottle crumples because the pressure inside is reduced.
3. Gases _____ when heated.
4. When Oxygen is consumed it reduces _____.
5. _____ pushes the water up the cylinder and it pushes hemispheres together.
6. When oxygen is consumed it _____ pressure.

APPENDIX J

MID & EXIT INTERVIEW QUESTIONS

MID INTERVIEW

1. Would you rather read aloud or silently in class?
2. Would you rather do labs, hands-on activities or worksheets?
3. Do you learn more from hands on activities or worksheets?

Exit Interview Questions

1. What type of learners do you think you are?
2. Of the different lectures which was your favorite? Why? What did you learn from it?
3. Thinking back what do you remember seeing?
4. Hearing?
4. Touching?
5. What do you remember learning about solids?
6. Density?
7. Fluids?
8. Pressure?
9. Buoyancy?

APPENDIX K

OBSERVATION RUBRIC

OBSERVATION RUBRIC

The follow table shows the research question and which assessment I am going to use to collect the data for the research part of my project.

| Observations Measuring On & Off-Task Behavior | | | |
|--|-----------------------------|------------------------------------|---|
| Class: C1 | | Date: March 9, 2011 | |
| Lecture Style: Traditional | | Beginning Class Time: 12:24 | |
| Observation Time | Number of Student OT | On/Off Task Behavior | What Event/Task Does Teacher do to Cause the On or Off Task Behavior |
| 12:28 | 0 | E | Students writing expectations |
| 12:34 | 0 | E | C1 Demo, explains, SI |
| 12:40 | 0 | E | C1 SI, explains, describes |
| 12:45 | 0 | E | Students writing or drawing observations |
| 12:49 | 0 | E | C1 Demo, explains, talks |
| 12:52 | 2 | OTV | C1 explains, talks, demo |
| 12:58 | 8 | OTM | C1 explains, talks |
| 1:00 | 11 | OTM, OTP | C1 explains, talks |
| 1:04 | 12 | OTM,OYP | C1 explains, talks, demo |
| 1:06 | 11 | OTM,OTV | C1 explains, talks |
| 1:08 | 0 | E | C1 demo, explains |
| 1:10 | 17 | OTM,OTP,OTV | C1 demo, explaining, talking |
| 1:12 | 19 | OTM,OTP,OTV | C1 talking, preparing next demo |
| 1:14 | 0 | E | C1 starts Demo ,SP |
| 1:16 | 16 | OTM,OTP,OTV | C1 talking. explaining |

Task Behavior -

Off-Task (OTM) - Instead of working on assigned task, the student is out of seat, fidgeting, playing with objects (e.g. pencil, toys, etc.) and/or other students, making gestures, acting silly or throwing things, etc.

b. Off-task verbal (OTV) - Instead of working on assigned task, the student is calling out, talking to someone, listening to or playing with MP3 Player, making noises, etc.

c. Off-task passive (OTP) - Instead of working on assigned task, the student is looking around, daydreaming, looking out window, sleeping, head down, delaying starting assigned task, etc.

d. Engaged (E) - Eyes on teacher, writing/doing assigned task, verbally participating.

SP=Student Participation, 5S= 5 senses, WOB=writes/draws on board

APPENDIX L
SCORING RUBRIC

Table 4
Scoring Rubric

| Scoring Guide for Research Project | | | |
|---|--|---|--|
| Project: | 5 Points | 3 Points | 1 Point |
| Student: | <ul style="list-style-type: none"> • Precisely and appropriately used scientific terminology. • Provided evidence of in depth, sophisticated understanding of relevant scientific concepts, principles or theories (big ideas). • Observable characteristics and properties of objects, organisms, and/or materials used went beyond the task/investigation to make other connections or extend thinking. | <p>Appropriately used scientific terminology.</p> <ul style="list-style-type: none"> • Provided evidence of understanding of relevant scientific concepts, principles or theories (big ideas). • Evidence of understanding observable characteristics and properties of objects | <ul style="list-style-type: none"> • No use, or mostly inappropriate use, of scientific terminology. • No mention or inappropriate references to relevant scientific concepts, principles, or theories (big ideas). • Some evidence of understanding observable characteristics and properties of objects, and/or materials used. |

APPENDIX M

INDIVIDUAL LEARNING STYLE SCORES

| 5th Period Learning Styles Assessment Chart | | | | | | | | |
|---|----------|----------|----------|-------|-----|-----|------|-------|
| K= Kinesthetic A=Auditory, V =Visual Learners | | | | | | | | |
| Name | Test # 1 | Test # 2 | Test # 3 | Total | V=5 | A=2 | K=12 | Mix=7 |
| Student # 1 | K | V/K | K | K | | | | |
| Student # 2 | K | K | K | K | | | | |
| Student # 3 | NA | K | V | V/K | | | | |
| Student # 4 | V/K/A | V | V/A | V | | | | |
| Student # 5 | V/A | K | V/A | V/A | | | | |
| Student # 6 | V | A | V | V | | | | |
| Student # 7 | VAK | K | K | K | | | | |
| Student # 8 | K | K | K | K | | | | |
| Student # 9 | A/V | V | K | V | | | | |
| Student # 10 | K | A | K | K | | | | |
| Student # 11 | V/A | A | K | A | | | | |
| Student # 12 | NA | NA | NA | NA | | | | |
| Student # 13 | NA | NA | K | K | | | | |
| Student # 14 | V/K | V | K | V/K | | | | |
| Student # 15 | A/K | A | A | A | | | | |
| Student # 16 | NO | V/K | K | K | | | | |
| Student # 17 | V/K | K | V | V/K | | | | |
| Student # 18 | V/K | K | K | K | | | | |
| Student # 19 | NA | NA | V | V | | | | |
| Student # 20 | K | K | K | K | | | | |
| Student # 21 | K | K | K | K | | | | |
| Student # 22 | K | A | K | K | | | | |
| Student # 23 | V/K | K | V | V/K | | | | |
| Student # 24 | NO | K | V | V/K | | | | |
| Student # 25 | V/A | V | V | V | | | | |
| Student # 26 | V/K | A/K | V | V/K | | | | |
| Student # 27 | K | K | V | K | | | | |
| Student # 28 | V | K | V | V | | | | |

| 7th Period Learning Styles Assessment Chart | | | | | | | | |
|---|----------|----------|----------|-------|------------------------------------|-------|----|-----|
| K= Kinesthetic A=Auditory, V =Visual Learners | | | | | | | | |
| Name | Test # 1 | Test # 2 | Test # 3 | TOTAL | Visual | Audio | K | Mix |
| Student # 1 Alberto | V | V | A | V | 11 | 5 | 10 | 1 |
| Student # 2 Marissa | UK | A | A | A | | | | |
| Student # 3 Brittany A | NA | NA | NA | NA | | | | |
| Student # 4 Seth B | V | V | K | V | | | | |
| Student # 5 Nikayla B | V | K | A | V | Because reads maps likes art, list | | | |
| Student # 6 Cammeron | K | K | K | K | | | | |
| Student # 7 Isaac D | V/K | K | K | K | | | | |
| Student # 8 Dalton D | K | V | K | K | | | | |
| Student # 9 Dakota E | A | A | A | A | | | | |
| Student # 10 Rykkaela | V | K | K | K | | | | |
| Student # 11 Derek | NA | NA | NA | NA | | | | |
| Student # 12 Erin K | K | A | A | A | | | | |
| Student # 13 Joslyn L | V/K | A | V | V | | | | |
| Student # 14 Dakota E | A | A | A | A | | | | |
| Student # 15 Jimmy M | NA | NA | V | V | | | | |
| Student # 16 Mike M | V | V | V | V | | | | |
| Student # 17 Chris M | NA | V | V | V | | | | |
| Student # 18 Alicia M | K | A | K | K | | | | |
| Student # 19 Kirsten | A | A | A | A | | | | |
| Student # 20 Stephen N | UK | K | K | K | | | | |
| Student # 21 Natasha | V | K | V | V | | | | |
| Student # 22 Kiersten P | V | V | V | V | | | | |
| Student # 23 Anthony S | K | K | K | K | | | | |
| Student # 24 Valli S | V | A | V | V | | | | |
| Student # 25 Heidi T | V/K | K | K | K | | | | |
| Student # 26 Spencer W | NA | V/K | K | K | | | | |
| Student # 27 Alex W | V | V | V | V | | | | |
| Student # 28 Cody W | K | K | K | K | | | | |
| Student # 29 Josh W | A/K | K | A | A/K | | | | |