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Effects of implementing kinesthetic activities in the classroom

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EFFECTS OF IMPLEMENTING KINESTHETIC ACTIVITIES IN THE CLASSROOM

by
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ABSTRACT

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The purpose of this study was to examine the effects kinesthetic lessons could have on academic achievement as well as learner attitudes. Subjects included 72 fifth grade science students from a suburban elementary school in Southern New Jersey. There were two control groups and two experimental groups. Throughout the three-week study, the experimental groups were presented with kinesthetic lessons, visual instruction and auditory instruction. The control groups received only visual and auditory instruction. Students completed one quiz and one test during the study, along with two likert-type attitudinal questionnaires, which were completed both before and after the study. Independent samples *t*-tests were used to analyze all data. Students in the experimental condition were found to have significantly higher quiz scores when compared with students in the control condition. However, a significant difference was not found between the test scores of students in the experimental condition and students in the control condition, and no significant differences were found between groups in regards to the pre to post difference scores of both attitudinal questionnaires.

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CHAPTER I: INTRODUCTION

Need

Education is a life-long process of learning. Teachers should attempt to educate young people about the world around them so that they can be successful in it. Learning should not consist of simply stuffing minds with information, but filling minds with meaningful knowledge (Barzun, 1991). There needs to be an understanding of school curricula instead of simply a memorization of school curricula (Stearns, 1993).

Contemporary schooling has the tendency to teach students surface-level knowledge without ever allowing students to understand the world in a deeper sense. The primary teaching methods in the classroom usually consist of some form of memorization technique by either verbal or written repetition (Armstrong, 2000). Students are not usually active, involved learners in the classroom. This may hinder them from fully understanding the majority of the material that is being taught in class (Armstrong, 2000). If teachers can discover ways to implement more active learning in the classroom, students may acquire a deeper understanding of the material learned in class.

Purpose

The purpose of this study is to examine and assess the effects of two different teaching styles. One teaching style will stimulate active learning through the bodily-kinesthetic intelligence. The other teaching style will be based on traditional teaching methods.

Hypothesis

It is hypothesized that the students who experience active learning through kinesthetic activities in the classroom will have significantly higher test scores than the students who experience the traditional learning style. It is also hypothesized that learner attitudes towards the subject matter will be significantly more positive for those students who experience the kinesthetic activities.

Theory/Background

The bodily-kinesthetic intelligence is one of eight intelligences discovered by Harvard psychologist Howard Gardner. Developed in 1983, Howard Gardner's theory of multiple intelligences (MI theory) suggests that each human being possesses not one, but eight distinct intelligences. Although some people naturally possess more of one than another, most people have the ability to develop each intelligence to an adequate level if given the opportunity (Armstrong, 2000).

The eight intelligences developed by Howard Gardner include the linguistic intelligence ("word smart"), logical-mathematical intelligence ("number/reasoning smart"), spatial intelligence ("picture smart"), bodily-kinesthetic intelligence ("body smart"), musical intelligence ("music smart"), interpersonal intelligence ("people smart"), intrapersonal intelligence ("self smart"), and the naturalist intelligence ("nature smart"). Armstrong argues that although we all learn in different ways, everyone can benefit from all the ways of learning.

In today's schools, the two intelligences that are used the most in the classroom are the mathematical and linguistic intelligences. The problem is that some students are

not mathematical or linguistic learners, therefore they do not benefit very much from the teaching methods implemented in the classroom (Armstrong, 2000).

Thomas Armstrong discusses several ways that the bodily-kinesthetic intelligence can be implemented in the classroom. The teacher could ask the students to use body answers by using their bodies as a medium of expression (Armstrong, 2000). For example, in a fourth grade language arts class, the teacher could teach the students punctuation marks by asking the students to use their bodies to form the shapes of the different punctuation marks as the teacher reads the sentences that require these marks (Armstrong, 2000).

Movement could also be implemented into the class by using the Classroom Theater Approach (Armstrong, 2000). Students can enact texts, problems, or any other form of material through drama. For example, students can learn a math problem involving three-step problem solving by demonstrating a three-act play (Armstrong, 2000).

The Kinesthetic Concepts Strategy is another way the bodily-kinesthetic intelligence can be used in the classroom (Armstrong, 2000). This entails introducing concepts to students by either illustrating them or asking students to pantomime them by turning information from linguistic or logical symbols into bodily expression. This can be done through a game of charades to explore topics such as soil erosion, political revolution, or subtraction of numbers (Armstrong, 2000).

Yet another strategy to use could be Hands-on Thinking, in which students manipulate objects with their hands (Armstrong, 2000). An example of this would be to have students study and learn spelling words by forming them in clay.

Using body maps also involves the bodily-kinesthetic intelligence (Armstrong, 2000). Teachers could tell their students to have their bodies represent the United States, with their heads being the Northern United States and their feet being the Southern United States. Teachers could ask the children where Florida would be on their bodies (Armstrong, 2000).

Definition of Terms

1. Multiple Intelligence Theory- Howard Gardner developed the theory of multiple intelligences in 1983. This theory suggests that the traditional measure of intelligence, based on IQ testing, is too limited. Instead, Dr. Gardner proposes eight different intelligences to account for a broader range of potential in children and adults.
2. Bodily-kinesthetic intelligence- One of eight intelligences developed by Howard Gardner, the bodily-kinesthetic intelligence involves the use of one's whole body to convey ideas and feelings. Dancers, other types of athletes, and sculptors possess high levels of the kinesthetic intelligence. This type of intelligence can be used in the classroom by turning the lesson into a physical experience.
3. Active learning- A process of learning from doing, performing, and taking action. Active learning can be accomplished through games, simulations, introspection, and role-playing.
4. Passive learning- Occurs in a traditional class in which the lecturing instructor verbalizes information to passive note-taking students.
5. Traditional class- Class in which the mathematical and linguistic intelligences are stimulated the most.

Assumptions

In this experiment, it is assumed that all students were prepared for the exams, the students were not grouped in the same class based on intelligence, the teacher scored each test in the same way, and the teacher was not biased towards a specific teaching style. It is also assumed that the exams given to the students during the time of the study accurately assess their knowledge of the material learned in the classroom. It is assumed that the students answered the attitude questionnaires honestly and accurately.

Limitations

This experiment has several limitations that should be noted. The population that is being used in this experiment is limited to middle class, fifth grade science students from one suburban public school. The sample size and diversity are also limitations in this experiment. The short duration of the experiment also causes another limitation, which is the time factor. Lastly, the instructor that will be implementing the kinesthetic activities is a first year teacher, which could be considered a limitation due her lack of experience in the field of education.

Summary

Chapter II will include a review of the research and ideas that relate to kinesthetic learning. This research will include studies that support active learning through the implementation of kinesthetic activities across a variety of educational subjects and levels. Chapter III will include the details about the design of the experiment. Chapter IV will include a review of the results of the actual experiment. Chapter V will include any conclusions that can be drawn from the experiment. This chapter will also include a discussion on research suggestions for the future. This includes how the experiment

could be conducted in a different way to produce stronger internal validity and external validity.

CHAPTER II: REVIEW OF THE LITERATURE

Introduction

The research discussed below is listed from the most general to the most specific as related to the current study. General research includes studies that involve multisensory teaching approaches, brain-based learning, and total physical response. More specific research includes studies conducted on college students, elementary level students, specific subject areas, learning disabled students, ethnic students, and learner attitudes.

General Research on Teaching Approaches

A substantial amount of research supports that matching teaching styles to learning styles increases student achievement (Beck, 2001). Garret (1991) examined the effects of learning style preferences on short-term and long-term vocabulary mastery with a sample of 535 high school students in a repeated measures design. Garret found a significant increase in both performance and attitude when the instruction matched the learning styles of individual students.

Further research suggests that using a multisensory approach to teaching is more effective than using a traditional approach. In a study conducted on an urban sample of 105 seventh grade students, it was found that using a multisensory approach in place of a traditional approach significantly increased achievement test scores, student empathy and attitude ratings towards the subject, and performance on the transfer of skills. In a more recent experiment involving science curriculum, it was found that a multisensory approach produced better attitudes, higher achievement test scores, as well as a

longer lasting memory of the content when compared to a traditional approach (Roberts, 2001).

Why Movement Should be Implemented in the Classroom

Other research suggests that although people can learn by sitting, it might not be the best way to learn (Jensen, 2000). Jensen states that over the past 400,000 years, humans have been primarily walking, sleeping, doing, running, leaning, or squatting. Sitting in chairs is a new innovation in history, which has only existed for the past 500 generations. Jensen claims that students who sit for longer than 10-minute intervals are likely to become fatigued, restless, and have a reduced level of concentration and awareness. Jenson also states that sitting for prolonged periods of time could also cause behavioral issues in the classroom.

Jenson explains that movement often increases performance because it increases heart rate and circulation. The chemicals noradrenaline (the hormone of risk or urgency) and dopamine (the neurotransmitter that produces good feelings) can be activated by certain kinds of movements. He claims that active learning is more effective than sedentary learning because it lasts longer, is better remembered, more enjoyable, and it reaches a diversity of learners. Jenson believes that educators need to realize that active learning is not only for physical education; it can and should be used effectively in all educational settings.

Neurophysiologist and educator Carla Hannaford also agrees that movement activities benefit learners (Hannaford, as cited in Pica, 1998). Hannaford claims that movement stimulates the neural wiring throughout the entire body, which causes the

whole body to become a learning instrument. Hannaford claims that starting from infancy and continuing through adulthood, physical movement plays a major role in the development of nerve cell networks that are vital to learning.

Educator, author, and consultant Mimi Brodsky Chenfeld (2004) claims that the most successful ways to learn, understand, absorb, and know is through movement, music, and kinesthetic experiences. Movement can be attached to every idea, lesson, and concept. Chenfeld believes educators can and should use movement in all areas of the curriculum.

Research on Brain-Based Learning

There are several established teaching methods that incorporate movement activities. One method is called brain-based learning, which is based on the functions of the brain (Caulfield et al., 2000). The theory behind brain-based learning is that learning engages the whole physiology and should be active, meaningful and connected.

Valley Park Elementary School, located in Kansas City, Kansas, used brain-based instruction to increase student learning (Caulfield et al., 2000). The concepts students were learning in courses such as math, English, science, and social studies were implemented into gym, music, and art courses. For example, in gym class the students used hula-hoops to imitate the motion of atoms when heated cooled or frozen. In art, the students were asked to build models of atoms with wire. It was thought that the repetition of a concept in different modalities would reinforce the connections and practical applications of the knowledge or skill, while also addressing multiple

intelligences. This was thought to cause students to remember the concept (Caulfield et al., 2000). After the brain-based instruction was implemented, there were significant gains in reading and mathematics.

In *20 Ways to Promote Brain-based Teaching and Learning* (2002), professor of special education at Central Washington University Debra J. Prigge recommends that teachers create an interactive environment because the brain learns best through active learning. Dr. Prigge suggests bringing the content to life and keeping the learner engaged by integrating movement into the lessons. Dr. Prigge also claims that developing sensory associations, including touch, will enhance memory.

Launa Ellison, an educator and editor of the Consortium for Whole Brain Learning newsletter and Betty Rothenberger, a teacher and consultant to UNICEF/Bangladesh (1999) brought brain-based learning and the multiple intelligence theory to teachers and students of Bangladesh. Since then, more children are attending school and students have become actively engaged and increasingly attentive in class.

Research on Total Physical Response

Total Physical Response (TPR) is another teaching method that incorporates movement activities into the learning process (Conroy, 1999). TPR is used by teachers of English as a second language (ESL) to aid in the instruction of students who are learning a second language. TPR calls for students to listen to their teachers and respond with movement. The students are not encouraged to speak unless they feel ready. In TPR, teachers give a command, model the action that goes with that command, give the command again without modeling the action, then students repeat the command and

perform the action. Individual students can be asked to give the command, while the rest of the class (including the teacher) is asked to verbally repeat the command and perform the appropriate action. This model can also be modified for the visually impaired by having someone else put them through the action or by having them feel the teacher demonstrating the physical response (Conroy, 1999).

It is a common belief that children are better at learning foreign languages than adults (Asher & Price, 1967). This may only be true because children in foreign countries tend to learn new languages through play activity (which includes action responses), while adults try to learn foreign languages independently of physical behavior. Using TPR, it was found that adult college students were actually superior to children ages 8-14 in learning a foreign language. The 8-year-olds actually had the lowest retention, the 10-and 14 year olds had the second highest retention, and the college students had the highest retention.

Despite these existing teaching methods, kinesthetic activities are not being used as much as they should be in the classroom (Patterson, 1997). The following research suggests that traditional teaching methods are not as effective as kinesthetic teaching methods.

Research on the College Level

Dr. Richard M. Felder from the Department of Chemical Engineering at North Carolina State University (1991) states that research generally shows that most students in lectures retain a substantial amount of what they hear within the first ten minutes of class, but only a minimal amount thereafter. One study found that immediately after a

lecture, students were able to recall 70% of the information presented to them within the first ten minutes of the class and only 20% of the information presented within the last ten minutes of the class (Felder, 1992). Students really only learn by thinking and doing, not by watching and listening (Felder, 1991). Active student involvement in the learning process leads to improved attendance, deeper questioning, better grades, and a genuine interest in the subject (Felder, 1992).

Felder and Brent (1999) claim that in a college classroom, a substantial amount of material can be "covered" in a short period of time. However, students can only absorb a certain amount of information in a given time frame. Active learning exercises should be implemented if the absorption of material is more important than how much material can actually be reviewed.

Felder and Brent (2003) also state that some instructors who have never used active learning strategies may hold the false belief that many of their students would not wish to participate in such activities. In their experience as professors, close to 100% of their students participate in active learning exercises after the initial few in which they may feel awkward or uncomfortable. Felder and Brent (1999) also state that some instructors are worried about regaining control after such an activity. They state that they have never had to wait longer than 10 seconds for everyone to get quiet after such an exercise, even with 400 people in the classroom.

In an article by Pricilla Laws (1991), an innovative method of teaching physics in college called "Workshop Physics" was employed in an effort to increase the success of engineering students. With over half of the students failing to pass the necessary physics

courses, a new method of teaching was developed at Dickinson College. The method employed various scientific gadgets to help students explore the subject kinesthetically without having to listen to lengthy lectures. Students were involved in activities such as pitching baseballs, pulling objects up inclined planes, and building electronic circuits. A member of the teaching staff designed go-carts for the students to ride in and experience the forces of nature on their own bodies. This innovative method of teaching resulted in the students' mastery of otherwise difficult concepts and led to them becoming more effective problem solvers. In addition, the students became more comfortable with the lab setting and more efficient at working out complex problems.

Research on the Elementary Level

According to elementary school teacher Kevin Mixon (2004), the kinesthetic learner has been the most neglected type within educational settings. In an elementary school with many problem students, it was found through the Learning Styles Inventory (LSI) that 64% of the students were either tactile or kinesthetic learners. However, the teaching styles that were being implemented in the classroom were not geared towards kinesthetic learners. After adjusting the teaching styles to benefit all of the different types of learners, along with other changes geared towards individual differences, the problem students were no longer a problem. Most were mainstreamed, their self-esteem rose, discipline issues were no longer a problem, grades were higher, and their attitudes towards learning were more positive.

Research on Reading Styles

Research on reading styles offers supporting evidence that the teaching styles used in most schools are not the best ways to teach all young students how to read (Carbo, 1987). Reading achievement depends heavily on how well the instructional program addresses the reading style of the student.

Reading teacher Lois LaShell conducted a study in which the reading achievement of 90 learning-disabled students, grades 2-6, was assessed (Carbo, 1987). The control group had a phonics based reading program, while the reading program for each student in the experimental group was based on his or her individual learning style, which was determined by The Reading Style Inventory (RSI).

It was found that most of the students in the experimental group were tactile/kinesthetic/global learners who needed "hands on" materials and learned best with holistic approaches, not phonics. After a period of 10 months, the control group advanced only 3.9 months in comparison to the experimental group, which advanced 1.4 years. It is important to note that during the previous year, with the same teachers and a phonics based approach, the experimental group only advanced four months. Similar findings have been reported by several other researchers who conducted similar experiments (Carbo, 1987). Carbo concludes that poor readers are not taught in ways that match their individual learning styles.

In more recent research, Marie Carbo and her colleagues (1997), after having 20 years of experience with reading styles, stated that we shouldn't label students as "slow" just because they are tactile/kinesthetic learners. Some students who are placed in lower

tracks are actually very intelligent, but their needs are not being met by the teaching strategies they experience. Some students need to experience a kinesthetic approach to understand the material being presented to them. According to Carbo and her colleagues, the predominant reading style of children of all abilities is global, tactile, and kinesthetic. Children need to be exposed to active learning, holistic programs, and emotional involvement.

Marilyn Nikimaa Patterson, M.S. (1997), claims that many "problem learners" are kinesthetic learners for the same reasons Marie Carbo and her colleagues (1997) discussed. The needs of kinesthetic learners are simply not being met in the classroom. Patterson also claims that kinesthetic activities enable all children to see the "whole picture" while activating a broader range of neural patterns. Kinesthetic activities stimulate the right side of the brain, which helps people understand concepts in their totality. Some kinesthetic activities stimulate both hemispheres simultaneously, which allows the brain to work as a whole instead of as two unconnected hemispheres.

Research on English Instruction

According to Richard Gage (1995), English teachers should become more aware of the different learning styles individual students possess. Gage states that because 15% of the student population is made up of kinesthetic learners, educators need to make adjustments as to how they present curriculum material. In fact, a study conducted by Rebecca Snyder (1999), showed that 81% of high school students in a sample were primarily tactile/kinesthetic and global learners, regardless of their GPAs. Gage claims that auditory and visual learners are favored in the educational system, whereas

kinesthetic learners are often disadvantaged. He suggests several kinesthetic teaching strategies that could be implemented into English classes such as role playing, making comic books to interpret pieces of literature, conducting "talk shows" in which students act as if they are interviewing famous poets, making commercials, and videotaping.

English teacher Wendy F. Simeone (1995) states that if English instructors do not provide teaching strategies to benefit kinesthetic learners, these types of learners may never fully understand the power of language. She claims that many language arts activities are passive, and this creates a problem for kinesthetic learners because they need to be engaged in active learning. As an English teacher, she incorporates video projects and a game called "Chalkboard Pictionary" in which the students form teams and play "Pictionary" using proverbs.

Research on Learning Disabled Students

Linda Hecker (1997), a post-secondary school English teacher who works with learning disabled students, claims that one of the hardest things for students with Attention Deficit Disorders to do in a classroom is sit still. Hecker states that educators should implement movement activities into their lessons instead of trying to fight for the students to sit still in class. Hecker suggests the use of walking strategies to incorporate the kinesthetic intelligence into the English classroom. In walking strategies, students walk their ideas across a room, switching directions when a change in either the logic of the argument or the series of events takes place. Hecker claims that this type of strategy can also benefit students without learning disabilities.

In a study by Murphy and McLaughlin, the effects of tactile and kinesthetic learning was shown to improve spelling in a learning disabled student. The study

explored the use of games, puzzles and tracing spelling words with a student who had problems with spelling. The results indicate an increase in spelling accuracy for the student using this method.

Worthing and Laster (2002) suggest using instructional tools called balsa-wood rods for severely delayed readers to help them make progress. Each rod has a reading strategy written in the first person on it. The students would be asked to choose a rod when they were in a reading situation and had trouble with either word recognition or comprehension. Being able to choose and hold the rods was thought to make the children become more independent, and also served as a visual, auditory, kinesthetic and tactile reminder of the strategies the students could use. There is supporting evidence that the use of balsa-wood rods increase both comprehension and word recognition in children with delayed reading skills.

Research on Social Studies and Science Teaching Strategies

Elementary school social studies and science teacher Paige L. Schulte (2005) realized during her first year of being an instructor that the teaching methods she was familiar with from school, including mostly reading, writing, and worksheets, were not working well with her students. As a teacher, she also felt bored with the structure of her lessons. She began implementing movement activities into her lessons and found these strategies to be the most effective in both social studies and science classes. Schulte claimed that the lessons involving movement benefited all of her students, not just the kinesthetic learners. She advocates using TPR and other kinesthetic approaches in the classroom, such as role playing, pantomiming, and playing games such as charades in

which each student is challenged to construct a movement to go along with a particular concept learned in class.

Patti Soderberg (1992) suggests using an activity she calls "marshmallow meiosis" to help students understand the complex subject of genetics. The students assemble two parents with marshmallows, antennae, two humps, and different colored eyes. In addition, they construct the parents' set of chromosomes on strips of paper, place them in separate bags for mom and dad, and create offspring with various characteristics. This kinesthetic exploration into the complex subject of chromosomes and genetics helps the students understand the subject and retain the information. Soderberg claims that this can be used from the elementary through the college level.

Research Related to Math Instruction

Educator Robert M. Fotoples (2000) claims that many students have a fear of math. Everyone learns differently, and teachers limit the chance for student success when they present a math lesson in only one way. Fotoples states that students learn new information better when it is channeled through their individual learning styles. When students are not given opportunities to learn through their primary perceptual channels, they may be mistakenly categorized as learning disabled. Kinesthetic learners must be physically involved in math lessons through hands-on activities. Fotoples claims that if instructors formulate lessons that address all different types of learners, they can help all of their students succeed in math.

Thompson and Rubenstein (2000) claim that many students benefit from more kinesthetic approaches when it comes to mathematical vocabulary. They list several exercises that teachers can use in the classroom so that kinesthetic learners can learn

through their primary perceptual channel. Students can use manipulatives to learn math vocabulary. For example, in geometry, students can build their own three-dimensional figures to learn the names, parts, and properties of certain geometric shapes. They can also break up into groups and create a theatrical presentation as a means to polish their vocabulary.

Alfinio Flores (2002) claims that too often, mathematical concepts are presented to students through abstract representations, which can be difficult to understand. Flores presents an interactive geometry program for middle school students called the rhythmic approach that implements the kinesthetic intelligence. The goal of this approach is to help students understand how curves are formed through using manipulatives.

Willis and Johnson (2001) claim that both children and adults can use their kinesthetic intelligence in math. Children can use their kinesthetic intelligence to learn new math concepts in school, and adult mathematicians can use their kinesthetic intelligence as they develop new mathematical models and formulas throughout their careers. Willis and Johnson cite Albert Einstein's description of his ways of theorizing as more "visual and motor" or "muscular" than linguistic.

Research on Learning Styles of Various Ethnic Groups

Another aspect of learning styles involves the preference of various ethnic groups. In an article by Clara Park (1997) the learning styles of Korean, Mexican, Armenian-American and Anglo high school students were explored. The results of the study showed a relationship between learning style and ethnic groups. Interestingly, all four ethnic groups showed a major preference for the kinesthetic learning style, regardless of sex and academic achievement level. All ethnic groups also showed a preference for

tactile learning. These results indicate the importance of providing physical involvement in the classroom. The author suggests using activities that involve both the mind and the body to enhance the education of students.

Research Studies Most Similar to Current Study

In a secondary school, Blahut and Nicely (1984) tested for a correlation between tactile learning and two learner attitudes: evaluative attitudes (how important the content was to the students) and pleasure attitudes (how pleasurable the content was to the students). It was discovered that the students who were given tactile learning activities rated the content as being more important than the students who were not given the tactile learning activities. This was significant at the .01 level of confidence. Although there was no significant difference found between the experimental group and the control group regarding the pleasurableness of the content, the researchers found that the students who were given tactile learning activities scored higher than the control group on content exams.

Sees (1998) conducted an experiment that involved implementing tactile/kinesthetic instruction into high school biology lessons. There were three experimental groups and one control group. The experimental groups received auditory, visual, and tactile/kinesthetic instruction. The control group received only auditory and visual instruction. The duration of the experiment was approximately six weeks, and scores on quizzes and tests were used to assess the effects of the teaching strategies. Although the results did not show a significant difference in test scores among the four groups, it would have been interesting to test for possible differences in attitudes towards the subject matter as Blahut and Nicely (1984) did in their study.

Summary

In summary, most current research suggests that the implementation of kinesthetic activities in the classroom would be beneficial to all students, regardless of academic ability, ethnicity, age, or even the content of the subject. According to the present research, all students need to experience movement activities in the classroom in order to gain a deeper, holistic understanding of the subject matter.

CHAPTER III: DESIGN

Participants

The participants in this experiment consisted of four fifth grade science classes from a suburban elementary school in Southern New Jersey. The same teacher taught the science curriculum to each of the four classes. There were two control groups and two experimental groups. Experimental Group 1 had 22 students, with 11 males and 11 females; Experimental Group 2 had 21 students, with 11 males and 10 females; Control Group 1 had 22 students, with 12 males and 10 females; Control Group 2 had 22 students, with 11 males and 11 females. The students ranged in age from 10 and 11 and the predominant race of every class was Caucasian.

Two males and four females from Experimental Group 1, three males and one female from Experimental Group 2, one male and one female from Control Group 1, and one male and two females from Control Group 2 were eliminated from the study due to incomplete data. This caused the total number of participants to drop from 87 students to 72 students.

Materials

The experimenter in collaboration with the instructor developed the kinesthetic activities that were used in the study (see appendix a). Students completed one quiz and one test which covered the material they learned throughout the study (see appendix b). The quiz was prepared by the teacher and consisted of fill in the blanks and short answer questions. The test, also prepared by the teacher, consisted of matching, drawing and labeling, multiple choice, true/false questions, fill in the blanks, and one essay question.

In addition, two Likert-type attitudinal questionnaires were used in this study (see appendix c). These questionnaires were originally developed by John M. Blahut and Robert F. Nicely (Blahut & Nicely, 1984). These scales have been revised to correlate with the content of the material the students learned within this study. Each questionnaire contained 24 short statements, half of which were presented in negative form. The statements were mixed in random form. Instructions and samples were included on the front page. In the Attitude 1 Questionnaire, students expressed their reactions to the statements according to a four-point forced choice scale. In the Attitude 2 Questionnaire, students expressed their reactions to the statements according to a five-point agree-disagree scale. Teacher instructions for these questionnaires were also provided (see appendix d).

Reliability/Validity of Scales

Test-retest reliability was obtained for both original questionnaires. For Attitude 1, the test-retest reliability was found to be .999 with a coefficient alpha of .814. For Attitude 2, the test-retest reliability was found to be .986 with a coefficient alpha of .907. Face validity was based on the guidance and examination of the original questionnaires by four competent judges.

Method

Before the experiment began, the instructional style of the classes consisted primarily of traditional lecture, note taking, films, hands-on labs, drawings, and worksheets. All worksheets, quizzes, and tests that were distributed to the class were teacher-made.

The specific content area for this study was astronomy. Two classes were randomly assigned to the experimental condition and two classes were randomly assigned to the control condition. Before the study began, all students completed two attitudinal questionnaires as a pre-test to determine each student's initial view of the material to be learned during the study. Attitude Scale 1 assessed how important, useful, valuable, and worthwhile the learners viewed the content to be. This attitude was defined as being "evaluative". Attitude Scale 2 assessed how exciting, pleasant, interesting, enjoyable, and how much fun the learners perceived the content to be. This attitude was defined as being "pleasurable". Teacher instructions and student instructions were provided for both questionnaires.

The day after the questionnaires were completed, the experimental groups were introduced to the bodily-kinesthetic teaching style, which included activities that used the entire body in movement. The experimental groups received kinesthetic instruction, visual instruction, and auditory instruction during a three-week period. The control groups received only visual and auditory instruction throughout the three-week period.

Each class met five days a week, and each period was forty-five minutes in length. Experimental Group 1 had science from 9:10-9:55 each day of the week, Experimental Group 2 had science from 11:25-12:10 daily, Control Group 1 had science from 9:55-10:40 daily, and Control Group 2 had science from 12:10-12:55 daily. Both the experimental and control groups were taught the same material and received the same examinations throughout the study.

One quiz and one chapter test were given throughout the study. The quiz was taken at the beginning of the second week of the study and the test was taken at the end

of the third week of the study. The material on the quiz related directly to the material learned during the time of the study. However, some information on the chapter test did not directly relate to the information learned during the study (some was learned before the study began). Immediately after the three-week period, the two attitudinal questionnaires were distributed to all students as a post-test in order to determine if there were any significant attitude changes at the conclusion of the experiment.

Independent and Dependent Variables

The independent variable in this experiment was the type of teaching style implemented. The dependent variables were the quiz scores, test scores, and the two attitudinal questionnaires that were distributed directly before and after the study. It was expected that quiz and test scores from the students in the experimental condition would be significantly higher than those from the students in the control condition. It was also expected that a significant difference would exist between the attitudes of the students in the experimental condition and the control condition towards the content. On both scales, the attitudes of the two experimental groups were expected to be significantly more positive than those of the two control groups.

Analysis of Data

After the three-week period, the scores from one test and one quiz given during this period were collected from each class. The data from the two experimental groups was averaged together, and the data from the two control groups was averaged together. Independent samples *t*-tests were performed on this data at the .05 level to determine if there was a statistically significant difference between the groups. The mean differences between the pretest and posttest scores for both the experimental and control groups were

analyzed for both attitude scales through the use of independent samples *t*-tests. Again, the data from both of the experimental groups was averaged together and the data from both of the control groups was averaged together.

Summary

In this study, four fifth grade science classes were randomly assigned to either the experimental condition or the control condition. The two experimental groups were exposed to kinesthetic activities and the two control groups were not. Both before and after the study, all students were instructed to answer two attitudinal questionnaires that were addressed towards the content of the subject they were learning, which was astronomy. Test and quiz scores were collected and independent samples *t*-tests were used to determine whether or not a significant difference existed between those in the experimental condition and those in the control condition. Independent samples *t*-tests were also conducted in regards to the pre and post attitudinal questionnaires. It was expected that the students in the experimental condition would show more positive attitudes on both scales and score higher on tests and quizzes due to the implementation of kinesthetic activities.

CHAPTER IV: RESULTS

Introduction

The purpose of this study was to discover the effects of implementing kinesthetic activities into the fifth grade science curriculum at an elementary school in Southern New Jersey. It was hypothesized that those students in the experimental condition would score significantly higher on tests and quizzes taken during the study due to kinesthetic learning. It was also hypothesized that the students in the experimental condition would perceive the subject matter to be more pleasurable and more important than those students in the control condition. This would be supported by a significant increase in scores on the two attitudinal questionnaires as compared to those in the control condition.

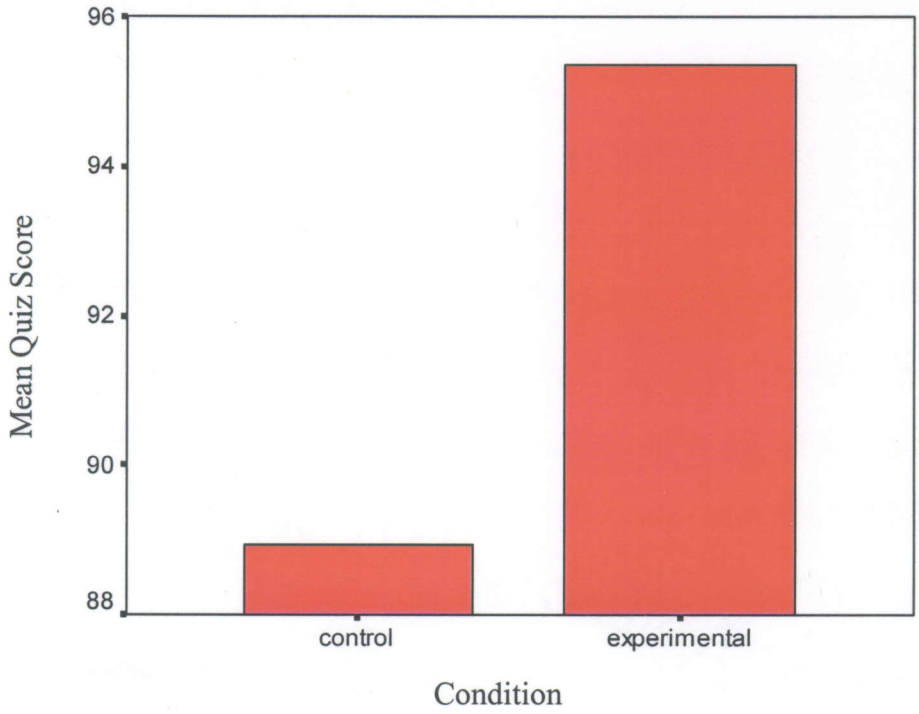
Results

During the course of the study, all students took one quiz and one test. The quiz was taken at the beginning of the second week of the study and the test was taken at the end of the third week of the study. The data from both experimental groups was combined to form one group, and the data from both control groups was combined to form one group. There were 39 subjects in the control condition and 33 subjects in the experimental condition.

A *t*-test for independent samples indicated a significant difference between the experimental group and the control group in regards to mean quiz scores, $p < .05$. The average score of the experimental group was significantly higher than the average score

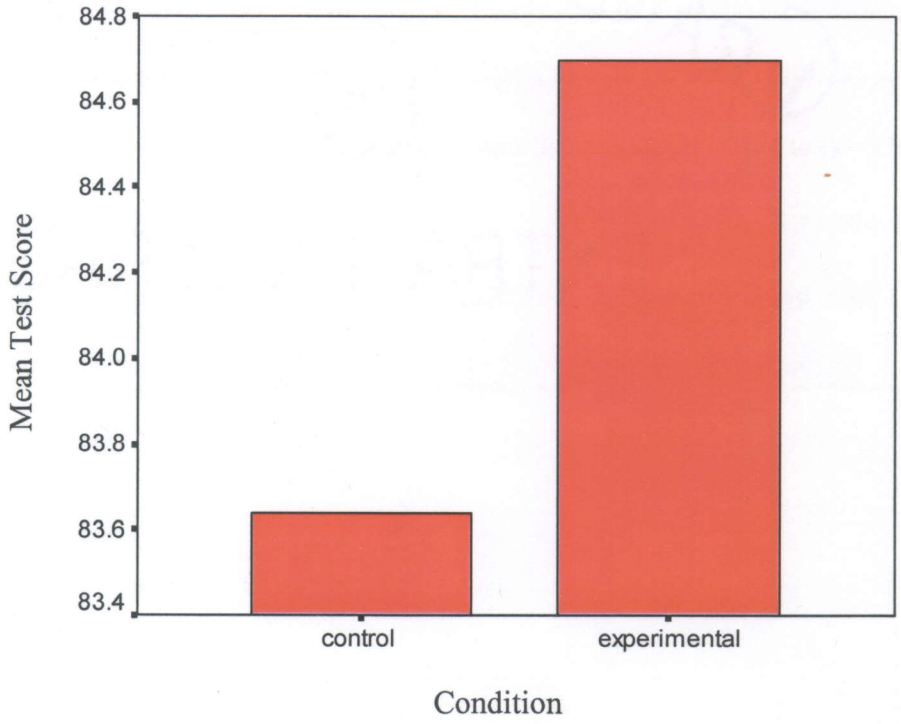
of the control group (see figure 4.1). The mean quiz score for the experimental group was 95.36 with a standard deviation of 8.75 and the mean quiz score for the control group was 88.92 with a standard deviation of 10.01. Equal variances were assumed according to the Levene's Test for Equality of Variances, and the reported *t* value was –2.882 with 70 degrees of freedom.

Figure 4.1 Mean quiz scores for the experimental group and the control group.



In regards to mean test scores, a *t*-test for independent samples showed a non-significant difference between those in the experimental condition and those in the control condition. However, it is important to note that the mean test score of the experimental group was slightly higher than that of the control group (see figure 4.2).

Figure 4.2 Mean test scores for the experimental group and control group.

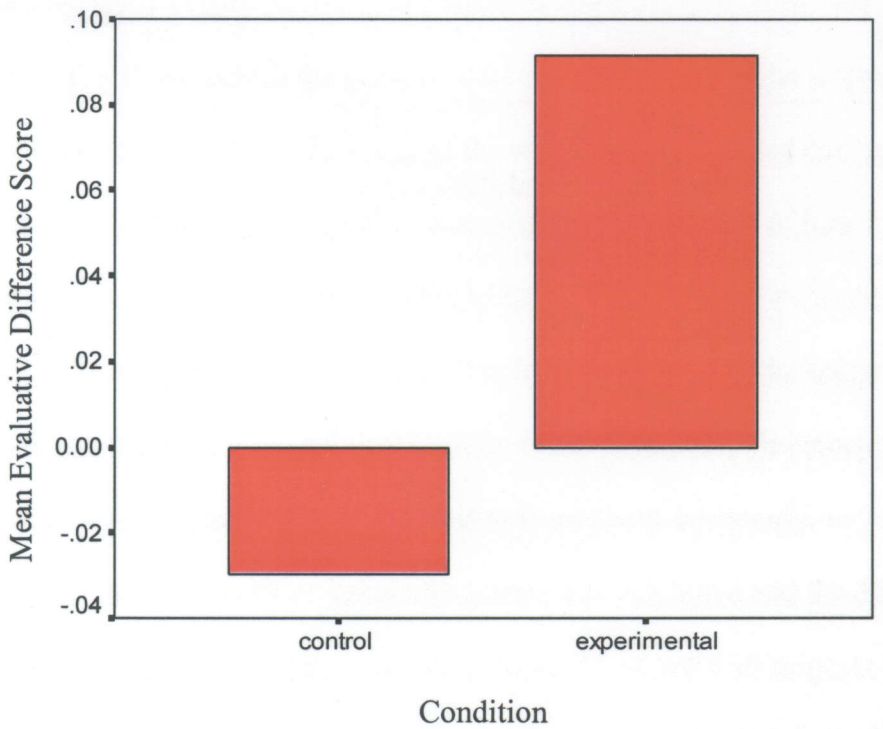


Before the study began, 72 fifth grade students filled out two attitudinal questionnaires. The statements in the questionnaire related directly to the science material they learned within the three weeks of the study, which included concepts relating to astronomy. These questionnaires assessed their initial view of how important (Attitude Scale 1) and pleasurable (Attitude Scale 2) it would be to learn about those concepts. After the study was over, the same 72 individuals filled out the same attitudinal questionnaires for a second time in order to determine if their perceptions changed about how pleasurable or important it is to learn about astronomy.

Again, the data from both experimental groups was combined and the data from both control groups was combined to form two groups. There were 39 subjects in the control condition and 33 subjects in the experimental condition. A *t*-test for independent

samples computed on the mean of the pre to post difference scores failed to indicate significant differences at the .05 level of confidence for both questionnaires. A significant difference was not found between those students in the control condition and those students in the experimental condition in regards to their attitudes measured by both the pleasurable and evaluative questionnaires. However, in regards to the evaluative questionnaire, the mean difference score of the experimental group was positive and the mean difference score of the control group was negative. In other words, on average, the students in the experimental condition perceived the material learned to be slightly more important than they originally thought and the students in the control condition perceived the material learned to be slightly less important than they originally thought (see figure 4.3).

Figure 4.3 Mean difference scores for two groups on the evaluative attitude scale.



Summary

In summary, there were four independent samples *t*-tests conducted in this study. A significant difference was found between the control group and the experimental group in regards to the mean quiz scores. The mean quiz score of the experimental group was significantly higher than that of the control group.

Although a significant difference was not found in regards to the two attitudinal questionnaires and the mean test scores, it is important to note that students in the experimental group rated the material to be slightly more valuable after the study and the students in the control group rated the material to be slightly less valuable after the study. It is also important to note that the mean test score of the students in the experimental condition was slightly higher than the mean test score of the students in the control condition.

CHAPTER V: DISCUSSION

Review of Results

After reviewing the data, it was found that the students in the experimental condition scored significantly higher than the students in the control condition on the astronomy quiz taken during the second week of the study. This finding supports the hypothesis that the students in the experimental condition would score significantly higher than the students in the control condition on the quiz taken during the study. This finding also supports the current research on the effectiveness of active learning through kinesthetic experiences. Although humans can learn by sitting, it may not be the most effective way to learn (Jensen, 2000). One of the most successful ways to learn is through the use of movement (Chenfeld 2004).

Despite the significant finding in regards to the quiz scores, no significant difference was found between the mean chapter test score of the experimental group and the control group. Although this finding fails to support the hypothesis of this study, this finding could be the result of the timing of the study. The science instructor began implementing the kinesthetic lessons two weeks after introducing the astronomy unit; therefore the chapter test included some material that was covered before the experiment began. However, the quiz only included questions that related to the material learned during the time of the study. This could account for the significant difference found in regards to the quiz scores. If the study would have begun as soon as the astronomy unit started, it is possible that a significant difference could have been found between the chapter test scores of the experimental group and the control group.

Despite the significant difference in quiz scores, there was no significant difference found between the control group and the experimental group in regards to both pleasurable and evaluative attitudes as measured by the attitudinal questionnaires. This finding does not support the hypotheses of this study. These results also fail to support the past research findings of Blahut and Nicely's six-week study (1984) in which tactile activities and learner attitudes were examined. Using the questionnaires that were revised for the current study, Blahut and Nicely found a significant difference between the mean of the pre to post difference scores in regards to the evaluative attitudes (Attitude Scale 1) of fifth grade students that experienced tactile learning activities and students that did not. Students that experienced tactile activities rated the material they learned to be significantly more important and more valuable than they originally thought compared to those who did not experience tactile activities.

Although the findings of the current study did not reveal a significant difference in regards to the evaluative attitudes of the students, the experimental group showed an increase in scores on the post-evaluative attitude questionnaires and the control group showed a decrease in scores on the post-evaluative questionnaires. In other words, after the study, the experimental group rated the material they learned to be more important and more valuable than they originally thought, whereas the control group rated that material they learned to be less important and less valuable than they originally thought. Perhaps if the current study was conducted over the same time period as Blahut and Nicely's study (six weeks instead of three weeks), the results might have shown a significant difference between the evaluative attitudes of students in the experimental group and students in the control group.

Although Blahut and Nicely found that students in the treatment condition rated the material more pleasurable (Attitude Scale 2) than students in the control condition, a significant difference was not found in regards to this attitude based on the questionnaires. In the current three-week study, the pleasurable attitudes of both the control and experimental students rose from the pre to the post-test. In fact, the students in the control condition actually rated the material more pleasurable than the students in the experimental condition, although this finding was insignificant. It is possible that an even longer study than Blahut's and Nicely's six-week study may be needed in order to find a significant correlation between kinesthetic learning and pleasurable learner attitudes.

Limitations

The first limitation of the current study is the length of the study. Due to time constraints, the duration of the study was limited to a three-week period. This length of time could have been too short to reveal accurate results. Unfortunately, this short period of time allowed for only one quiz and one test on the unit of astronomy. Therefore, the amount of data used in this study was limited to only two performance scores along with the pre-test and post-test questionnaire scores. In addition, the attitudinal questionnaires used in this study may have been outdated due to the fact that Blahut and Nicely developed the original versions in 1984.

Another limitation relates to the timing of the study. It would have been ideal to begin the study during the introductory week of the astronomy unit; however, the instructor was not prepared to implement the kinesthetic lessons at that time due to a

predetermined project the students were instructed to complete during the first two weeks of the unit.

This leads to another limitation of the study, which is that all students worked on a power point project for the first two weeks of the astronomy unit. The instructor informed the experimenter that most students had never created a power point presentation before that time, so it was very exciting for them. This could have affected their attitudes towards the content, and also could have affected their test scores.

The instructor that implemented the kinesthetic activities in this study was a first year teacher, which could also be considered a limitation due to her lack of teaching experience. She reported that she had never implemented kinesthetic activities in her science lessons before the experiment; therefore she might have felt awkward or uncomfortable instructing the movement activities. On the other hand, because the students in the study had never experienced such activities in that particular class before, they may have felt uncomfortable with performing the activities. These issues could have negatively affected the results of the experiment.

The experimenter chose the kinesthetic activities involved in this study, which could be another limitation of the experiment. Although the instructor involved in the study was given thorough instructions as to how to teach the kinesthetic lessons, the experimenter was not present during the implementation of these exercises. This did not allow the experimenter to monitor the implementation of these exercises to ensure successful delivery.

Another limitation of the study involves both the sample size and characteristics of the participants. The study only contained 72 fifth grade science students from

predetermined groups (their science classes). All of the subjects were middle class and came from one suburban elementary school in Southern New Jersey; therefore diversity is also a limitation.

Conclusion

In conclusion, the results of this study show a significant difference between the quiz scores of the students who experienced kinesthetic activities in their lessons (experimental condition) and the students that did not experience kinesthetic activities in their lessons (control condition). Specifically, the students in the experimental condition scored significantly higher than the students in the control condition on the quiz taken during the beginning of the second week of the study. Although there was no significant difference found between the test scores and attitudinal questionnaire scores of the students in the experimental condition and the students in the control condition, it has been determined that further research is needed to assess more accurate effects of the implementation of kinesthetic activities in the classroom.

Implications for Further Research

There is a need for more research on the effects of the implementation of kinesthetic activities in all grade levels, educational settings, and schools throughout the country. It would be interesting to examine the effects of long-term studies conducted in which kinesthetic activities are implemented in several grade levels across several different subject areas in numerous school districts. It would also be interesting to study the longitudinal effects of implementing kinesthetic lessons at the college level across many different fields of study at several institutions. Studying the effects of kinesthetic learning for students in special education could also be a path for further research. The

kinesthetic approach to instruction should continue to be studied in order to gain a better understanding of the long-term effects it may have on the education of all students.

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APPENDIX A

Kinesthetic Activities used with Experimental Group

APPENDIX A

Kinesthetic Activities used with Experimental Groups

Globe Exercise (Berlin, n.d.): In order for the students to gain an understanding of the concept of the proportions of water and the proportions of land that exist in the world, students will sit around in a circle and pass a "beach ball globe" around to one another. The instructor is asked to keep track of how many times the students' hands land on the water part of the globe and how many times the students' hands land on the land part of the globe. After each child has had a turn to catch the ball, the results are tallied up.

Rotation vs. Revolution Exercise: In this exercise, the students will physically experience rotation and revolution in order to better understand these concepts. The students are first instructed to spin around in place. As the students are doing this task, the instructor tells them that they are rotating the axis that goes through the center of their bodies. Then, students are asked to walk around groups of desks while spinning around themselves. While they are doing this, the instructor informs them that they are revolving around the desks and are rotating at the same time. The students are then asked to experiment by rotating and revolving at different speeds.

The Sun, Moon, and Earth Exercise: Students will be broken up into five groups and rotate so that they all experience each part of this exercise. During each round, one student will play the part of the sun, one student will represent the earth, and one student will be the moon. The students are then asked to physically demonstrate how the moon moves around the earth, while the earth moves around the sun.

Day and Night Exercise (*Elementary School*, n.d.): Students are first asked to form a circle around a lamp with their backs facing the light. Then, they are asked to make four quarter turns to the left, stopping at each point to note their field of view in regards to the lightbulb. They repeat this several times and say the words night, sunrise, day, sunset as they turn with their arms extended to the light.

Seasons Exercise (*Elementary School*, n.d.): For this exercise, students will be broken up into groups of four. Each student is given a blue balloon attached to a balloon holder on a stick with the equator drawn through the center of it and the letters USA written on it. The students are asked to hold the balloons on a slight angle and point them to the same corner of the classroom while standing in a circle around a lamp. They are asked to place a meterstick between the lightbulb and the USA in order to determine the angle of radiation. In this way, students can easily decipher which balloon Earths are representative of each of the four seasons in the United States.

Phases of the Moon Exercise: This exercise is used in order to demonstrate that different parts of the world see different phases of the moon at different times. Using a sphere shaded half black and half white, students will circle the room representing the different phases of the moon. The window side of the classroom will represent the sun and the hallway side of the classroom will represent the outer universe. The students must make sure the moon is positioned correctly during this exercise.

Constellations Exercise: For this activity, the students will be working in groups. Each group will be assigned a specific constellation. The students will be instructed to practice forming their assigned constellations using flashlights. Then, one group at a time will demonstrate their constellation pattern for the rest of the class.

Planets Exercise: Each planet will be assigned to each student in the class. A desk will represent the sun. Students will be given cards to hold with pictures of their planets on the front. The back of their cards will contain four important facts that they will need to know about their assigned planet/sun for an upcoming quiz or test. The students will recite these facts while standing in order representing the distance from the sun.

APPENDIX B

Quiz and Test Taken During the Study

APPENDIX B

Quiz and Test Taken During the Study

Planet - Quiz

Name_____ Date_____

H.R. Teacher_____ Number#_____

Saturn * Earth * Uranus * Mars * Mercury * Jupiter * Neptune * Venus * Pluto

1. List the planets in order starting with the one closest to the sun. Circle the planets that are the Outer planets.

_____

_____

_____

_____

_____

_____

_____

_____

_____

2. Which planet is the water planet?

_____

3. Which planet is known as the red planet? -

_____

4. Which planet is known as the ice planet? (*hint far from the sun)

_____

5. Which planet is surrounded by huge rings?

_____

6. Which two planets are split by the asteroid belt?

_____

7. Which planet is the closest to the sun?

_____

8. Which planet is sometimes the last planet from the sun other than Pluto? _____

9. Which planet is known as earth's twin?

_____

10. Which planet looks to us to be tilted on its side?

_____

Astronomy I - Test

Name_____ Date_____

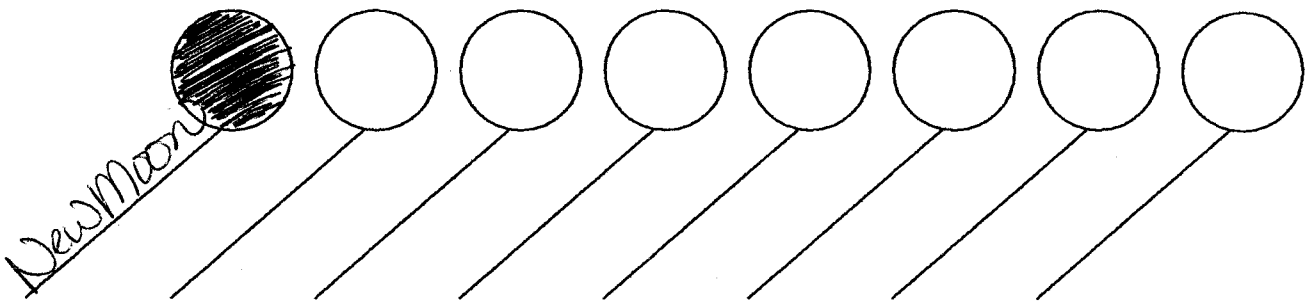
H.R. Teacher_____ Number#_____

Vocabulary -

1. _____ Astronomy	**A.** A meteoroid that enters Earth's atmosphere and burns with a streak of light
2. _____ Planet	**B.** A ball of ice and rock that orbits the Sun
3. _____ Meteor	**C.** A number of stars that appear to form a pattern
4. _____ Meteorite	**D.** The study of objects in space
5. _____ Comet	**E.** A blocking of the view of the full moon when the Moon passes into earths shadow
6. _____ Lunar Eclipse	**F.** Any part of a meteor that strikes earth
7. _____ Solar Eclipse	**G.** A large body orbiting the sun or other star
8. _____ Constellation	**H.** A blocking out of the sun when the Earth passes through the moons shadow

- **Phases of the moon**

Draw and label the phases the phases of the moon in the correct order, starting with the New Moon.



- **Lunar Eclipse and Solar Eclipse**

Label the correct either Lunar Eclipse or Solar Eclipse under the picture

_____ _____

- **Multiple Choice**

_____ **1.** Which time zone in the United States has the earliest time right now?

a. Eastern Standard Time **b.** Mountain Standard Time

c. Pacific Standard Time **d** Central Standard Time

_____ **2.** If it is 5:00 pm in New Jersey (Eastern Standard Time), what time is it in California (Pacific Standard Time)

a. 5:00pm **b.** 2:00pm

c. 5:00am **d.** 12:00 pm

_____ **3.** The Sun is at its highest point in the sky at what time _____.

a. 6:00am **b.** 9:00am

c. 10:00am **d.** Noon

_____ **4.** Which famous constellation includes the North Star _____.

a. Little dipper **b.** Big Dipper

c. Orion's belt **d.** Ursula Major

_____ **5.** The shortest day of the year is the _____.

a. Winter Solstice **b.** Summer Solstice

c. Vernal Equinox **d.** Autumnal Equinox

_____ **6.** A day that has equal hours of day and night and is the first day of spring is the _____.

a. Winter Solstice **b.** Summer Solstice

c. Vernal Equinox **d.** Autumnal Equinox

_____ **7.** The moon phase where the entire side that faces the Earth is light up it is called a _____.

a. Full Moon **b.** New Moon

c. 1st Quarter Moon **d.** Waxing Crescent

_____ **8.** A lunar month is how many days _____.

a. 15 **b.** 31

c. 30 **d.** 29

_____ **9.** What phase of the moon come directly before the 1st quarter moon _____.

a. Waning Gibbous **b.** Waning Crescent

c. Waxing Crescent **d.** Full Moon

- **True or False-**

_____ 1. The Sun rises in the east and sets in the west.

_____ 2. The Earth takes 365 days to complete one rotation.

_____ 3.The United States is broken up into 6 standard time zones

_____ 4. When the Earth's Axis is tilted towards the sun it is summer.

_____ 5. The moon orbits around the Sun

_____6. The shape of the lighted part of the moon is a called a cycle.

_____7. Mercury, Venus, Earth and Mars are gas giant planets.

_____ 8. A stars is huge hot ball of gas that give off it own light.

- **Fill in the Blanks**

1. The tilt of the earth causes us to have _____.

2. The _____ and _____ planets are divided by the asteroid belt.

3. _____ phases of the moon are slowly getting smaller.

4. When the northern hemisphere in the winter season the earth's axis is tilted

_____ from the sun.

5. The summer solstice is the _____ day of the year.

6. The constellation Pegasus is seen in the _____ sky.

- **Essay**

Describe the eight phases of the moon. Tell why the moon looks like it is changing shape during theses phases. Use 5-6 complete sentences.

_____

_____

_____

_____

_____

_____

APPENDIX C

Student Instructions and Attitudinal Questionnaires

APPENDIX C

Student Instructions and Attitudinal Questionnaires

Number _____

Home Room Teacher _____

In the following items you are to describe how you feel about each statement. THIS IS NOT A TEST. There are no right or wrong answers. You simply tell how you feel toward each statement by placing an "X" in the box which best describes your feeling.

Please fill in your choices for these examples:

For example:

1. I like ice cream.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

2. I like to be punished.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

3. I don't like candy.

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree

Attitude 1 - Evaluative Questionnaire

	Strongly Agree	Agree	Disagree	Strongly Disagree
1. Learning about the characteristics of the planets is useful.				
2. Learning about astronomy is worthless.				
3. Learning how astronomy affects the seasons is worthless.				
4. Learning about astronomy is useless.				
5. Learning how astronomy affects the seasons is useless.				
6. Learning about the characteristics of the planets is worthless.				
7. Learning how astronomy affects day and night is worthwhile.				
8. Learning about rotation and revolution is not important.				
9. Learning how astronomy affects day and night is important.				
10. Learning how astronomy affects the seasons is important.				
11. Learning how astronomy affects day and night is valuable.				
12. Learning how astronomy affects day and night is useless.				
13. Learning about rotation and revolution is useful.				
14. Learning about rotation and revolution is worthless.				
15. Learning about constellations is important.				
16. Learning about astronomy is worthwhile.				
17. Learning about constellations is valuable.				
18. Learning about the characteristics of the planets is not important.				
19. Learning about constellations is useless.				
20. Learning about the characteristics of the planets is not worthwhile.				
21. Learning about the planets is not important.				
22. Learning how astronomy affects the seasons is worthwhile.				
23. Learning about rotation and revolution is worthwhile.				
24. Learning about constellations is worthwhile.				

Attitude 2 - Pleasurable Questionnaire

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1. Learning how astronomy affects the seasons is interesting.					
2. Learning about constellations is enjoyable.					
3. Learning about the characteristics of the planets is enjoyable.					
4. Learning about constellations is boring.					
5. Learning about constellations is fun.					
6. Learning about the planets is exciting.					
7. Learning how astronomy affects day and night is boring.					
8. Learning about rotation and revolution is not fun.					
9. Learning about rotation and revolution is dull.					
10. Learning how astronomy affects the seasons is fun.					
11. Learning about the characteristics of the planets is not fun.					
12. Learning about astronomy is not fun.					
13. Learning about astronomy is enjoyable.					
14. Learning about the characteristics of the planets is boring.					
15. Learning about rotation and revolution is interesting.					
16. Learning how astronomy affects day and night is fun.					
17. Learning how astronomy affects day and night is exciting.					
18. Learning how astronomy affects the seasons is enjoyable.					
19. Learning about astronomy is interesting.					
20. Learning about rotation and revolution is not enjoyable.					
21. Learning how astronomy affects the seasons is dull.					
22. Learning about constellations is exciting.					
23. Learning about the characteristics of the planets is dull.					
24. Learning how astronomy affects day and night is not enjoyable.					

APPENDIX D

Teacher Instructions for the Questionnaires

TEACHER INSTRUCTIONS:

Please assign each student with a number and keep record of the number corresponding to each student's name. This is crucial for scoring purposes. Place each student's number on the questionnaire, as well as the class period the student is in. Please distribute the questionnaires both before the astronomy unit and after the completion of the study.

Please read instructions aloud to the class:

In the following items you are to describe how you feel about each statement. THIS IS NOT A TEST. There are no right or wrong answers. You simply tell how you feel toward each statement by placing an "X" in the box which best describes your feeling.

For example:

	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1. I like ice cream.					
2. I like to be punished.					
3. I don't like candy.					

Fill in your choices for these examples. (PAUSE) Are there any questions?
The following statements deal with astronomy, which is the study of objects in space. Mark the following statements just as you did the three examples.