THE EFFECTS OF MULTIPLE INTELLIGENCES BASED INSTRUCTION ON SIXTH GRADERS' SCIENCE ACHIEVEMENT AND ATTITUDES TOWARDS SCIENCE

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ABSTRACT

THE EFFECTS OF MULTIPLE INTELLIGENCES BASED INSTRUCTION ON SIXTH GRADERS' SCIENCE ACHIEVEMENT AND ATTITUDES TOWARDS SCIENCE

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The purpose of the study was to investigate the effects of multiple intelligences based instruction on sixth grade students' science achievement, and attitudes towards science.

This experimental research was conducted in the 2nd term of 2002 – 2003 educational year with sixth graders in METU Ankara College Primary School, and lasted for three weeks. A randomly chosen class was assigned to the experimental group and instructed by Multiple Intelligences Science Instruction, and the other randomly chosen class was assigned to the control group and instructed by Traditionally Designed Science Instruction. A total 50 students' scores were used

for the analyses. Two classes were instructed with the same teacher. The background of the teacher was sufficient to apply multiple intelligences teaching strategies from the seminars that the teacher had been participated.

The measuring tools were Science Achievement Test and Science Attitude Scale. Also an interview were made with the teacher of the groups. The pilot study was conducted with 57 sixth grade students in Atatürk Primary School in Niğde. According to the results of the pilot study, some questions were revised in Science Achievement Test. Science Achievement Test and Science Attitude Scale were administered twice as pretest before the treatment and as posttest after the treatment to both groups to assess and compare the effectiveness of two different types of instruction utilized in science teaching.

The data obtained from the posttests were analyzed by statistical techniques of multivariate analyses of covariance (MANCOVA). Results of the statistical analyses indicated that multiple intelligences science instruction was more effective than traditionally designed science instruction with respect to science achievement. However, the statistical analyses failed to show any significant differences between the experimental and control group's attitudes towards science. The teacher of the groups had positive views and opinions about the implementation of the theory.

Keywords: Multiple Intelligences Theory, Science Education, Attitude Towards Science.

ÖZ

ÇOKLU ZEKA TEMELLİ ÖĞRETİMİN ALTINCI SINIF ÖĞRENCİLERİNİN FEN BAŞARISINA VE FEN TUTUMLARINA ETKİSİ

Akbaş, Aydın

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Bu çalışmanın amacı, çoklu zeka temelli öğretimin altıncı sınıf öğrencilerinin fen başarısına ve fene karşı olan tutumlarına olan etkisini araştırmaktır.

Çalışma deneysel olup; 2002 – 2003 öğretim yılının II. döneminde ODTÜ Geliştirme Vakfı Özel Ankara İlköğretim Okulu II. Kademe 6. sınıf öğrencileri ile 3 hafta boyunca yürütülmüştür. Rastgele seçilen bir sınıf deneysel grup olarak anılmış ve çoklu zeka temelli öğretim metodu ile ders görmüş, rastgele seçilen bir başka sınıfta kontrol grup olarak anılmış ve geleneksel öğretim metodu ile ders görmüştür. Toplam olarak 50 öğrencinin verdikleri cevaplar analizlerde kullanılmıştır. Her iki

gruba aynı öğretmen ders vermiştir. Öğretmen, seminerlerde önceden aldığı eğitimlerden dolayı çoklu zeka temelli öğretim metoduna dayalı dersleri uygulamakta yeterlidir.

Araştırmada, Fen Bilgisi Başarı Testi ve Fen Bilgisi Tutum Ölçeği kullanılmıştır. Ayrıca grupların öğretmeni ile birebir görüşme yapılmıştır. Pilot çalışma Niğde Atatürk İlköğretim Okulu II. Kademe 57 6. sınıf öğrencisi ile gerçekleştirilmiştir. Pilot çalışma sonuçlarına göre, Fen Bilgisi Başarı Testindeki bazı sorular kısmen değiştirilmiştir. Fen Bilgisi Başarı Testi ve Fen Bilgisi Tutum Ölçeği her iki gruba farklı öğretimin etkisini karşılaştırmak için, ön-test ve 3 haftalık bir öğretim sonunda da son-test olarak uygulanmıştır.

Son-testlerden elde edilen veriler ortak değişkenli çok yönlü varyans (MANCOVA) istatistiksel tekniği kullanılarak analiz edilmiştir. İstatistiksel sonuçlar, çoklu zeka temelli öğretimin öğrencilerin fen başarıları açısından geleneksel öğretim metoduna göre daha etkili olduğunu göstermiştir. Fakat sonuçlar fen tutumları açısından deney ve kontrol grupaları arasında anlamlı bir fark olmadığını göstermiştir. Öte yandan, ders öğretmeninin Çoklu Zeka Kuramı'nın fen derslerinde uygulanması ile ilgili olumlu düşünce ve görüşlere sahip olduğu saptanmıştır.

Anahtar Kelimeler: Çoklu Zeka Kuramı, Fen Eğitimi, Fene Karşı Tutum.

To My Family

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TABLE OF CONTENTS

LIST OF TABLES

TABLE

LIST OF FIGURES

FIGURE

LIST OF SYMBOLS

SYMBOLS

MI	: Multiple Intelligence
MISI	: Multiple Intelligences Science Instruction
TDSI	: Traditionally Designed Science Instruction
SAT	: Science Achievement Test
SAS	: Science Attitude Scale
EG	: Experimental Group
CG	: Control Group
df	: Degrees of Freedom
n	: Sample Size
SD	: Standard Deviation
α	: Siginicance Level
MANCOVA	: Multivariate Analyses of Covariance
ANCOVA	: Analysis of Covariance
PREACH	: Students' Science Achievement Pre-Test Scores
PREATT	: Students' Science Attitude Pre-Test Scores
POSTACH	: Students' Science Achievement Post-Test Scores
POSTATT	: Students' Science Attitude Post-Test Scores
MEL	: Mother's Educational Level
FEL	: Father's Educational Level

SES : Socio Economic Status

MOT : Methods of Teaching

MRC : Multiple Regression Correlation

CHAPTER 1

INTRODUCTION

The importance of meaningful understanding of the basic concepts of science is increasing everyday, since the subjects that must be learned are changing, being improved, and becoming more complex with the technological improvements. So the mission of science courses in adopting the pupils to rapidly changing environment is very important. Science education makes great contributions to individuals in developing skills such as thinking creatively, examining, searching, and estimating (Kaptan & Korkmaz, 1999).

Many authors and researchers have discussed the definition of science and the ways of teaching science for more than one hundred years. However, a full understanding of science and the most effective way of teaching science could not be achieved yet. Researchers should address the importance of science in further studies (Miller, 1984). The importance of science in our life, the relationship between science and the rest of our culture, the definition of science and the most effective way of teaching science will be discussed as science and technology improves.

1.1. Science Education

Science is an effort searching, exploring, and finding fundamental and universal principles concerning the existence in a field, and discerning the future phenomena by means of these principles (Kaptan & Korkmaz, 2001). Science consists of facts, concepts, principles, generalizations, theories and laws. Science is the field of study which attempts to describe and understand the nature of the universe on a whole scale such as physics or chemistry, or a part such as biology (Özdemir, 2002). Science is offered as a course in schools in early ages

Many researchers and authors have discussed the science education since the late nineteenth century. Many learning theories such as Piaget's Developmental Theory, Constructivism, Behaviorism, Neuroscience, Brain-Based Learning Styles, Right Brain/Left Brain, Thinking, Communities of Practice, Control Theory, Observational Theory, Multiple Intelligences Theory have been explored during this period in order to find most effective way of teaching science. New teaching strategies such as problem-based learning, project-based learning, constructivism, and learning based on laboratory and experiments, learning through observations, cooperative learning, computer-assisted learning and multiple intelligences have been developed according to these theories for science education.

In science curricula, generally the purposes of science education are providing students with the opportunity to attain high levels of scientific literacy, to gain thinking and hand skills, and constituting the background for the profession in science and technology (Kaptan & Korkmaz, 2001).

1.2. Science Education in Turkish Primary Schools

Like in the world, there have been many attempts to increase the quality of science education in primary schools in Turkey. If the students could not get the basic concepts concerning the science, it is almost impossible to progress in this area in middle or high schools. In order to improve the quality of the science education, Turkish National Science Curriculum was changed in 1992. According to the innovations in science education, Turkish National Science Curriculum was changed again in 2001. In this curriculum, the three main goal of science education were explained as to explain the basis concepts about science to students (scientific literacy), to develop positive attitudes in students towards science and teach the skills of the ways reaching scientific knowledge.

With the new curriculum, the expectations from the teacher and students are different. Teachers are expected to implement student centered lessons and encourage them to reach the knowledge by themselves, to make observations, researches, and experiments and to share their knowledge with other students. The expectations from the students are realizing that they can solve every problem by creative, constructive and scientific thinking, acquiring the skills of making observations, researches, experiments, reaching the knowledge by themselves, sharing the knowledge with others, applying the learned topics to real life.

1.3. Electricity Concept in Science Education

As a branch of science, physics is a difficult course to construct meaningful learning. It is clear that because of the lack of meaningful learning, students' achievement in physics courses and the mean of the Physics tests in university

entrance examination are very low in Turkey. Basically, the concepts of Physics are the matter, the energy and relationship between them. Electricity is one of the most important concepts of physics and it is also one of the most abstract subjects for the students. Students come to class with their own knowledge about the electricity. However, this knowledge may be contradictory even they can think that electricity as a substance. Electricity is something mysterious for us since we can only see its effect (Dupin & Johsua, 1989). In addition, during the education in schools the students may construct many conflicting definitions about "electricity" and these definitions remove the correct meaning of it (Yalvaç, 1998).

In Turkish National Science Curricula, the electricity concept is introduced as a type of energy very briefly at the 4^{th} grade in the "Nature of Matter" unit. At the 6^{th} grade, Static Electricity and Current Electricity concepts are given to the students in the "Electricity: Guiding Our Life" unit. At the end of this grade, students are expected to have meaningfully understood the basic phenomena of the electricity. Therefore, electricity is one of the Physics concepts being instructed in science courses in primary schools at 6^{th} grade.

1.4. Traditional View of Intelligence

Traditionally, intelligence seemed to be quantifiable. Like you measure someone's actual or potential height, you can measure someone's actual or potential intelligences. (Gardner, 1993). Alfred Binet first developed intelligences tests in order to measure intelligence quotient (IQ) in the beginning 1900's in response to the request of Paris educators for ways to predict which youngsters would succeed and which will fail in the primary grades of Paris schools. He believed that intelligence

was a general ability that could be measured by pencil-and-paper instruments and IQ tests could be used as a scientific tool to predict academic achievement. IQ tests had been used to place students at an appropriate academic level and label them as intelligent or not (Gardner, 1993).

The main aspects of traditional view are the following:

- Intelligence can be measured by short answer tests such as Stanford-Binet Intelligence Quotient Wechsler Intelligence Scale for Children (WISCIV), Woodcock Johnson test for Cognitive Ability and Scholastic Aptitude Test.
- People are born with a fixed amount of intelligence.
- Intelligence level does not change over a lifetime.
- Intelligence consists of ability in logic and language
- In traditional practice, teachers teach the same material to everyone.

1.5. Multiple Intelligences Theory

Multiple Intelligences Theory was proposed by Howard Gardner (1983) in his seminal book, Frames of Mind: The Theory of Multiple Intelligences. In this book, he defined the intelligence as "the ability to solve problems or to create products that are valued within one or more cultural settings" (Gardner, 1983; pp 60). Firstly, he identified seven intelligences; linguistic intelligence, logical / mathematical intelligence, musical intelligence, spatial intelligence, bodily / kinesthetic intelligence, interpersonal intelligence and intrapersonal intelligence. Gardner talked about the Naturalist Intelligence in a conversation with Checkley (1997) and added this intelligence to his original seven intelligences. Finally, Gardner (1999) in his book, Intelligence Reframed: Multiple Intelligence for the 21st Century, identified

nine intelligences, adding the existential intelligence as a 9th intelligence. This theory is a challenge to the traditional view of intelligences in many aspects. According to Gardner,

- All human beings possess all nine intelligences in varying amounts.
- Each person has a different intellectual composition.
- Education can be improved by addressing the multiple intelligences of the students.
- These intelligences are located in different areas of the brain and either work independently or together.
- These intelligences may define the human species.

Multiple Intelligence Theory has brought many innovations to view of intelligence. The main aspects of this theory are the following:

- Assessment of an individual's multiple intelligences can foster learning and problem-solving styles. Short answer tests are not used because they do not measure disciplinary mastery or deep understanding. They only measure one's ability to do well on short answer tests. Some states have developed tests that value process over the final answer, such as PAM (Performance Assessment in Mathematics) and PAL (Performance Assessment in Language).
- Human beings have all of the intelligences, but each person has a unique combination, or profile.
- We can all improve each of the intelligences, though some people will improve more readily in one intelligence area than in others.

- There are many more types of intelligences which reflect different ways of interacting with the world.
- Multiple Intelligences pedagogy implies that teachers teach assess differently based on individual intellectual strengths and weaknesses.
- Teachers structure learning activities around an issue or question and connect subjects. Teachers develop strategies that allow for students to demonstrate multiple ways of understanding and value their uniqueness.

The nine intelligences proposed by the Multiple Intelligences Theory are presented following:

Linguistic Intelligence:

There four elements of the linguistic intelligence. These are phonology, syntax, semantics and pragmatics (Selçuk, 2002). Phonology consists of the ability to differentiate between synonyms of like words and to handle with sound, rhythm, and inflection of words. Syntax is the sensitivity to rules for the correct ordering of words. Semantic is about the meanings of the words and the interaction with people in the aspects of these meanings. Pragmatic is using the language for encouraging, explaining, persuading other individuals, conveying information, or excite people.

This intelligence is the intelligence of words, or the ability to use the core components of language with clarity. It is the kind of ability exhibited in its fullest form, perhaps by poets (Gardner, 1993). People who have this kind of intelligence enjoy reading, writing, speaking with words and learn well by listening.

Logical / Mathematical Intelligence:

Logical / mathematical intelligence can be identified as the ability to use inductive and deductive reasoning, solve abstract problems, and understand the

complex relationships of interrelated concepts, ideas, and things. It is the intelligence of numbers and reasoning. It includes solving problems, analyzing the objects and situations, using abstract symbols, skills of classifying, formulating scientific hypothesis, understanding cause-effect relationships. In short, it is the ability to think comprehensively without concrete objects.

Predicting, discovering, criticizing, realizing the oppositions, constructing logical reasoning, categorizing, ordering, classifying are some of the routine activities of logical / mathematical intelligence. People who have this kind of intelligence like to solve mathematical problems, play strategy games such as checkers and chess, do things with data, use graphic organizers both to please themselves and to present their information to others.

Musical Intelligence:

The three components of the musical intelligence are pitch of the voice, rhythm, and timbre. The pitch reflects the melody of a part; rhythm shows the tempo and the flowing. Timber is about the quality of a tone. Musical intelligence is related with the linguistic intelligence, since musical notation provides an accessible and lucid symbol system. There are also evidences that brain play important roles in perception and production of music, especially the right hemisphere. Moreover, there is a biological link to particular intelligence. All of these sources bring the interpretation of musical ability as intelligence.

Spatial Intelligence:

There are three main abilities that are the elements of spatial intelligence. These are the capacity to perceive the visual world accurately, to be able to recreate

one's visual experiences, and the ability to see form, color, shape, and texture in the "mind's eye" and to transfer these to concrete representation in art forms.

It includes reading a map, remembering the place of an object, finding an address. People with this kind of intelligence like to draw, paint, or sculpt their ideas and often represent moods and feelings through art. They enjoy solving mazes and putting together jigsaw puzzles. They tend to think in pictures and learn best from visual presentations such as movies, pictures, videos, and demonstrations using models and props.

Bodily / Kinesthetic Intelligence:

This is the intelligence of the whole body. It involves the ability to control and interpret body motions, manipulate physical objects, and establish harmony between the mind and the body. This is not means that the development of this intelligence is limited to sportsmen. A surgeon during a heart operation, a pilot during a flight, a science teacher during an experiment uses this intelligence.

People, who have this intelligence like move around, act things out, touch the people they are talking to. They enjoy physical act, and sports of all kind. They tend to process information through the sensation they feel in their bodies and they are good at both small and muscle skills.

Interpersonal Intelligence:

This intelligence is the ability to understand and relate to other people. It is the intelligence of social understanding. It includes the capacity to understand and interact with other people, verbal and nonverbal communication skills, conflict management, consensus-building skills, collaborative skills, and the ability to trust, respect, lead, and motivate others to the achievement of a beneficial goal.

People with this kind of intelligence like working in groups, learn while interacting and cooperating, and often serve as mediators in case of disputes, both in school environment and home. They enjoy friends and social activities of all kinds. Cooperative learning methods are very suitable for them.

Intrapersonal Intelligence:

This intelligence can be identified as the intelligence of self-knowledge. It is the ability to know oneself and assume responsibility for one's life and learning. It is the intelligence that allows people to understand themselves, their abilities, and their options. The three main parts of this intelligence are recognizing his/her range of emotions, distinguishing his/her sensation from thoughts, and drawing on them to direct his/her behavior.

People who have this kind of intelligence like working on their own projects and just being alone. They tend to be independent and self-directed, and have strong opinions on controversial subjects. They have great sense of self-confidence.

Naturalist Intelligence:

Gardner added this intelligence to his original seven in 1995. This intelligence focuses on the individual's ability "to recognize and discriminate among flora and fauna, and other things in the world like clouds or rocks". It is the ability to recognize species of plant and animal in the environment and to create taxonomies that classify the many different subspecies. It includes recognizing, thinking and acting about natural species.

People who have this kind of intelligence like to pick out different types of flowers, name different types of animals, or even arrange such items as cars, shoes or designer clothes into common categories. This intelligence related with logical and

intrapersonal intelligences. Classifying the natural phenomena is similar with classifying objects in mathematical intelligence. Being independent and self-directed that are the characteristic of intrapersonal intelligence can be seen in naturalists'.

Existential Intelligence:

This intelligence is concerning the sensitivity and capacity to tackle deep questions about human existence, such as the meaning of life, why do we die, and how we get here.

1.6. Multiple Intelligences in Classroom

Application of Multiple Intelligences Theory in classrooms brings several benefits to teachers. They may come to regard intellectual ability more broadly. The activities such as drawing a picture, composing, or listening to music, watching a performance may be as important as writing and mathematics. These activities can be a vital door to learning. According to many studies, many students who perform poorly on traditional tests are turned on to learning when classroom experiences incorporate artistic, athletic, and musical activities.

The teachers will provide opportunities for authentic learning based on their students' needs, interests and talents. The multiple intelligences classroom acts as like the real world: the author and the illustrator of a book are equally valuable creators. Students become more active, involved learners.

Involvement of parent and community in schools may increase learning. This happens as students demonstrate works in panels and in front of the audiences. Activities including apprenticeship learning bring members of the community into the learning process.

Students will be able to demonstrate and share their strengths. Building strengths gives a student the motivation to be a specialist. This can in turn lead to increase self-esteem.

When teachers teach for understanding, their students accumulate positive educational experiences and the capability for creating solutions to problems in life.

1.7. Significance of the Study

MI theory has been implemented in education around the world for over fifteen years. Implementing MI theory requires changing pedagogy and assessment techniques and it takes more time to develop MI curriculum. So educators continue to work in finding ways to use MI theory to help students, and themselves, grow (Hoerr, 2002).

According to Chapman (1993) and Armstrong (1994) Multiple Intelligence Theory makes greatest contributions to education by suggesting that teachers need to expand their repertoire of techniques, tools and strategies beyond the typical ones predominantly used in the classroom. Armstrong (1994) suggests different teaching strategies and assessment instruments for different intelligences suggested by the MI theory.

Gardner (1993) has brought a new approach to education by offering the future schools that would work under the assumptions that people all have different interests and different abilities and as a result no two persons learn in the same way, and no one can learn everything that he/she is obliged to learn. This requires educators to scrutinize the teaching-learning activities predominantly used in the classrooms and develop them according to students' interests and abilities.

Many studies has been carried out in different levels and areas about the effects of Multiple Intelligences Theory based teaching learning activities on students achievements and their attitudes in Turkey and in the world. Campbell (1989), Metteal, Jordan & Harper (1998), Coşkungönüllü (1998), Demirel & Korkmaz (1999), Demirel & Şahinel (1999), Kaptan & Korkmaz (2000), Korkmaz (2001), Özdemir (2002) observed that the teaching - learning activities based on MI theory have positive effects on students achievement in different areas and levels. In spite of these studies, Korkmaz (2001) stated that there is a demand to execute further studies in order to determine the effect of multiple intelligences in classrooms.

As stated earlier, Turkish national science curriculum has been changed recently. The new curriculum is student-centered and it offers many innovations in order to develop positive attitudes in students towards science and explain the basic concepts to them. So if the goal is to achieve all of the objectives of new science curriculum, the students must be instructed with the appropriate teaching strategies instead of traditional science instruction (Kaptan, 2001).

All of these arguments show that it is essential to investigate the significant effects of the suggestions made by many educators and experts concerning the integrating Multiple Intelligences Theory in educational programs on science achievement of learners and their attitudes towards science in our primary educational program.

The purpose of this research was to investigate the effect of teaching strategies based on the principles of Multiple Intelligences Theory on sixth graders science achievements and their attitudes toward science. It was also investigated the

views and opinions of the teacher about the implementation of teaching strategies based on the principles of Multiple Intelligences Theory in science classroom.

CHAPTER 2

REVIEW OF RELATED LITERATURE

In this chapter, the previous researches that constitute the theoretical and empirical background for this study are presented.

As mentioned earlier, in order to improve science instruction many teaching strategies has been developed according to different types of learning theories last hundred years. Multiple Intelligences Theory is one of the most important theories that have been discussed recently. Many qualitative and quantitative researches were conducted on learners from different grade levels and different educational settings in order to determine the effectiveness of Multiple Intelligences Theory.

This chapter consists of three subchapters. In the first subchapter, the four big projects that were carried by Gardner are presented. In the second subchapter, the studies concerning the application of Multiple Intelligences Theory in different educational setting in the world are presented. Finally, the studies concerning the application of Multiple Intelligences Theory in different educational setting in Turkey are presented

2.1. Four Big Projects Related To Multiple Intelligences Theory

This subchapter presents the four big projects that were explained by Gardner (1993) in his book “Multiple Intelligences: The Theory in Practice”. These projects were administered at different educational levels to which Multiple Intelligences Theory has been applied.

The Project Spectrum was a long term, collaborative research project that was executed by several researchers from Howard Project Zero and David Feldman at Tufts University. The project presented an innovative approach to assessment and curriculum development for the early childhood. "Every child has the potential to develop strength in one or several areas" (Gardner, 1993; pp 89) was the starting assumption of the project.

First of all, the research team identified a number of core capacities in each of seven intelligences. Rather than attempting to look at intelligences in pure form, they examined the domains of accomplishment of the culture through those forms taken up by children. They looked at cognitive or working styles of children as well as intellectual capacities in order to capture fully their approach to a task. The classroom was supplied with games, materials, puzzles and learning areas addressing the noticed intelligences. The team addressed fifteen areas of cognitive ability and eighteen stylistic features. The areas of cognitive ability examined in Project Spectrum were dinosaur game and bus game for numbers activities; assembly activity, treasure hunt game, water activity and discovery area for science activities; music production activity, and music perception activity for music activities; storyboard activity and reporting activity for language activities; art portfolios for

visual arts activities; creative movement and athletic movement for movement activities; classroom model and peer interaction checklist for social activities.

After one year, the research team in a brief essay called Spectrum Report summarized the information gathered about each child from the above activities. The report described the child's personal profile of strengths and weaknesses and proposed specific recommendations for parents and teachers about what to do at home, in school or in wider community to construct strengths and support areas of relative weaknesses.

In addition to the Spectrum Report the research team prepared a Parent Activities Manual giving suggestions for activities in the different domains specified by Spectrum emphasizing on the idea that each child is unique.

The primary questions that the project interested in were the following:

"1. Do young children have domain-specific as well as more general strengths?

2. Is there any correlation between performances in different activities?
3. Does a child's strength in one domain facilitate or hinder performance in other domains?" (Gardner, 1993; pp 94)

The analyses presented below was based on data collected during the 1986-1987, and 1987-1988 school years from two preschool classrooms at the Eliot-Pearson Children's School at Tufts University in Medford, Massachusetts. The class consisting 19 children whose ages ranging from 48 to 59 months with a mean age 52 months was the 1986-87 class, and the other class consisting 20 children whose ages ranging from 42 to 58 months with a mean age 53 months was the 1987-88 class.

Eight of the fifteen Spectrum activities were involved in analyses in 1986-87 class, and ten of them were involved in analyses in 1987-88 class. In each of samples, children's strengths and weaknesses were investigated, considering that a child who scored one standard deviation or more above the mean on the Spectrum measures had strength in a domain, and a child who scored one standard deviation or more below the mean had a weakness. They found that each child demonstrated at least one strength and one weakness relative to him or herself. For answering the second question they created a matrix of correlations between pairs of the ten activities executed in 1987-88 class. They concluded that there was very little correlation between activities at $p=0.01$ level, supporting the opinion that the Spectrum measures nonoverlapping capabilities in different content areas. For the third question they concluded that there was some evidence that a child's strength in one area might facilitate performance in another. For example, one student having strength in music production demonstrated interest also in creative movement sessions.

The project interested in "working styles" of children in addition to their performances. The questions that the project Spectrum tried to answer were the following:

"1. Do children utilize distinctive working styles when solving problems from different domains? (And if so, what is the nature of the differences in a child's areas of strength and weakness?)

2. Are some working styles more effective than others in particular domains?" (Gardner, 1993; pp 97). The working styles depended on the activity of the content area for the majority of the children. More engaged, confident and focused working

styles were obtained in the area of strength, and distractible, less engaged working styles were observed in the area of weakness. For instance, one who found it difficult to remain focused on most of the activities worked in a focused and persistent manner when she was presented with the material for the assembly activity in her area of strength. This showed that structures of tasks might be reinforcer or a barrier for the children to show confident and focused performance. These results gave the teacher valuable information about how they might use children strength to engage them in focused work in the class. With regard to second issue, some of the children had changing working styles when dealing with different activities in different domains, while some of them had consistent working styles.

The parents and teachers of the 1987-88 class were asked to fill out a questionnaire, in order to determine whether the specified strengths of the children by Spectrum revealed abilities that were unrecognized by parents or teachers. It was obtained that the parents obtained eight out of thirty strengths of their children, while teachers specified only one out of thirty strengths of their students. The comparison uncovered that Spectrum identified twelve strengths that had not been identified by either parent or teacher, and identified nine strengths specified both by parents and teachers. From the comparison, it also appeared that while some areas like language and numbers, can be easily obtained, other areas, like music perception, mechanical skills and social analysis can not be observed so easily.

Gardner (1993) talked about another project called "The Project Approach in the Key School Setting" in his book. The project started to be executed officially in 1987 in a K6 elementary school in Indianapolis 8, Indiana. Key school, which allows students to exhibit their interests through activities exercising seven intelligences,

was a recent approach to learning through experience based on Multiple Intelligences Theory.

In Key Schools, through the Multiple Intelligences curriculum pods were formed where each student participated each day in order to work with peers of different ages and a competent teacher to master craft or discipline of interest. There were a dozen pods, in a variety of areas ranging from architecture to gardening, from cooking to making money. An outside specialist, often a parent, visited the school in order to demonstrate an occupation or a craft to all students once a week. These specialists gave speeches about the topics that fit into the school theme of the week in the school. According to Gardner (1993) the final avenue for growth at the Key School and the most important involved the students' projects. The students executed three new projects related to their theme each year. The themes might be quite broad such as "Patterns", "Connections" or more focused such as "The Renaissance", "Mexican Heritage". All project presentations were videotaped and each student accumulated a video portfolio containing everything that s/he produced during daily activities, considering that each portfolio was an evolving cognitive model of the students development over the course of his life in the Key School.

The research team focused on the projects and students' portfolios in terms of five different dimensions that can be assessed:

1) Individual profile represented that the project revealed about the specific cognitive strengths, weaknesses, and tendencies of the students. It included students' temperament toward work and their intellectual proclivities of the seven intelligences.

2) Mastery of facts, skills and concepts could be obtained by looking at the students' capacity to showcase his/her command of factual knowledge, mastery of concepts, and skills in deploying the standard curriculum.
3) Quality of work revealed the innovation, imagination, aesthetic of each project which was considered as an instance of a certain genre - a comic play, a mural a science experiment, a historical narrative.
4) Communication was provided with a wide audience, with peer collaboration, with teachers and other adults, and with themselves.
5) Reflection was provided by students' working together in pods.

Practical Intelligence for School (PIFS) was another project mentioned by Gardner (1993). The project constructed to determine how the academic intelligences work together with the more practical interpersonal and intrapersonal intelligence in scholastic life. The purpose of the project was to inspect the relationship of academic success to the functions of adaptation to selection of and shaping of environment. This project based both on the Multiple Intelligences Theory and the Triarchic Theory of Intelligence. As noted earlier, the Multiple Intelligences Theory stresses the importance of skills being used in specific cultural context. The Triarchic Theory of Intelligence by Robert Sternberg (1985-1988) defines intelligences in terms of:

"1. The internal world of the individual (the information-processing components of metacognitive, performance, and knowledge-acquisition components),

2. The external world of the individual (the individual's ability to adapt to and shape existing environments, or select new ones), and

3. The experience of the individual in the world (how the individual copes with novelty and automatizes information processing)" (Gardner, 1993; pp 122).

PIFS required knowledge in three areas in terms of Multiple Intelligences Theory together with Sternberg's Theory. The three areas were i) the child's own intellectual profile, learning styles and strategies, representing the intrapersonal intelligence; ii) the structure and learning of academic task representing the manifestation of academic intelligences and combinations of intelligences in particular domains; iii) the school as a complex social system, representing the interpersonal intelligence.

As Gardner stated that the sixth and seventh grades (ages eleven to twelve), in particular, are a time when students should have already developed considerable practical knowledge about the school environment, and a time after which lack of such knowledge proves increasingly deleterious to scholastic performance (Gardner, 1993; pp 123). Moreover, at the beginning of adolescence they are starting to undergo major physical, intellectual, and emotional growth and change. For these reasons, the target population of PIFS was middle school students. They conducted a series of in-depth interviews with fifty fifth and sixth graders (ten to eleven years old) from a variety of socioeconomic backgrounds in five schools in the Boston area, in order to determine what students themselves understood about their roles as students. Study habits, the evaluation process, subject matter differences, the demands of academic tasks, the roles of teachers and administrators, interaction with peers, and the school system were the topics that the interviews deduced the students' opinions about. Analyzing the responses to the questions, the research team divided the students into high, middle, and low PIFS profile categories with respect to three main factors called elaboration of responses, strategies and resources, self as learner. These factors explained as follows:

Elaboration of responses. Low profile students were restricted by limited vocabulary and they had difficulty while explaining the reasons underlying their preferences and responses. On the other hand, high-profile students were clarifying their answers easily and were better able to differentiate among courses, academic tasks, personal strengths and weakness. ***Strategies and resources.*** In awareness and use of studying strategies and sources, the highs and lows varied greatly. High-profile students understood their strengths and weaknesses and were able to vary their approaches to different subject accordingly, while lows were almost unaware, advocating a more global, all-encompassing strategy. ***Self as learner.*** While lows thought most tasks obligatory, suffered from studying and had a disciplinary view; highs elicited a strong sense of themselves as learners and related the school tasks to both their personal and long term goals. Despite these factors that separated students as high, middle and low profile, there was a factor called ***subject matter differences*** which revealed a similarity between them. There was an important similarity between high and low PIFS students about similarities and differences among different subject matters. Through the interviews, the research team identified the themes that permeate each of the PIFS curriculum units as "ability and willingness to take an active role as learner; understanding of the learning process involved in different academic activities; and ability to take pluralistic view of school tasks and roles" (Gardner, 1993; pp126).

The purpose of the prepared PIFS curriculum was to show students how problems in different domains related to each other. The infusion curriculum based on two assumptions of Multiple Intelligences Theory that one student learns information best when it is prepared in a rich context; and transference from school

work to life situations or to the kinds of problems arising during school work is difficult. Gardner (1993) identified the PIFS curriculum as "metacurriculum" like a bridge between usual curriculum and thinking or study skills curriculum. The curriculum consists of a set of infusion units; each of them is aimed to accomplish the different subject matter assigned in school. *Finding the right mathematical tools* and *choosing a project* were two examples of units. Through choosing a project unit, students chose, planed and presented school projects more effectively and it provided the students with the opportunities to study a topic in depth. It included three sets of activities; "Understanding Projects", "Choosing a Project Appropriate to You", and "Planning a Project Appropriate to the Audience and Resources (Gardner, 1993; pp127). The aim of the *finding the right mathematical tools* unit was to introduce students with a range of mathematical resources and to help them to apply resources suitable to particular types.

There were some principles that each PIFS infusion unit reflected: i) practical intelligence skills are most fruitfully nurtured in domain-specific context; ii) concepts that present difficulties for students should be analyzed and clarified in focused activities; iii) concepts taught in the PIFS units are most effectively implemented when used in service of a particular purpose; iv) students acquire knowledge best when it is related to their own sets of abilities and interests; v) practical intelligence skills are most powerfully integrated when presented in both scholastic and real-world context; vi) students benefit from a focus on process as well as product; vii) self-monitoring helps students to take active responsibility for their own learning.

Evaluation of PIFS units was done considering the definitional, task-oriented and metatask components. The definitional component explains students' understanding of the problem. The task-oriented component asks students to start or to complete a task, or to deal with a problem area. The metatask component requires students to reflect on the nature of the process or skills included in a particular task by asking them for their self evaluation.

Finally, the research team found brief answers to some questions. First of all, they concluded that the students Multiple Intelligences Theory can be productive if the school focus on seven intelligences stating that students who had difficulty in traditional academic areas seem perform better and feel more empowered when given the chance to show their knowledge and understanding through seven domain.

Arts PROPEL was a project conducted in the Pittsburg Public Schools in Pennsylvania, in cooperation with the educational Testing of Harvard Project Zero. Production, perception and reflection were concerned to be three competences to improve education of arts. Production was concerned as composing or performing music, painting or drawing, engaging in imaginative or creative writing. Perception was concerned as effecting distinctions or discriminations within an art form. Reflection was concerned as stepping back from one's own perceptions or productions, or those of other artists, and the seeking to understand the goals, methods, difficulties and effects achieved. Arts PROPEL project deals with these three issues and combine them with Multiple Intelligences Theory. This project was new approach to curriculum and assessment in arts principally in the high school level (Gardner, 1993).

2.2. Application of Multiple Intelligences Theory in the World

Campbell (1992) carried out a project to explore student reactions to a multiple intelligences – based instructional model. He conducted the study in his third grade classroom of 27 students during the 1989 – 1990 school year in Marysville, WA. The lesson plans were prepared with respect to new criteria, teaching each topic in seven different ways. He constructed seven learning centers based upon the intelligences identified by Howard Gardner in his book, Frames of Mind. These centers were reading center concerning the linguistic intelligence, building center concerning the bodily / kinesthetic intelligence, math center concerning the logical / mathematical intelligence, music center concerning the musical intelligence, art center concerning the spatial intelligence, working together center concerning the interpersonal intelligence, personal work center concerning the intrapersonal intelligence. Students visited each center for $\frac{1}{2}$ - 2 hours for each topic during the school day.

Analyzing the collected the data and observations, Campbell validated some hypothesis. “Cooperative skills improved in all students. Daily work with music and movement in content areas helped students to keep information. Students became progressively more skilled at working effectively in this unique and non-traditional classroom. The role of the teacher changed as the year progressed, becoming less directive and more facilitative, more diversified, less of a taskmaster and more of a resource person and guide. The students displaced increased independence, responsibility and self-direction over the course of the year. Students previously identified as having behavioral problems made significant improvement in their

behaviour. Ability to work multimodally in students' presentation increased through the school year with students using a minimum of three to five intelligence areas in their classroom reports. The more kinesthetic students particularly benefited from the active process of moving from the center to center every 15 – 20 minutes. Parents reported frequently that behaviour improved at home, more positive attitudes about school were exhibited, and attendance was increased. Leadership skills emerged in most students. Several students who had not previously displayed leadership abilities took the lead with their groups in the Music, Building, Art and particularly in the Working Together Center" (Campbell, 1989).

Hoerr (1994) studied the implementation of Multiple Intelligences Theory on the curriculum of an independent preschool and elementary school in the City of St. Louis, called the New City School. Before the implementation, the teachers in the school studied the book "Frames of Mind" by Howard Gardner with Hoerr. They concentrated on students' strengths rather than weaknesses, and the students were talented at designing, drawing, creating model buildings with legos or discarded machine parts. They constructed learning centers according to multiple intelligences in order to engage students in rich and enjoyable activities through the curriculum. At the end, students improved high rate of self-esteem, creativity, critical thinking and independence.

Teele (1994) was conducted a study to describe a school where teachers are actively providing instruction based on the theory of multiple intelligences and identify the relationship of multiple intelligences to the instructional process. This qualitative study examined through interviews, observations, and analysis of documents how students, teachers, parents, principal, school board and district office

and community respond to an instructional environment where students and teachers' dominant intelligences can become actively involved in the learning process.

The theoretical framework focused on the theory of multiple intelligences and its application to the instructional process to see what outcomes are produced at a school when all students are taught through the seven intelligences.

The findings have demonstrated a strong relationship between multiple intelligences and the instructional process. Four domains, physical setting, organizational factors, human aggregate and social climate have been identified as elements that were prominent at the school studied and that can be utilized to provide a common framework in establishing schools where multiple intelligences and the philosophy that all children can and will learn is the foundational base. A model has emerged that defines the relationship between multiple intelligences and the instructional process. The four domains have key aspects that focus on how to provide a positive and personalized learning environment where all students can and will learn and develop extensive and intensive interpersonal relationships that enable the major players at the school to positively interact with one another to facilitate the growth and development of students.

The model is interactive with the students at the core of the schooling process. The theory of multiple intelligences becomes the vehicle for all students to achieve and is the key to providing quality instruction. Each of the elements have five key aspects that contribute to creating a personalized learning environment for the school and help develop a community of learners that together can provide quality instruction to all students. A restructured educational system has been

created. This new system provides a very different social climate which in turn creates a child-centered educational environment.

Mueller (1995) carried out a study to investigate social interactions and acquisition of content knowledge within a heterogeneous multiple intelligence cooperative group and a homogeneous multiple intelligence cooperative group based on Howard Gardner's theory of multiple intelligences and the Johnson and Johnson cooperative learning strategy. A science unit on the human body, adapted from a science lesson designed by David Lazear, was used in a fourth grade classroom.

The study was a quasi-experimental design combined with sections Strauss' Grounded Theory qualitative technique. Twenty-two fourth graders who attended Metcalf Laboratory School, Normal, Illinois during the 1994 – 1995 school year participated in the testing. The study concentrated on eight students chosen from the multiple intelligence strengths and weaknesses, checklists, observations, and interviews were used. Based on the assessment tools, four students were assigned to the homogeneous multiple intelligence group and four students were assigned to the heterogeneous multiple intelligence cooperative group. The Human Body Pretest / Posttest were given to assess content knowledge acquisition. Assessment tools including observations, field notes, written journal entries, interviews and a networking questionnaire were used to examine social interactions.

Multiple Intelligence assessment tools provided varying profiles of students' strengths and weaknesses. The tools did not indicate individuals with a particular strength, but instead often provided a profile with two or more strengths per student. In some cases, students who were chosen for the heterogeneous multiple intelligence

group indicated strength in the area they were chosen for in addition to another intelligence that someone in the homogeneous group had.

The homogeneous logical / mathematical group was able to complete the project more efficiently than the heterogeneous group. Each student in the homogeneous group assumed their role and took responsibility for the group's success. They felt they had done well as a group and had succeeded in all the requirements for the project.

The heterogeneous group had a more difficult time attending to the task and taking responsibility for their assigned roles. No strong leader emerged in the group, but each member worked on some part of the task. Members were satisfied with their individual and group efforts to complete the project successfully.

Numerous multiple intelligence assessment tools must be used to complete a student's profile of strengths and weaknesses. All students in the class made a gain from the pretest to the posttest Human Body content acquisition test. When using the cooperative learning strategy, the importance of teaching social skills cannot be ignored. The division of cooperative learning groups by multiple intelligence strengths is not detrimental to the students' learning of content knowledge.

Beckman (1996) suggested that the underlying framework for the use of multiple intelligences in the classroom is that being aware of the Gardner's seven intelligences and knowing how to view children's way of learning and the ways in which they exhibit intelligence. From this view, she improved lesson plans about the concepts in the curriculum concerning these seven intelligences applied them in her 2/3 (seven and eight year old students) at the Miller Research Learning Center on the campus of Edinboro University of Pennsylvania. She designed seven centers where

several materials are available to extend student learning through a variety of activities within a specific intelligence.

In the Linguistic center, there were word games, many books and dictionaries, a picture file and teacher-made packets involving the activities in the areas of spelling, comprehension, discrimination, and phonology.

In the Logical-Mathematical center, there were math manipulatives, science experiments, legos, gears, and teacher-made packets involving activities in the areas of math and science.

In the Musical center, there were records, a record player, a tape player and a keyboard where children can play familiar songs, and compose on music paper.

In the Spatial (art) center, there were multicolored construction paper, paints, glue, markers, colored chalk, scissors, beads, yarn, clay, and weaving boards.

In the Bodily-Kinesthetic center, there were a place where they can move to musical center, puppets and dressing clothes for dramatic play.

In the Interpersonal center, there were games such as chess, mastermind, and teacher-made folder games and packets.

In the Intrapersonal (quiet) center, there were a set of non-working earphones where students have the opportunity to be alone while working.

"Celebration of learning" (Armstrong, 1994) was the time where children showed that they had learned during covering each unit. The list of choices that students looked at included such things as making a model, creating a mural, a dance, a song/rap, an experiment, a picture display, a video, a report, keep a journal, give a talk, etc. After they decide to do and how they will accomplish the goal, they were

left free to work on these celebrations in school or at home. When the decided day arrived, each student came forth to present what they have learned until that day.

Beckman stated that the beauty of including the Gardner's Seven Intelligences in to the classroom was that it allowed for all children to learn through their strengths and to share their expertise. The MI theory allowed teachers to determine their student's weaknesses and strengths. This theory was a way of thinking; it was an attitude about people which allowed for similarities and differences. It allowed for inclusion and enrichment, for self-esteem building and the development of respect for each individual and the gifts they brought to classroom. Finally, she talked about Sample's idea. "If education is to give a gift to the future, then that gift must be one of wholeness - wholeness that is inherent in our design and our experience on this planet" (Sample, 1992, p.66). She then added that including this theory into the classroom provided opportunities for meaningful learning and gave the gift of wholeness to all who pass this way.

Wiseman (1997) conducted a study in order to determine the multiple intelligences of high school students enrolled in theoretical science (physics) and applied science (applied physics) courses. Although the results in standardized testing were similar for both groups, the instructional methodology and processes were different. Analysis of multiple intelligences profile collected from the groups showed that there were significant differences between the groups with respect to logical-mathematical, bodily-kinesthetic and intrapersonal intelligences.

In a qualitative research carried out by Fischer (1997) focused on Howard Gardner’s Theory of Multiple Intelligences. A cross-case survey was conducted to answer the following questions: Does teaching to a student's individual intelligence

as defined by Howard Gardner have an effect on student's progress. Progress is defined as steady improvement or advancement in a particular area. Secondly, the variables that influence the relationship between matching individual intelligence to a particular type of instruction were examined. The overall effect of Gardner's Theory on the learners in each population was examined.

A complete literature review search was conducted. From that search eight relevant studies were pinpointed for review and analysis. Next, the findings and characteristics of the studies were described. These descriptions served to deepen the understanding of Gardner's Theory of Multiple Intelligences in the environments the theory was utilized in.

Similarities and differences were examined and final conclusions were drawn from the studies. Studies revealed that the use of Gardner's Theory in school does serve to heighten student progress in an indirect way. The theory serves to heighten the awareness of student needs in many different types of classroom settings. Additionally, Gardner's Theory has positive influences when developing curriculum, utilizing cooperative education, and working with different populations of students. Finally, the use of Gardner's Theory enables educators to create learning environments that better enable all types of students to learn.

Baney (1998) described the experience and perspectives of four fifth-grade teachers as they worked together as a team to implement strategies based on Howard Gardner's Theory of Multiple Intelligences (MI). An observational case study design from a qualitative research approach was used as the teachers planned and began to incorporate teaching strategies based on MI Theory into an interdisciplinary social studies unit on power and responsibility. Through the process, participants enhanced

their knowledge of MI Theory and gained insights into their own teaching practices through personal reflection and through interaction with each other.

Since much of the current published materials about MI Theory detail the success stories of MI programs and schools highlighting their accomplishments, this study was designed to provide a glimpse into the daily experiences of four teachers in their attempts to begin the process of implementing Gardner's MI Theory. By gaining a deeper understanding of process of MI implementation, as well as the driving and restraining forces associated with it, other teachers can make their own decisions and choices about utilizing MI strategies in their classrooms. The experiences of teachers in the study also provide insights and implications for education regarding educational change and putting research theory in practice.

Hart (1999) carried out a study and obtained that students who have troubles in responding to verbal-linguistic teaching strategies respond positively when the topic is presented with music. The academic concepts were presented with a sample of songs with the help of many classroom and music teachers to more than 400 students at 3 – 5 grades level. The students test scores and retention scores were improved by 13% and 12%, respectively. Therefore, music can enhance students' learning and enrich their learning experience.

Beam (2000) conducted a study to compare the social studies of fifth grade students involved in two different modes of instruction in a public school setting. The two modes of instruction, the theory of multiple intelligences and traditional textbook-teacher instruction were the bases for determining if there is a difference in the mean scores of the control and the experimental group. Twenty-four 5th grade students participated in a five-week study. The control group was taught with

traditional textbook-teacher mode of instruction. The experimental group was instructed using the process of the theory of multiple intelligences. Portfolio assessment was used as an evaluation tool for measurement. At the end of a five-week period, a test was used to analyze the mean scores. Students' portfolio grades were based on a rubric scale recommended by the school system. The rubric or number is covered to a percentage and assigned a letter grade based on the grading system of the Georgia Department of Education. The results indicated that there is no significant difference between students in the control group and the experimental group with respect to achievement level. Results of the present study indicated that two modes of instruction were effective in teaching social studies concepts. Examination of one's multiple intelligences and the correlation to learning and teaching styles made the researcher aware of an obligation of educators to distinguish the abilities and intelligences of each student. Having determined the strengths and the weaknesses of intelligences in the classroom, instructional methods should correlate to facilitate the learning of every child.

2.3. Application of Multiple Intelligences Theory in Turkey

Although Multiple Intelligences Theory has been in practice in USA since it was proposed by Howard Gardner in 1983, it is new for Turkey. However, the application of the theory in schools has become widespread in recent years. Teachers have been educated about the application of Multiple Intelligences Theory in their classroom. Many schools like METU College, Erkenbaşarı College, Ayşeabla College, Çakabey College, Arı College, Ankara University College, İstek Foundation Schools and Ceceli Schools have conducted seminars to educate their teacher about

the implementation of Multiple Intelligences Theory and started to integrate the theory in their curriculum.

The interests of authors, researchers and teachers in Multiple Intelligences Theory increase every day. Many authors such as Selçuk (2002), Bümen (2002), and Saban (2002) have presented the Multiple Intelligences and the usage of it in educational settings in their books. The multiple intelligence instruction has become an alternative teaching style for educators in Turkey.

In Turkey, the studies related with the implementation of Multiple Intelligences Theory were first carried out by Demirel and his colleagues (Demirel, 1998 and Tarman, 1999).

Coşkungönüllü (1998) carried out a study to investigate whether there was a significant effect of Multiple Intelligences Theory on fifth graders' mathematics achievement. It was also investigated whether there was a significant effect of this theory on fifth graders' attitudes towards mathematics; and what opinions and views students and teachers possessed about the implementation of the theory in mathematics classrooms. This experimental research was conducted in the second term of 1997 – 1998 educational year with fifth graders in TED Ankara College Primary School and lasted for three weeks. After the treatment, analyzing the data it was found that there is a significant effect of Multiple Intelligences Theory on fifth graders' mathematics achievement. However, there is no significant effect of Multiple Intelligences on fifth graders' attitudes towards mathematics. Both students and their teacher had positive views and opinions about the implementation of the theory.

Demirel & Şahinel (1999) carried out a study to investigate effect of thinking abilities and Turkish Curriculum based on Multiple Intelligences Theory on developing linguistic abilities. From the results it was found that there is a significant effect of thinking abilities and Turkish Curriculum based on Multiple Intelligences Theory on students achievement. It was also found that the students that were enrolled to experimental group develop positive views towards new teaching model.

Güneysu & Demircioğlu (2000) pointed out that in Turkey, most of the students can not benefit from the education given in the schools which serves only two types of intelligences; linguistic and logical / mathematical intelligences. Since most of the people think that the purpose of education is to get high scores from the examinations at school and lycee entrance examination, the teachers generally focus on these two intelligences and ignore the others.

Korkmaz (2001) conducted a study related to effects of Multiple Intelligences Theory on students' science achievement and science attitudes including experimental and control groups. The results showed that there was significant difference between the groups in favor of the experimental group.

Özdemir, Kaptan & Korkmaz (2002) conducted a research to explore the effects of multiple intelligence - based science education at fourth level on students' high order thinking abilities. These levels were comprehension and higher orders. They used the experimental method in their research and conducted it with a group of 32 students at Beytepe Primary School Çankaya - Ankara in 2001-2002 Spring Semester.

They determined the students' multiple intelligences by using the Armstrong's scale. The scale was filled by students and students' teachers and parents. These data

were used while preparing the teaching-learning activities based on MI theory. Before and after applying the activities, the science test, measuring the high order thinking abilities, including the knowledge, comprehension, problem solving and scientific method levels was carried out.

Collecting the data and analyzing them, they found that MI-based instruction caused a significant difference in the students' abilities in knowledge, comprehension, problem solving and scientific method levels and between the total test scores before and after the instruction.

Finally, they concluded that the classroom activities based on multiple intelligences theory had a positive effect on high order thinking skills.

Özdemir (2002) carried out a study to investigate whether there was a significant difference between the effects of “Diversity of Living Things unit developed according to the principles of Multiple Intelligences (MI) Theory and that with Traditionally Designed Science Instruction (TDSI) on students’ science achievement and attitudes towards science as a school subject and retention of knowledge. This study was also interested in comparison of intelligence types that each students use before and after the treatment. This experimental research was conducted in the second term of 2001 – 2002 educational year with fourth graders in Beytepe Elementary School, and lasted for four weeks. After the treatment, analyzing the data it was found that there is a significant difference between the effect of the instructional strategies used according to the principles of Multiple Intelligences Theory and that of Traditionally Designed Science Instruction in the favor of the experimental group on understanding of science concepts and on students’ retention of knowledge related with the concepts in the unit. On the other

hand no effect in terms of students' general attitudes towards science was found. The results of Teele Inventory of Multiple Intelligences revealed that fourth grade students' most dominant intelligences were logical – mathematical and interpersonal.

Aşcı (2003) carried out a study to explore the effects of multiple intelligences based instruction on ninth grade students' ecology achievement, attitudes towards ecology, and multiple intelligences. The study was conducted in the academic year of 2001 – 2002. Results of statistical analyses indicated that multiple intelligences based instruction were more effective than traditional method in terms of students' ecology achievement and multiple intelligences. However, the statistical analyses failed to show any significant differences between the experimental and control group's attitudes toward ecology.

CHAPTER 3

PROBLEM AND METHOD

In this chapter, the main problem associated the hypotheses, and the methodology of the research involving design, subjects, instruments, and the treatment of the study are presented.

3.1. The Main Problem

What are the effects of the multiple intelligences science instruction on sixth grade students' science achievement and their attitudes towards science?

3.2. Hypotheses

The main problem stated above was examined with the following hypotheses, which were stated in null form.

Null Hypothesis 1

$H_{0[1,2]}: m_{MISI} - m_{TDSI} = 0$

1: Scores on science achievement post-test, 2: Scores on science attitude post-test

MISI: Multiple Intelligences Science Instruction, TDSI: Traditionally Designed Science Instruction

There will be no significant effects of multiple intelligences based science instruction on the population means of the collective dependent variables of sixth grade students' science achievement posttest scores and science attitude posttest scores when students' gender, science achievement pretest scores, science attitude pretest scores, mother's educational level, father's educational level and socioeconomic status are controlled.

Null Hypothesis 2

$H_{0[1]}: m_{MISI} - m_{TDSI} = 0$

There will be no significant effects of multiple intelligences based science instruction on the population means of sixth grade students' science achievement posttest scores when students' gender, science achievement pretest scores, science attitude pretest scores, mother's educational level, father's educational level and socioeconomic status are controlled.

Null Hypothesis 3

$H_{0[2]}: m_{MISI} - m_{TDSI} = 0$

There will be no significant effects of multiple intelligences based science instruction on the population means of sixth grade students' science attitude posttest scores when students' gender, science achievement pretest scores, science attitude pretest scores, mother's educational level, father's educational level and socioeconomic status are controlled.

3.3. Variables

There are nine variables included in this study, which were categorized as dependent and independent variables. Two variables are dependent and the others are

independent. Independent variables are divided into two groups as covariates and membership. Table 3.1 indicates the characteristics of these variables.

Table 3.1 Identification of Variables

Type of Variable	Name	Type of Value	Type of Scale
Dependent	POSTACH	Continuous	Interval
Dependent	POSTATT	Continuous	Interval
Independent	PREACH	Continuous	Interval
Independent	PREATT	Continuous	Interval
Independent	MEL	Discrete	Nominal
Independent	FEL	Discrete	Nominal
Independent	SES	Discrete	Nominal
Independent	MOT	Discrete	Nominal
Independent	Gender	Discrete	Nominal

3.3.1. Dependent Variables

The dependent variables of the study are Students' Science Achievement Posttest Scores (POSTACH) and Students' Science Attitude Posttest Scores (POSTATT) concerning electrostatic concepts as measured by Science Achievement Test (SAT) and Science Attitude Scale (SAS), respectively. POSTACH and POSTATT are continuous variables and measured on interval scales. Students' possible minimum and maximum scores range from 0 to 100 for POSTACH and 1 to 5 for POSTATT, respectively.

3.3.2. Independent Variables

The independent variables of the study are collected in two groups: Block A and Block B. Science Achievement Pretest Scores (PREACH), Science Attitude Pretest Scores (PREATT), Mother's Educational Level (MEL), Father's Educational Level (FEL), Socioeconomic Status (SES) and gender are considered within Block A as covariates to match two groups statistically. Methods of Teaching (MOT) (multiple intelligences science instruction and traditionally designed science instruction) are included in Block B as group membership. In Block A, PREACH and PREATT are considered as continuous variables and measured on interval scales. MEL, FEL, SES and students' gender are determined as discrete variables and measured on nominal scale. In Block B, the MOT is also considered as a discrete variable and measured on nominal scale.

The mother's educational level (MEL) and father's educational level (FEL) was coded with illiterate as 1, primary education as 2, elementary education as 3, lycee education as 4, university education as 5 and master or doctorate education as 6. The socioeconomic status (SES) was coded with monthly income less than 500.000.000 TL. as 1, monthly income between 500.000.000 and 1.000.000.000 TL. as 2, monthly income between 1.000.000.000 and 2.000.000.000 TL. as 3 and monthly income more than 2.000.000.000 TL. as 4. The students' gender was coded with female as 2 and male as 1. The students' possible minimum and maximum scores range from 0 to 100 for PREACH and 1 to 5 for PREATT, respectively. The methods of teaching were coded with multiple intelligences science instruction as 1 and traditionally designed science instruction as 2.

3.4. Methodology of the Research

3.4.1. Design of the Study

In this study, randomized pretest-posttest control group design was used. There were control and experimental groups which were randomly assigned.

Science Achievement Test was applied to both groups as a pre-test at the beginning of the study in order to determine whether there would be a significant difference between the groups. After the treatment, the same test was carried out to both groups as a post-test in order to determine whether there would be a significant difference between the groups.

Similarly, both groups were administered to Science Attitude Scale before and after the treatment as pre-test and post-test. The Table 3.2 summarizes the quasi-experimental design of the study.

Table 3.2 Quasi-experimental Design of the Study

Groups	**Pre-test**	**Treatment**	**Post-test**
E.G.	S.A.T. S.A.S.	M.I.S.I	S.A.T. S.A.S.
C.G.	S.A.T. S.A.S.	T.D.S.I.	S.A.T. S.A.S.

In this table, EG represents the Experimental Group being exposed to the multiple intelligence science instruction, CG represents control group being exposed

to traditionally designed science instruction. SAT represents Science Achievement Test, SAS represents Science Attitude Scale, MISI represents Multiple Intelligence Science Instruction, and TDSI represents Traditionally Designed Science Instruction.

3.4.2. Subjects

The subjects of this study consisted of 50 6^{th} grade students from 2 classes of General Science course in METU Ankara College Primary School, which is a private school located in Ankara, the capital city of Turkey. The population of the study was 6^{th} grade students in METU Ankara College Primary School.

The study carried out during carried out during the spring semester of the 2002-2003 academic year. Two classes were instructed with the same teacher. A randomly chosen class was assigned to the control group and instructed by TDSI; the other randomly chosen class was assigned to the experimental group and instructed by MISI. The students of both groups were administered to science achievement pre-test and science attitude pre-test.

Population of each class was about 30. However, due to the occasional absences during the 3-week treatment, and the absences in the post-tests, not all students could fully participate in the research. The data used in the analyses were obtained for 25 students in CG and 25 students in EG.

3.4.3 Instruments

In this study Science Achievement Test and Science Attitude Scale were used as instruments.

3.4.3.1. Science Achievement Test

This test was constructed by the researcher (Appendix B). The test was constructed according to the instructional objectives of Electrostatic subject-first chapter of "Electricity Guiding Our Life" unit, which is a part of a new national science curriculum being applied since 2001-2002 academic year in Turkey (Appendix A). The table of specification for the science achievement test was given in Appendix B.1.

The test included 27 multiple choice questions related to “Electrostatic” subject of “Electricity Guiding Our Life” unit. Each item had one correct answer and three distracters. Since the language of the instruction in 6^{th} grade in METU Ankara College Primary School was Turkish, the questions were prepared in Turkish.

This test was used as a pre-test to determine whether the students’ previous knowledge and their backgrounds related to the topic were at the same level or not. It was also used as a post-test to determine whether the treatment affected the students’ understanding of science concepts related to the topic or not.

3.4.3.2. Science Attitudes Scale

This was Science Attitude Scale as modified from the Fennema-Sherman Attitude Scale by Diana Doepken, Ellen Lawsky, and Linda Padwa (Appendix C). The scale consisted 47 items in 5 point likert type scale which are fully agree, agree, undecided, disagree, fully disagree. From this scale students can get minimum of 47 and maximum of 235 points. The scale translated to the Turkish by the researcher and an English teacher who was working at METU Niğde College Primary School. The score of each student was calculated my dividing the total score that she or he

get from the scale to the 47. Therefore, each student can get a minimum score 1 and a maximum score 5 from the scale.

3.4.3.3. Multiple Intelligences Interview with the Teacher of the Groups

In order to determine the views and opinions of the teacher of the groups on science lessons implemented with Multiple Intelligences Theory, an unstructured interview was prepared by the researcher. The interview was carried out after the treatment and lasted in 15 minutes. The researcher dictated the answers.

3.4.3.4 Validity and Reliability of the Instruments

To establish the face and content validity, the SAT about electrostatic concept was checked by one science teacher, one instructor from the Department of Secondary School Science and Mathematics Education at METU and an expert from the METU Ankara College Administration according to the content and format of the instrument. All of these people were explained about the main purpose of the test and then they checked the instrument according to given criteria of appropriateness of items to the grade level, appropriateness of the format, representativeness of content by the selected items. Suggestions were taken into consideration for the revision of instrument.

A pilot study was carried out with 57 sixth grade students at Atatürk Primary School which is a public school located in Niğde 350 km to Ankara in order to

observe the reliability of the Science Achievement Test. Analyzing the results in SPSS program, the reliability coefficient of the test was found as 0.78. According to results of the pilot study, some questions of Science Achievement Test were revised.

The reliability of Science Achievement Test was tested again after the revision of some questions. From the results of data obtained from the pretest scores of 50 students the reliability coefficient of the test was calculated to be 0.72 from SPSS. From the results of data obtained from the posttest scores of 50 students the reliability coefficient of the test was calculated to be 0.80 from SPSS.

In order to test the reliability of the science attitude scale a pilot study was implemented in Atatürk Primary School which is a public school located in Niğde. From the results of the analyses of the data obtained from 57 students of that school the reliability coefficient of the scale was calculated to be 0.86 from SPSS.

The reliability of the science attitude scale was tested again according to pretest and posttest scores. From the results of data obtained from the pretest scores of 50 students the reliability coefficient of the scale was calculated to be 0.93 from SPSS. From the results of data obtained from the posttest scores of 50 students the reliability coefficient of the scale was calculated to be 0.91 from SPSS.

3.4.4. Treatment

This study was a pre-test – post-test control group design of experimental research method. The study was conducted over three weeks during the spring semester of the 2002-2003 education year at METU Ankara College Primary School.

There were six sixth graders class instructed with two science teachers. The control group and the experimental group were randomly assigned from three classes instructed with the same teacher in order to eliminate the personal effect.

During the treatment, the topics included in the lesson plans were about the Electrostatic subject-first chapter of “Electricity Guiding Our Life" unit, which is a part of a new national science curriculum being applied since 2001-2002 academic year in Turkey. The lesson plans prepared with MI teaching strategies were constructed by the researcher for experimental group. The lesson plans prepared with traditional strategies were constructed by the science teacher for the control group. All of the materials of activities and worksheets as for the intrapersonal intelligence activities were prepared by the researcher. The classroom instruction period was three 40-minutes sessions per week.

In the control group, the students instructed with the traditional teaching strategies. The science teacher asked questions to the students about the topic, wrote on the blackboard, gave readings and handouts, and made some experiments about the topic. During the instruction, generally, the teacher presented the topic and the students listened to their teacher and answered some questions that their teacher asked. The laboratory work most of the time was carried by the teacher as demonstration. They used their textbooks and some worksheets about the topic prepared by the teacher.

In the experimental group, the students were instructed with the MI teaching strategies. The lesson plans were prepared according to principals of MI Theory. The lesson plans included teaching-learning activities designed with respect to eight intelligences within the theory. The lesson plan samples prepared for the MI

instruction were used while preparing the activities for different types of intelligences that students have. Since all of the intelligences were included in the lesson plans all students participated in the activities according to their strengths. They participated in all activities prepared for eight intelligence types. Each student participated in a specific intelligence more actively with respect to his/her strength areas of intelligences.

During the treatment, both of the groups were instructed by the same teacher. The science teacher has four years teaching experience and she knows about Multiple Intelligence Theory from the seminars that she has been participated. The teacher and the researcher are working in the same foundation, METU Private Schools. The administration of this school organized several seminars for the teachers including the topic “Multiple Intelligences Theory” that the teacher and the researcher had been participated. Therefore, the background of the teacher was sufficient to apply multiple intelligences teaching strategies. Even the teacher uses Multiple Intelligences teaching strategies in her lectures.

During the treatment, since the researcher was also working as a science teacher in METU Niğde College Primary School, all of the lessons could not be observed by him. The lessons of both groups were observed by the researcher once a week. The researcher paid attention on the approaches of the teacher to the students, the participation of the students to the activities and the interrelationship among them in the group works.

In order to concern each intelligence in the classroom, different types of activities were used. Reading, speaking, storytelling, listening to a story were some of the activities used in order to involve the linguistic intelligence in the classroom.

For instance, each lesson the teacher presented a story about the topic written by the researcher. Experimenting, problem solving, collecting data, measuring, classifying, predicting, learning the scientific model were some of the activities used to include the logical/mathematical intelligence in the classroom. For example, students conduct many experiments about charging by friction, charging by touching, charging by effect, using an electroscope, determining an object's charge. In the worksheets the students also used classifying, reasoning, problem solving concerning the logical/mathematical intelligence. Visualizing, sketching, graphing, illustrating, making 3D projects were some of the activities used to concern the spatial intelligence in the classroom. For example, the students were demonstrated with cards, transparencies, pictures, photographs during the instructions. They prepared electroscopes as a 3D project. Concept-mapping were used frequently in classifying the matters with respect to their conductivity, charging and structure of an atom. Dramatizing, using cooperative groups, experimenting, and creative movement were some of the activities related to bodily-kinesthetic intelligence in the classroom. For instance, the students formed small groups while making experiments related to the topic. They dramatized the stories that had been presented by the teacher. They presented the concepts about the topic by using body language. Playing background music, imitating the sounds, tapping out a rhythm were some of the activities to engage the musical intelligence in the classroom. For example, the students listened to classical music while studying as groups and experimenting. They sang various songs and imitated various sounds related to concepts of the unit. Cooperative learning, group work, discussing, peer teaching were some of the activities to deal with the interpersonal intelligence in the classroom. For instance, the students made

the experiments cooperatively. They discussed the concepts about the unit and the peers taught each other about these concepts. Imagination, working individually, expressing, thinking were some of the activities about the intrapersonal intelligence in the classroom. For instance, the students imagined many situations related to topic. They studied on the worksheets individually and were encouraged to think and express about different situations in order to make connections to specific subject. Categorizing, classifying, observation, researching, giving examples to topic from the real life were some of the activities to include naturalist intelligence in the classroom. For instance, the students categorized the matters as conductors and nonconductors and gave examples to them. They were encouraged to give examples about the subjects they had been instructed from real life.

3.4.5 Analyses of Data

Data list, consisting of POSTACH, POSTATT, PREACH, PREATT, MEL, FEL, SES, MOT and students' gender were prepared by using SPSS in which columns show variables and rows show the students participating the study. The statistical analyses were done by using SPSS.

3.4.5.1 Descriptive and Inferential Statistics

The mean, standard deviation, skewness, kurtosis, range, minimum, maximum values and the histograms were presented for the control and experimental groups. In order to test the null hypotheses, all statistical computations were done by using statistical package program (SPSS). Statistical technique named multivariate analysis of covariance (MANCOVA) was used since it incorporates two or more

dependent variables in the same analysis (Fraenkel & Wallen, 1996). Table 3.3 shows all variables set entry order that were used in the statistical analyses.

Table 3.3 MANCOVA Variable Set Composition and Statistical Model Entry Order

Variable Set	Entry Order	Variable Name
A (Covariates)	1st	X1 = PREACH X2 = PREATT X3 = MEL X4 = FEL X5 = SES X6 = Gender
B (Group membership)	2nd	X7 = Methods of Teaching
A*B (covariates * group interactions)	3rd	X8 = X1*X7 X9 = X2*X7 X10 = X3*X7 X11 = X4*X7 X12 = X5*X7 X13 = X6*X7

As shown in Table 3.3, Block A (covariates) was entered first in the MANCOVA model. Therefore, variances due to the PREACH, PREATT, MEL, FEL, SES and gender can be removed before the entry of the treatment variables. Block B (group membership) was entered second in the analysis and Block AxB (covariate*group membership) was entered third to determine covariate-group membership interactions. Block AxB must be statistically non-significant for MANCOVA model to be valid.

During analyses, the probability of rejecting true null hypothesis (probability of making Type 1-error) was set to .05 as a priori to our hypothesis testing as in the most of the educational studies. This study was carried out with 50 sixth grade students and the number of the variables was 9. Effect size was set to medium in this study ($f^2 = 0.10$). From the sample size, effect size and number of variables the power of the study was calculated as .60. Therefore, the probability of failing the reject the false null hypothesis (probability of making Type 2-error) was found as .40 (i.e., 1-.60).

CHAPTER 4

RESULTS

The results of this study are explained in three sections. Descriptive statistics associated with the data collected from the administration of science achievement posttest and science attitude posttests are presented in the first section. The second section presents the inferential statistical data produced from testing three null hypotheses. Finally, the last section summarizes the findings of the study.

4.1 Descriptive Statistics

Descriptive statistics related to the students' Science Achievement Pretest Scores (PREACH), Science Achievement Posttest Scores (POSTACH), Science Attitude Pretest Scores (PREATT) and Science Attitude Posttest Scores (POSTATT) for both experimental and control groups are presented in Table 4.1.

Students' achievement scores range from 0 to100 with higher scores meaning greater science achievement. As the Table 4.1 indicates, the mean of the PREACH is 36.74 and the POSTACH is 70.22 for the experimental group. On the other hand the mean of the PREACH is 33.93 and the POSTACH is 50.52 for the control group. Therefore, experimental group shows a mean increase of 33.48 while the change of

mean for control group is 16.59 points on the Science Achievement Test (SAT). It can be seen that the experimental group students have gained greater science achievement than the control group students.

Table 4.1 Basic Descriptive Statistics Related to the Science Achievement Scores and Science Attitude Scores

	Experimental Group		Control group	
	Pretest	Posttest	Pretest	Posttest
Scores on Science Achievement Test				
N	25	25	25	25
Mean	36.74	70.22	33.93	50.52
Standard Deviation	8.48	15.25	9.78	18.58
Skewness	-0.708	-0.526	0.919	0.155
Kurtosis	-0.492	-0.614	0.376	-0.923
Range	29.63	55.55	33.34	70.35
Minimum	18.52	37.04	22.22	14.81
Maximum	48.15	92.59	55.56	85.16
Scores on Science Attitude Scale				
Mean	3.54	3.82	3.31	3.92
Standard Deviation	0.46	0.48	0.58	0.49
Skewness	0.914	0.414	0.648	-0.295
Kurtosis	0.581	-0.610	-0.197	-0.893
Range	1.79	1.70	2.21	1.64

Table 4.1 (continued)

Minimum	2.89	3.09	2.43	3.02
Maximum	4.68	4.79	4.64	4.66

Students' attitude scores range from 1 to 5 in which higher scores mean more positive attitude towards science, lower scores mean negative attitudes towards simple electric circuits. As Table 4.1 indicates, experimental group shows a mean increase of 0.28 while the change of mean for control group is 0.61 for the Science Attitude Scale (SAS).

Table 4.1 also presents some other basic descriptive statistics like standard deviation, skewness, kurtosis, range, minimum and maximum values. For the experimental group, the value of skewness for the PREACH was –0.492, and changed to –0.614. For the control group, the value of skewness for the PREACH was 0.919 and changed to 0.155. In a similar manner, the value of skewness for the PREATT was 0.914 and changed to 0.414 for the experimental group. The value of skewness for the PREATT was 0.648 and changed to -0.295 for the control group. The skewness values for this study can be accepted as approximately normal as suggested by Kunnan (as cited in Ağazade, 2001). He states that the skewness and kurtosis values between -2 and +2 can be assumed as approximately normal. Therefore, the kurtosis values as shown in Table.1 can also be accepted as approximately normal.

By looking at Table 4.1, effects sizes of achievement and attitude were calculated as 0.91 (high) and 0.67 (medium), respectively. It is obtained by dividing

the difference between the means of the two groups by the standard deviation of the control group. However, these effect size calculations are not based on adjusted means of students' achievement and attitude. Therefore, the real effect size values are different than these values.

Figure 4.1, Figure 4.2, Figure 4.3 and Figure 4.4 show the histograms with normal curves related to the POSTACH and POSTATT for the control and experimental groups. These are also an evidence for the normal distribution of these four variables.

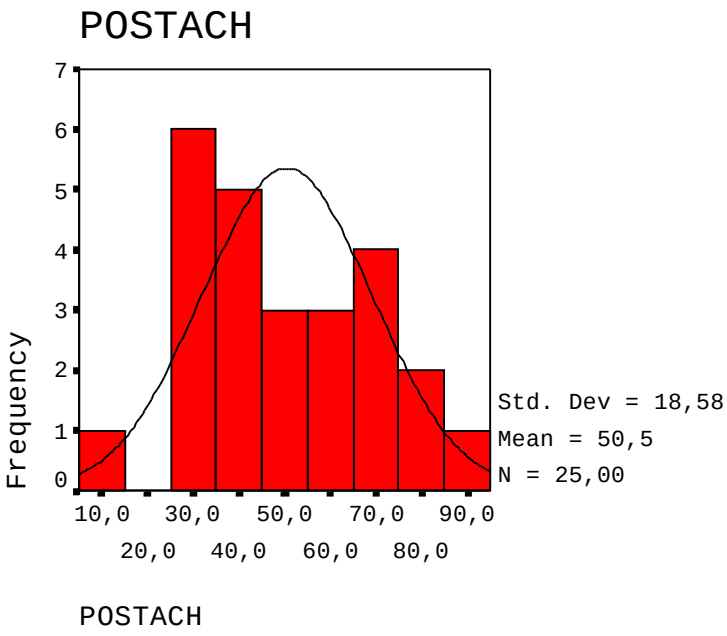

Figure 4.1 Histogram with normal curve related to the POSTACH for the control group on electrostatic.

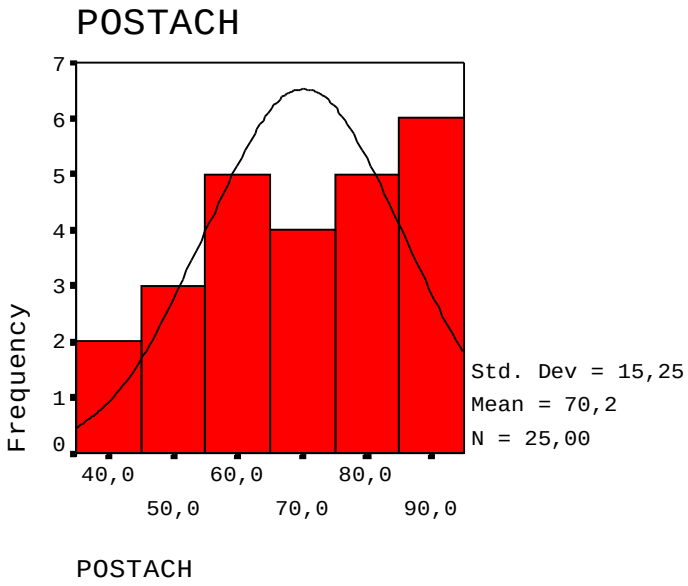

Figure 4.2 Histogram with normal curve related to the POSTACH for the experimental group on electrostatic.

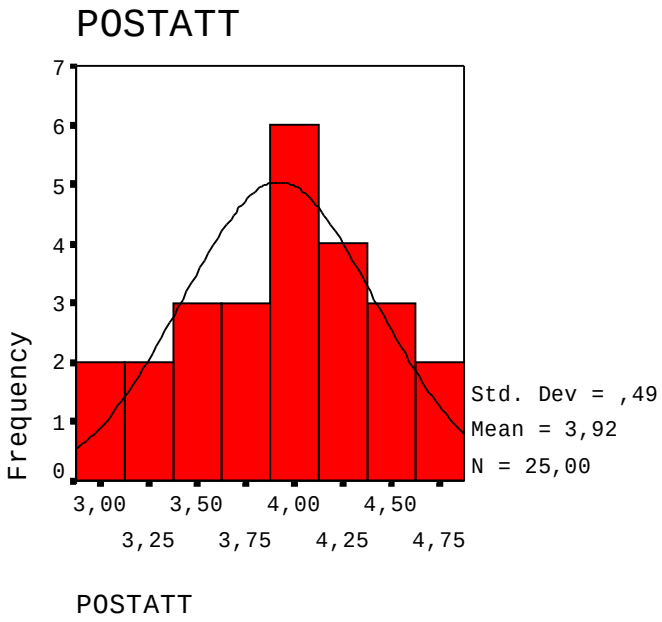

Figure 4.3 Histogram with normal curve related to the POSTATT for the control group on electrostatic.

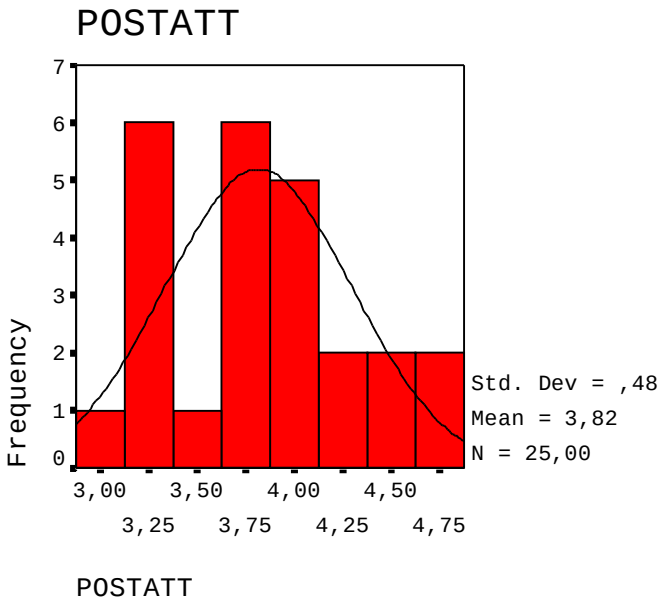

Figure 4.4 Histograms with normal curve related to the POSTATT for the experimental group on electrostatic.

4.2 Inferential Statistics

This section deals with the missing data analysis, determination of the covariates, verification of multivariate analysis of covariance (MANCOVA) assumptions, the statistical model of MANCOVA, the analyses of the hypotheses, the results of the interview with the teacher and the results of classroom observations.

4.2.1 Missing Data Analysis

Before starting the inferential statistics, the missing data analysis was carried out. Initially, pretests were applied to 58 students. However, eight students who had

been pretested were absent on the date of posttests. Therefore, the data of these eight students were excluded from the statistical analysis of the study completely.

Missing data in students' science attitude pretest scores (PREATT) and students' science attitude posttest scores (POSTATT) constitutes a range smaller than 5% of the whole data so they easily replaced with the series mean of the entire subjects. There were not any missing data in the rest of the data

4.2.2 Determination of Covariates

Six independent variables; PREACH, PREATT, MEL, FEL, SES and gender were pre-determined as potential confounding factors of the study. To statistically equalize the differences among the experimental and control groups, these variables were included in Block A as covariates. All pre-determined independent variables in Block A have been correlated with the dependent variables dependent variables of POSTACH and POSTATT. Table 4.2 presents the results of these correlations and their level of significance. Only one of the independent variables in Block A; gender have significant correlations with at least one of the dependent variables of the POSTACH and POSTATT. However, PREACH, PREATT, MEL, FEL and SES did not have significant correlation with dependent variables. Hence; gender was determined as covariates for the following inferential analyses.

Table 4.2 Significance Test of Correlations between the Dependent and Independent Variables

Variables	Correlation Coefficients	
	PSTACH	PSTATT
PREACH	.223	-.105
PREATT	.179	.92
MEL	.085	-.129
FEL	.125	-.061
SES	.151	.265
Gender	.184	.457*

*Correlation is significant at least .05 level (2-tailed)

Table 4.3 indicates the correlation between covariate gender and the other independent variables. There is no significant correlation between gender and the other independent variables. None of the correlation value is greater than 0.80. So no multicollinearity can be detected among covariate and other independent variables.

Table 4.3 Significance Test of Correlations between Covariates

Variables	PREACH	PREATT	MEL	FEL	SES
Gender	.061	.086	-.093	-.017	.172

*Correlation is significant at least .05 level (2-tailed)

4.2.3 Assumptions of Multivariate Analysis of Covariance

MANCOVA has the assumptions of normality, homogeneity of regression, equality of variances, multicollinearity and independency of observations. All the variables were tested for all the assumptions.

For the normality assumption, skewness and kurtosis values were used. The values for skewness and kurtosis of POSTACH and POSTATT were given in

Section 4.1. The skewness and kurtosis value were in approximately acceptable range for a normal distribution.

Homogeneity of regression assumption means that the slope of the regression of a dependent variable on covariates must be constant over different values of group membership. Table 4.4 indicates the results of Multivariate Regression Correlation (MRC) analysis of homogeneity of regression. For this analysis, one new interaction terms was produced. These interaction term was prepared by multiplying the group membership with the covariate of gender. After that, three different blocks were produced. Covariate variable was set to Block A, group membership was set to Block B and interaction terms set to Block C. Then MRC was performed to test the significance of R^2 change using enter method for each dependent variable.

Table 4.4 Results of the MRC Analysis of Homogeneity of Regression

Model	Change Statistics				
POSTA	R^2 Change	F Change	df1	df2	Sig. F Change
Block A	.193	6.866	1	48	.002
Block B	.181	4.606	1	47	.007
Block C	.160	2.871	1	46	.025
POSTAT					
Block A	.192	12.643	1	48	.001
Block B	.183	6.497	1	47	.003
Block C	.171	4.361	1	46	.009

As seen from Table 4.4, for the POSTACH, contribution of all blocks are significant (F (1,46) = 2.871, p = .025). Similarly, for the POSTATT, contribution of all blocks are significant (F (1,46) = 4.361, p = .009).

Table 4.5 indicates the Box's Test of Equality of Covariance Matrices. As seen from the table, the observed covariance matrices of the dependent variables are equal across groups.

Table 4.5 Box's Test of Equality of Covariance Matrices

Box's M	1.496
F	.476
df1	3
df2	414720
Sig.	.699

Levene's Test of Equality was used to determine the equality of variance assumption. As Table 4.6 indicates, the error variances of the selected dependent variables across groups were equal.

Table 4.6 Levene's Test of Equality of Error Variances

	F	df1	df2	Sig.
PSTACH	.186	1	48	0.381
PSTATT	.783	1	48	0.668

As Table 4.2 indicates, there is only one covariate. The correlations between the covariates must be smaller than .80. So the assumption of multicollinearity was also supplied.

Another assumption states that observations should be independent of one another. This assumption was met with the observations of the researcher. It is observed that all participants did their test by themselves.

4.2.4 Multivariate Analysis of Covariance Model

Dependent variables of the study are POSTACH and POSTATT. The variable of the gender is covariate of the study. Table 4.7 presents the results of MANCOVA. As seen from the table, methods of teaching (MOT) explain 27.7 % variance of model for the collective dependent variables of the POSTACH and POSTATT.

Table 4.7 MANCOVA Test Results

Effect	Wilks' Lambda	F	Hypothesis df	Error df	Sig	Eta Squared	Observed Power
Intercept	.102	194.59	2.0	46.0	.000	.894	1.000
Gender	.724	8.75	2.0	46.0	.001	.276	.961
MOT	.723	8.80	2.0	46.0	.001	.277	.962

In Table 4.7, it can be seen that, all of the variables has significant effect on the dependent variables of POSTACH and POSTATT.

4.2.5 Null Hypothesis 1

The first null hypothesis was; "there will be no significant effects of multiple intelligences based science instruction on the population means of the collective dependent variables of sixth grade students' science achievement posttest scores and

science attitude posttest scores when students' gender, science achievement pretest scores, science attitude pretest scores, mother's educational level, father's educational level and socioeconomic status are controlled".

MANCOVA was conducted to determine the effect of the MOT on the collective dependent variables of the POSTACH and POSTATT. As seen from Table 4.7, the first null hypothesis was rejected (λ= 0.723, p =.001). Significant differences were found among multiple intelligences science instruction and traditionally designed science instruction on the collective dependent variables of the POSTACH and POSTATT.

In order to test the effect of independent variable of the MOT on each dependent variable, an analysis of covariance (ANCOVA) was conducted as follow-up tests to the MANCOVA. Table 4.8 indicates the result of the ANCOVA.

Table 4.8 Test of Between-Subjects Effect

Source	DV	Type III Sum of Squares	df	Mean Square	F	Sig	Eta Squared	Obs. Power
Correct. Model	PSTATT	2,494	2	1,247	6,497	,003	,217	,888
	PSTACH	5636,104	2	2818,052	10,128	,000	,301	,980
Intercept	PSTATT	56,566	1	56,566	294,737	,000	,862	1,000
	PSTACH	12902,096	1	12902,096	46,370	,000	,497	1,000
Gender	PSTATT	2,358	1	2,358	12,288	,001	,207	,930
	PSTACH	784,191	1	784,191	2,818	,100	,057	,376
MOT	PSTATT	9,333E-02	1	9,333E-02	,486	,489	,010	,105
	PSTACH	5003,188	1	5003,188	17,981	,000	,277	,986

Table 4.8 (continued)

Error	PSTATT	9,020	47	,192
	PSTACH	13077,411	47	278,243
Total	PSTATT	759,370	50	
	PSTACH	200925,871	50	
Corrected Total	PSTATT	11,514	49	
	PSTACH	18713,515	49	

4.2.6 Null Hypothesis 2

The second null hypothesis was; "There will be no significant effects of multiple intelligences based science instruction on the population means of sixth grade students' science achievement posttest scores when students' gender, science achievement pretest scores, science attitude pretest scores, mother's educational level, father's educational level and socioeconomic status are controlled".

As seen from Table 4.8 the second null hypothesis was rejected ($F(1, 47) = 17.981$, $p = .000$). That is; multiple intelligences science instruction was effective in increasing the POSTACH. Students instructed by multiple intelligences science instruction had higher science achievement scores than the students thought by traditionally designed science instruction.

4.2.7 Null Hypothesis 3

The third null hypothesis was; "There will be no significant effects of multiple intelligences based science instruction on the population means of sixth grade students' science attitude posttest scores when students' gender, science

achievement pretest scores, science attitude pretest scores, mother's educational level, father's educational level and socioeconomic status are controlled".

As seen in Table 4.8, the third null hypothesis is not rejected (F (1,47) = .486, p =. 489). That is, there is no significant difference in the means of the POSTATT between the experimental and control groups when the effects of the covariates have been controlled.

4.2.8. Interpretations from the Interview with the Teacher of the Groups

An unstructured interview was made with the teacher of the both groups in order to explore her ideas. The teacher was asked to answer how the participation of the students in was experimental and control group during the treatment and how was the interaction among them while participating the activities. "Did the pupils in low level in experimental group make any progress during the treatment?" was an important question. The teacher was also asked to reply that in which activities the participation of the pupils were maximum.

According to the teacher of the groups, her students liked the science lessons based on Multiple Intelligences Theory. She stated that all of the students participated the activities even the pupils from the low level and they were not aware of the time during the lessons. They enjoyed most of the activities and told their teacher that they wanted to perform the science lessons in this way. She emphasized that some lessons the students in the experimental group did not even want to go out for the break. She also stated that the pupils in the experimental group participated in linguistic, logical / mathematical and interpersonal activities with most willingness.

In spite of these positive views, the teacher stated some difficulties about the application of Multiple Intelligences Theory in the classroom. She said that since they have many extra works during each day, they do not have sufficient time to prepare such activities and worksheets for each lesson. She argued that application of Multiple Intelligences Theory in lessons took much more time than the traditional ones. She also added that it is difficult to determine a suitable activity for each intelligence in some topics. She was even using Multiple Intelligences Theory teaching strategies before in her lessons for some topics. She claimed that it brought an extra work to teachers. If a teacher handbook including the activities and the worksheets was prepared by the Ministry of National Education, the implementation of the Multiple Intelligences Theory would be possible.

All of these showed that the teacher of the both groups had positive views towards Multiple Intelligences Theory. She believed in the effectiveness of the implementation of Multiple Intelligences Theory in science education.

4.2.9 Interpretations from the Classroom Observations

From the observations obtained during the research the lessons of control group and the experimental group compared with respect to classroom atmosphere, students' participation to the activities and the interrelationship between the pupils.

Since there were many different types of activities for each topic, there became much noise in the experimental group with respect to control group. However, this was not a handicap for students in experimental group. Because, students interact and learn from each other, and they felt relaxed in such student-centered lessons.

There were great differences between the experimental group and the control group with respect to students' participation to the lessons. In the experimental group, the students seemed to participate to the activities with willingness and they wondered what was coming next in the next activity and even in the next lesson. They spent most of their time wit different activities and do not write more from the blackboard. In the control group, participation of the students was low; they seemed to be bored and showed little interest in answering the questions. Sometimes, some of the students do not participate one time during a lesson. They spent most of their time by listening, answering the questions and writing from the blackboard.

In the experimental group, the students encouraged each other when they were answering questions especially in group work. They taught each other by peer editing and learned cooperatively. In the control group, interaction between the students was very low. The students even tried to catch mistake of each other. Since the lessons were teacher-centered, the students could not cooperate and profit from other students.

CHAPTER 5

ASSUMPTIONS AND LIMITATIONS

5.1. Assumptions

1. Pre-test will not interact with the treatment.
2. There will be no interaction between the students of different groups.
3. The subjects of the study will answer the questions in the instruments sincerely.
4. The teacher will be expected to fill all of the requirements to implement Multiple Intelligences Theory.
5. The teacher will be expected to encourage students' inclusion in this project.
6. The tests of the study will be administered under standard conditions.

5.2. Limitations

1. This study will be limited to 6^{th} grade students from METU Ankara College Primary School.
2. This study will be limited to chapter of "Electrostatic" part of the unit "Electricity: Guiding Our Life".

3. This study will be limited to only 50 students attended all tests.
4. The generalizability of the results is limited.

5.3. Internal Validity of the Study

In this study, since the control group and the experimental group were assigned randomly rather than individuals, subject characteristics such as previous science knowledge, gender, age, maturity, attitude, socioeconomic status, ethnicity, and intelligence should be discussed as threats. Whether the dependent variable are directly related to the independent variable or related to these extraneous variables will determine the internal validity of the study.

The students' previous science knowledge determined at beginning of the study. A science achievement test was administered to randomly assigned two groups and, it was found that there was no significant difference between the groups with respect to previous science knowledge.

In the experimental group, 16 of 25 students were male and 9 of them were female. In the control group, 14 of 25 students were male and 11 of them were female. Therefore, the groups were similar with respect to gender. So it can be considered that gender is could not be a threat to the study.

Considering the ages of the students, all of the students were 12 – 13 years old. Therefore, maturation is not likely to be an effective threat to the study.

In order to determine students' attitudes towards science a science attitude scale was implemented at the beginning of the study to both groups. The results of this scale showed that there was no significant difference between groups with respect to their attitudes towards science.

The 9th question in the first part (personal information) of the science attitude scale was about the socioeconomic status of the students. From the results of the scale and the interview with the teacher of both groups showed that socioeconomic status and ethnicity are unlikely to be effective threats to the study.

In order to eliminate the Hawthome effect, the students in experimental group were not informed that they were receiving a special treatment.

Since the teacher of experimental and the control group was same the study did not affected from the implementer threat.

In order to eliminate the confidentiality threat, the names and the characteristics of the students were not used in the study and they were informed about this situation at the beginning of the treatment.

Concerning the personal bias, researcher did not interfere any of the activities.

For eliminating the location threat, both groups were instructed under the same conditions and the tests were administered at the same time.

5.4. External Validity

The subjects of this study were 50 6th grade students from a private primary school. Therefore, generalization of this study is limited. The generalizability of this study would be acceptable for similar populations of private primary school students with a broader target population.

CHAPTER 6

CONCLUSIONS, DISCUSSION AND RECOMMENDATIONS

This chapter summarizes the methodology of the research, the results of the research, the discussion of the results and the recommendations for the further researches concerning the Multiple Intelligences Theory in science education.

6.1. Conclusions

In this study, the effects of teaching strategies based on the principles of Multiple Intelligences Theory on sixth graders science achievements and their attitudes toward science were investigated.

The research was conducted during the second semester of 2002-2003 educational year at METU Ankara College Primary School lasted in three weeks. Randomly selected control and experimental groups were instructed by the same teacher and the science unit for these groups was the same. The topic was electrostatic. The lesson plans and teaching strategies were prepared by the researcher in the view of Multiple Intelligences Theory as suggested by Gardner (1993), Armstrong (1994) and Campbell (1994). Each lesson included activities

related with the eight of the intelligences that the Multiple Intelligences Theory suggests.

Science achievement test and science attitude scale were used as measurement instruments for this research. These instruments were implemented to both groups before and after the treatment as a pre-test and a post-test.

From the results of the Science Achievement Test, it was determined that there was a significant difference between the experimental group exposed to multiple intelligences science instruction and the control group exposed to traditionally designed science instruction with respect to science achievement after the treatment. Results of MANCOVA showed that the Multiple Intelligences Science Instruction was more effective than Traditionally Designed Science Instruction with respect to science achievement.

From the results of the Science Attitude Scale, it was determined that there was no significant difference between the groups with respect to attitudes towards science after the treatment. The results also showed that both of the groups had positive attitudes after the treatment. Similarly, student's scores on Science Attitude Scale were high before the treatment. Therefore, we can conclude that Multiple Intelligences Science Instruction had no effect on students' attitudes towards science.

From the results of the interview with the teacher of the groups and the classroom observations it was determined that the participation of pupils in experimental group was much more than the ones in the control group. The interactions between the pupils in experimental group were more positive. They encourage each other and work cooperatively during the activities. Therefore, we can conclude that Multiple Intelligences Science Instruction enhance teaching learning

process by contributing students participation and cooperative working. It was also determined that students in experimental group interested in all activities concerning the eight intelligences especially in linguistic, logical / mathematical and interpersonal intelligences.

6.2. Discussion of the Results

Results of the Science Achievement Test indicated that Multiple Intelligences Science Instruction was more effective than the Traditionally Designed Science Instruction on students' science achievement. When the results of this research were compared with those of the previous ones with respect to achievement of students in courses, this research supports the findings. Many studies have been executed in different levels and areas about the effects of Multiple Intelligences Theory based teaching strategies on students' achievements in different areas in Turkey and in the world. Campbell (1989), Metteal, Jordan & Harper (1998), Coşkungönüllü (1998), Demirel, Korkmaz & et. al. (1999), Kaptan & Korkmaz (2000), Korkmaz (2001), Özdemir (2002), Aşcı (2003) observed that the teaching - learning activities based on MI theory have positive effects on students achievement in different areas and levels.

Results of the Science Attitude Scale indicated that Multiple Intelligences Science Instruction had no effect on students' attitudes towards science. When the results of this research were compared with those of the previous ones with respect to attitudes of students towards a specific field, this research supports the findings. In the literature, the researchers could not determine any effect of Multiple Intelligences based instruction on students' attitudes towards a field. For instance, Coşkungönüllü (1998) could not find any effect on students' attitudes towards mathematics in spite

of the significant effect of multiple intelligences instruction on mathematics achievement of fifth graders. Similarly, Özdemir (2002) found no effect of Multiple Intelligences Science Instruction on fourth grade students' attitudes towards science. Although the instruction based on Multiple Intelligences Theory improves learning, it has no effect on students' attitudes towards courses according to this research and many previous researches. This result is really interesting and the reasons might be investigated in future studies.

Science Attitude Scale used in this study was modified from the Fennema-Sherman Attitude Scale by Diana Doepken, Ellen Lawsky, and Linda Padwa. It was translated to Turkish by the researcher and an English teacher. Actually, this scale consists of four factors. These are personal confidence about the subject matter, usefulness of the subject' content, subject is perceived as a male domain and perception of teacher's attitudes. Since in this research the purpose was to investigate the effects of Multiple Intelligences based instruction on sixth graders' science achievement and their attitudes towards science, we did not deal with each factor specifically. According the purpose of a research, each of these factors might be discussed in future studies.

Another subject that must be discussed is what science teachers can infer from this research. Science teachers must be aware of how each student learns, and what are their strengths and weaknesses. According to Multiple Intelligences Theory no two people can learn in same way. The students should be informed about their strengths and weaknesses, and they must be aware of that they are strong in some areas and weak in other areas. The teachers should also understand the background and the culture of the group they teach.

The worksheets which are prepared by the researcher were solved by the students during the lessons. These worksheets were assembled by the students for studying to the examinations. These worksheets made great contributions to the students in stiffening and developing their knowledge obtained in the lessons.

6.3. Recommendations for Further Research

- Similar research studies might be constructed for different fields and at different grade levels.
- The sample of further researches might involve more number of groups and students in both state and private schools for more accurate results.
- A research study with a longer period of treatment might be conducted.
- The further studies might be constructed to determine the students' strengths and weaknesses concerning the intelligences.
- The further studies might be conducted to determine why multiple intelligences instruction has no effect on students' attitudes towards science.
- Observation checklists might be used during the classroom observations in the further studies.
- The measurement tools might be developed according to principals of Multiple Intelligences Theory in further studies.
- The factors of Science Attitude Scale might be discussed specifically in further studies.

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APPENDICES

APPENDIX A

YAŞAMIMIZI YÖNLENDİREN ELEKTRİK ÜNİTESİ

AMAÇ VE KAZANIMLARI

AMAÇLAR:

Bu ünite ile öğrencilerin;

1. Elektriklenme çeşitlerini, elektrik yüklerini ve cinslerini,
2. Elektrik yükleri arasında itme ve çekme kuvvetlerini,
3. Devre elemanlarını, gerilim (voltaj, potansiyel farkı) ve akım şiddetinin ölçülmesini,
4. Maddelerin iletkenlik ve yalıtkanlık özelliklerini,
5. Bir iletkenin direncini, dirençlerin seri ve paralel bağlanışını gözlemlerle, uygulamalarla, deneylerle ve farklı etkinliklerle kavrayarak basit devreler oluşturup çalıştırmaları amaçlanmaktadır.

ÖĞRENCİ KAZANIMLARI:

Bu üniteyi başarıyla tamamlayan her öğrenci;

1. Çevresinden elektrikle ilgili örnekler verir.
2. Sürterek cisimleri elektrikler ve elektriklenmeye çevresinden örnekler verir.
3. Elektrik yüklü cisimlerin etkileşerek birbirlerini itip çektiklerini gösterir.
4. Doğada zıt yüklere sahip iki tür elektrik yükü olduğunu fark eder.
5. Elektrik yüklü iki cismin birbirini nasıl ittiğini ya da çektiğini açıklar.
6. Bir cismin elektrik yüklü olup olmadığını elektrik yüklüyse yükün türünü belirler.
7. Atomun yapısından hareketle elektriklenmede protonların ve elektronların oynadığı rolü açıklar.
8. Cisimlerin artı elektrik yüklü, eksi elektrik yüklü ve yüksüz (nötr) olmalarının ne anlama geldiğini açıklar.
9. Sürtme esnasında cisimlerin nasıl artı yüklü yada eksi yüklü hale geldiklerini açıklar.
10. Cisimleri dokunmayla elektrikler ve dokunmayla elektriklenmenin nasıl olduğunu açıklar.
11. Cisimleri etkiyle elektrikler ve etkiyle elektriklenmenin nasıl olduğunu açıklar.
12. Elektrik yüklerinin hareketine bağlayarak maddeleri sınıflandırır, iletken ve yalıtkanlara örnekler verir.
13. Şimşek ve yıldırımın atmosferdeki doğal elektriklenme olayları olduğunu fark eder; bunları şekil çizerek açıklar ve korunma yollarına örnekler verir.

14. Basit bir pil yaparak pilin ana parçalarını belirtir, pilin kutupları arasına ampul bağlar ve ampulün ışık verdiğini gösterir.
15. Bir pilin kutuplarını fark eder ve kutupların nasıl oluştuğunu açıklar.
16. Bir pilin kutupları arasına bağlanan ampuldeki telden elektronların nasıl akarak elektrik akımı oluşturduğunu açıklar.
17. Elektrik akımının yarattığı etkileri (ışık, ısı) fark eder.
18. Elektrik akımının varlığını nasıl fark edeceğini belirtir ve akımı ampermetre kullanarak ölçer.
19. Pilin kutupları arasındaki gerilimi (voltajı) fark eder, açıklar ve voltmetre ile ölçer.
20. Akımın her telden aynı kolaylıkta akmadığını, iletkenlerin akıma direnç gösterdiklerini fark eder.
21. Sürtünmeyle direnç arasında benzerlik olduğunu gösterir.
22. Bir telin direncinin nelere bağlı olduğunu fark eder.
23. Akıma karşı telin direnç göstermesinin doğurduğu sonucu açıklar ve direnç nedeniyle elektrik enerjisinin ısı enerjisine dönüştüğünü gösterir.
24. Dirençlere ve dirençlerin kullanıldığı yerlere örnekler verir.
25. Bir devre elemanı için enerji ve gücü tanımlar.
26. Pil, ampul ve anahtardan oluşan devrede pilin enerji ürettiğini, ampulün ise bir direnç olduğunu ve enerji tükettiğini fark eder.
27. Pilleri ve ampulleri seri ve paralel bağlayarak devreler kurar, kurduğu devrenin şemasını çizer, devredeki akımları ve gerilimleri ölçerek karşılaştırır (iki ya da üç lambayı geçmeyen).

28. Elektrik devresini genel anlamıyla tanımlar, örnekler verir, kapalı devre ve açık devrenin anlamlarını örneklerle açıklar.
29. Pillere ve bu pillerin kullanım yerlerine örnekler verir.
30. Kullanılmış pillerin doğrudan çöpe atılması durumunda çevreyi kirleteceğini fark eder ve alınacak önlemleri belirtir.

KONULAR:

A) DURGUN ELEKTRİK

1. Çevremizdeki Elektrik
2. Elektrikle İlk Tanışma: Cisimlerin Elektriklenmesi
3. Elektrik Yükleri Arasında İtme ve Çekme
4. İki Tür Elektrik: Artı ve Eksi Yükler
5. Elektriğin Kaynağı: Maddenin Temel Taşı Atomlar
6. Dokunma ve Etki ile Elektriklenme
7. İletken ve Yalıtkan Maddeler
8. Atmosferde Doğal Elektriklenme: Şimşek, Yıldırım

B) AKAN ELEKTRİK

1. Basit Bir Pil Yapalım: Kimyasal Tepkimeler Yükleri Ayırır
2. Protonlar Akamaz; Fakat Elektronlar Akar
3. Elektrik Akımı Görülemez; Fakat Etkilerinden Gözlenip Ölçülebilir
4. Bir Pilin Kutupları Arasındaki Gerilim (Voltaj)

5. Elektronlar İletkenden Akarken Dirençle Karşılaşır
6. Elektrik Enerjisi Direnç Nedeniyle Isıya Dönüşür
7. Ampul Bir Dirençtir
8. Dirençler Seri ve Paralel Bağlanabilir
9. Elektrik Devreleri Kuralım ve Çalıştıralım
10. Çeşitli Piller ve Bunların Kullanıldığı Yerler
11. Pilleri Çöpe Atmayalım, Çevremiz Temiz Kalsın

APPENDIX B

FEN BİLGİSİ BAŞARI TESTİ

Adı :
Soyadı :
Numarası :
Sınıfı :
Okulu :

Bu test "Yaşamımızı Yönlendiren Elektrik" ünitesindeki "Durgun Elektrik" konusu ile ilgili bulunduğunuz düzeyi belirlemek için hazırlanmıştır. Test 27 sorudan oluşmaktadır. Testteki soruları cevaplandırırken aşağıdaki noktaları göz önünde bulundurmanız yararlı olacaktır.

- Bütün soruları dikkatlice okuyunuz.
- Sorular, çoktan seçmeli olarak hazırlanmıştır. Her soruda, seçenekler arasından doğru cevabı bularak soru kağıdı üzerinde işaretleyiniz. Ayrıca bir cevap kağıdı verilmeyecektir.
- Sınav süresi 40 dakikadır.
- Adınızı, soyadınızı, numaranızı, sınıfınızı ve okulunuzu ayrılmış bölüme yazmayı unutmayınız.

BAŞARILAR...

1. Bir cisim sürtünme sonucunda artı (+) yükle yüklenmiştir. Bu cisim için aşağıdakilerden hangisi doğrudur?
   A) Proton almıştır. B) Proton vermiştir.
   C) Elektron almıştır. D) Elektron vermiştir.

2. Saçlarımızı taradığımız tarağın negatif yükle yüklenmesinin sebebi aşağıdakilerden hangisidir?
   A) Tarağın elektron alması B) Saçlarımızın proton vermesi
   C) Tarağın proton vermesi D) Saçlarımızın elektron alması

3. Elektriklenme sonucunda aşağıdaki cisimlerden hangileri birbirlerini iterler?
   A) Balon - plastik çubuk B) Plastik çubuk - cam çubuk
   C) Cam çubuk - balon D) Cam bardak - plastik çubuk

4. Elektriklenme sonucunda aşağıdaki cisimlerden hangileri birbirlerini çekerler?
   A) Cam çubuk - cam bardak B) Plastik çubuk - balon
   C) Balon - plastik tarak D) Plastik tarak - cam bardak

5.
   I. Artı (+) yüklü cisim
   II. Eksi (-) yüklü cisim
   III. Nötr cisim

   Yüksüz bir elektroskoba bir cisim dokundurulduğunda yapraklar açılıyor. Bu cismin yükü yukarıdakilerden hangileri olabilir?
   A) Yalnız I B) I ve II C) II ve III D) I, II ve III

6. Eksi (-) yüklü bir elektroskop kullanılarak bir cismin yükü belirlenmek isteniyor. Aşağıdakilerden hangisinde elektroskoba dokundurulan cismin yükü yanlış belirlenmiştir?

Elektroskopta neden olduğu değişiklik	Cismin yükü
A) Yapraklar daha çok açılır	-
B) Yapraklar biraz kapanır	+
C) Yapraklar tamamen kapanır	+
D) Yapraklar önce kapanır, sonra açılır	-

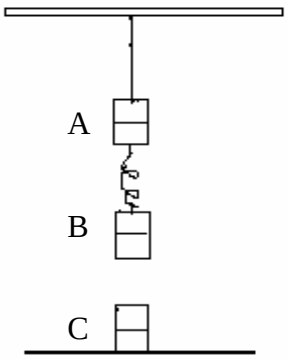
7. Artı (+) yüklü bir elektroskop kullanılarak bir cismin yükü belirlenmek isteniyor. Aşağıdakilerden hangisinde elektroskoba dokundurulan cismin yükü doğu belirlenmiştir?

Elektroskopta neden olduğu değişiklik	Cismin yükü
A) Yapraklar daha çok açılır	-
B) Yapraklar biraz kapanır	Nötr
C) Yapraklar tamamen kapanır	+
D) Yapraklar önce kapanır, sonra açılır	+

8. Selin, eksi yüklü elektroskobun topuzuna artı yüklü bir cisim dokundurduğunda elektroskobun yapraklarının önce kapanıp sonra açıldığını gözlüyor. Bunun nedeni aşağıdakilerden hangisidir?
   A) Elektroskobun yükünün daha büyük olması
   B) Cismin yükünün daha büyük olması
   C) Cisim ile elektroskobun yüklerinin eşit olması
   D) Cisim ile elektroskobun yüksüz olması

9. Aşağıdakilerden hangisinde atomun yapısındaki yüklü parçacıklar verilmiştir?
   A) Proton - nötron
   B) Nötron - elektron
   C) Elektron - proton
   D) Proton - elektron - nötron

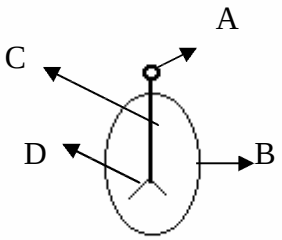
10.



Yandaki şekilde A, B ve C cisimleri özdeştir. Bu cisimlerin yükleri aşağıdakilerden hangisindeki gibi olursa yaydaki uzama en fazla olur?

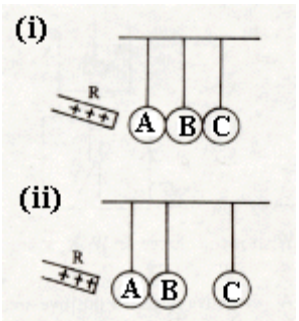
	A	B	C
A)	+	+	-
B)	Nötr	-	+
C)	-	+	-
D)	-	Nötr	+

11.



Yandaki şekilde gösterilen elektroskobun çalışabilmesi için hangi bölümün yalıtkan olması gerekir?
   A) A
   B) B
   C) C
   D) D

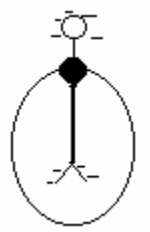
12. Şekil 1 deki A, B ve C çelik küreleri pamuk ipliklere asılı ve birbirleri ile temas halindedir. Pozitif yüklü R çubuğu A küresine dokundurulmadan yaklaştırılmaktadır.



Şekil 2 de, A ve B küreleri temas halinde iken ve R çubuğu hala A küresine yakınken C küresi uzaklaştırılıyor.
Son durumda bu kürelerin yükleri aşağıdakilerden hangisinde doğru olarak verilmiştir.

	A	B	C
A)	-	+	+
B)	Nötr	nötr	nötr
C)	-	nötr	+
D)	-	-	-

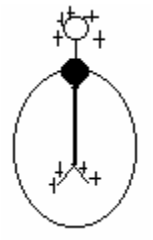
13.



Şekildeki eksi yüklü elektroskop topraklanırsa aşağıdakilerden gerçekleşir?

A) Elektroskobun yaprakları daha çok açılır.
B) Elektronlar toprağa doğru akar.
C) Protonlar elektroskoba doğru akar.
D) Elektroskop pozitif yükle yüklenir.

14.



I. Topuza artı yüklü cisim dokundurmak
II. Topuza negatif yüklü çubuk yaklaştırmak.
III. Elektroskobu topraklamak

Yukarıdakilerden hangileri elektroskobun yapraklarının kapanmasına neden olur??

A) I-II B) I-III C) II-III D) I-II-III

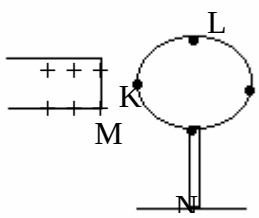
15. Şimşek ve yıldırım sırasında elektron atlamasının gerçekleştiği bölümler aşağıdakilerden hangisinde doğru olarak verilmiştir?

	Şimşek	Yıldırım
A)	Bulut - bulut	bulut - yer
B)	Yer - bulut	bulut - bulut
C)	Bulut - yer	bulut - yer
D)	Bulut - bulut	bulut - bulut

16. Bir öğrenci, iki yüklü cisim arasındaki mesafeleri değiştirerek farklı uzaklıklarda elektriksel kuvveti ölçmektedir. Bu sırada, yük miktarı ve diğer değişkenleri sabit tutmaktadır. Bu öğrenci aşağıdaki sorulardan hangisine cevap aramaktadır?

A) Elektriksel kuvvet yük miktarına bağlı mıdır?
B) Elektriksel kuvvet cisimlerin arasındaki uzaklığa bağlı mıdır?
C) Cisimlerin yük miktarları uzaklıkla nasıl değişir?
D) Cisimlerin arasındaki uzaklık elektriksel kuvvetle nasıl değişir?

17.

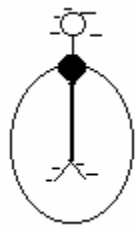


Şekildeki yüksüz küreye artı (+) yüklü bir cisim yaklaştırıldığında kürenin hangi noktasında artı yük toplanır?

A) K
B) L
C) M
D) N

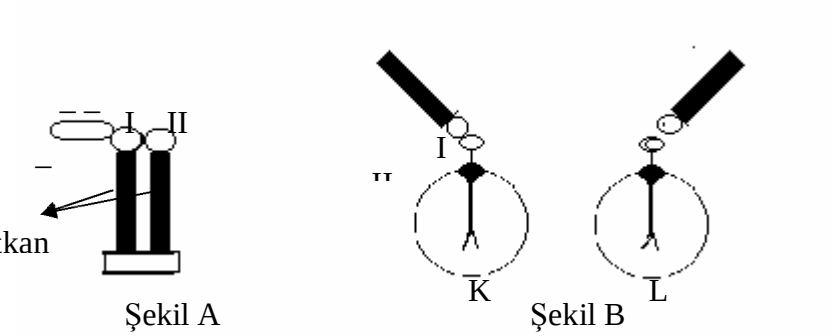
18. A, B ve C küreleri elektrik yüklüdür. A, B küresini itmekte ve C küresini çekmektedir. C küresi artı (+) yüklü olduğuna göre, A ve B kürelerinin yükleri için aşağıdakilerden hangisi doğrudur?

A) A artı, B eksi B) A eksi, B artı
C) A eksi, B eksi D) A artı, B artı

19. 

Yandaki elektroskoba yüklü bir cisim yaklaştırıldığında aşağıdakilerden hangisi gerçekleşir?

A) Yapraklar zıt yükle yüklenir.
B) Elektroskobun yük cinsi değişir.
C) Yapraklar arasındaki açı değişir.
D) Yapraklar aynı yükle yüklenir.

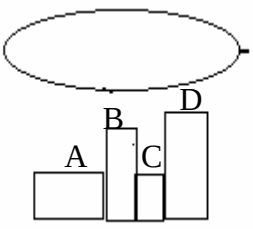
20. 

Şekil A Şekil B

Yüksüz metal iki küre Şekil A daki gibi birbirlerine değecek şekilde duruyorken, eksi (-) yüklü bir metal çubuk I. küreye değdirilip çekiliyor. Daha sonra bu küreler ayrılarak şekil B deki gibi birincisi K elektroskobuna dokundurulurken, ikincisi de L elektroskobunun topuzuna dokundurulmadan yaklaştırılıyor. Buna göre, elektroskopların yapraklarının son durumda yükleri aşağıdakilerden hangisinde doğru verilmiştir?

	K	L
A)	-	+
B)	+	-
C)	-	-
D)	-	Nötr

21. Yandaki şekilde yıldırım düşme olasılığı fazla olan nokta aşağıdakilerden hangisidir?



A) A
B) B
C) C
D) D

22. Yıldırım oluşumu sırasında sırasıyla gerçekleşen elektriklenme türleri aşağıdakilerden hangisinde doğru olarak verilmiştir?

A) Dokunma - etki B) Sürtünme - etki
C) Dokunma - sürtünme D) Etki sürtünme

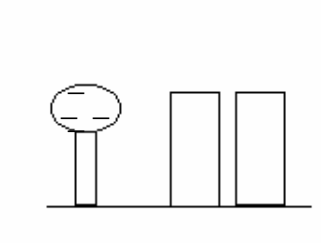
23.
I. Plastik tarak
II. Tuzlu su
III. Tahta kaşık
IV. Cam kase
Yukarıdakilerden hangileri elektrik akımını iletmez?
A) Yalnız IV B) I - II - IIII C) II - IV D) I - III - IV

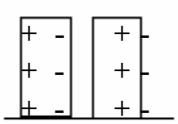
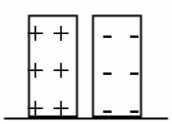
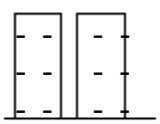
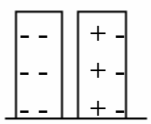
24. A küresi artı, B küresi eksi yüklüdür ve her ikisi de iletkendir. Bu küreler birbirlerine dokundurulup ayrılıyor. Son durumda, bu kürelerin yükleri aşağıdakilerden hangisindeki gibi olamaz?
A) İkisininki de eksi B) İkisininki de artı
C) A artı, B eksi D) İkisininki de nötr

25. Bir atomun yapısındaki proton, nötron ve elektronların yükleri ile ilgili aşağıdakilerden hangisi doğrudur?

	Proton	Nötron	Elektron
A)	+	+	-
B)	-	Nötr	+
C)	+	Nötr	-
D)	Nötr	-	-

26. Bir öğrenci, elektriklenen plastik tarak ile balonun birbirlerini ittiğini gözlemledikten sonra, aynı deneyi plastik tarak ve cam çubukla tekrarlayarak bu cisimlerin birbirlerini çektiğini gözlüyor. Buna göre bu öğrenci aşağıdaki soruların hangisine cevap aramaktadır?
A) Elektriklenen balon ile plastik tarak birbirlerini iterler mi?
B) Elektriklenen plastik tarak ile cam çubuk birbirlerini çekerler mi?
C) Elektriklenen cisimlerin birbirlerini itip çekmeleri,maddelerin cinsine bağlı mıdır?
D) İtme ve çekme kuvvetinin büyüklüğü elektriklenen cisimlerin cinslerine bağlı mıdır?

27. 
Şekildeki eksi (-) yüklü küre, iletken levhalardan birincisine dokundurulup uzaklaştırılıyor. Son durumda levhaların yükleri aşağıdakilerden hangisindeki gibi olur?

A) 
B) 
C) 
D) 

Tablo A.1: Fen Bilgisi Dersi 6. Sınıf Yaşamımızı Yönlendiren Elektrik Ünitesi Durgun Elektrik Konusu Fen Bilgisi Başarı Testi Belirtke Tablosu

FEN BİLGİSİ 6. SINIF DURGUN ELEKTRİK KONUSU BELİRTKE TABLOSU													
ALANLAR	BİLİŞSEL ALAN												
	BİLGİ		KAVRAMA										
	Atomun yapısından hareketle elektriklenmede protonların ve elektronların oynadığı rolü açıklar	Sürterek cisimleri elektrikler ve elektriklenmeye çevresinden örnekler verir.	Elektrik yüklü cisimlerin etkileşerek birbirlerini itip çektiklerini gösterir	Doğada zıt yüklere sahip iki tür elektrik yükü olduğunu fark eder.	Elektrik yüklü iki cismin birbirini nasıl ittiğini ya da çektiğini açıklar	Bir cismin elektrik yüklü olup olmadığını elektrik yüklüyse yükün türünü belirler	Cisimlerin artı elektrik yüklü, eksi elektrik yüklü ve yüksüz (nötr) olmalarının ne anlama geldiğini açıklar	Sürtme esnasında cisimlerin nasıl artı yüklü yada eksi yüklü hale geldiklerini açıklar	Cisimleri dokunmayla elektrikler ve dokunmayla elektriklenmenin nasıl olduğunu açıklar	Cisimleri etkiyle elektrikler ve etkiyle elektriklenmenin nasıl olduğunu açıklar	Elektrik yüklerinin hareketine bağlayarak maddeleri sınıflandırır, iletken ve yalıtkanlara örnekler verir	Şimşek ve yıldırımın atmosferdeki doğal elektriklenme olayları olduğunu fark eder; bunları şekil çizerek açıklar ve korunma yollarına örnekler verir	TOPLAM
Elektrikle İlk Tanışma: Cisimlerin Elektriklenmesi		* *											2
Elektrik Yükleri Arasında İtme ve Çekme			* *					*					3
İki Tür Elektrik: Artı ve Eksi Yükler				*	*		*	*					4
Elektriğin Kaynağı: Maddenin Temel Taşı Atomlar	* *												2
Dokunma ve Etki ile Elektriklenme						* *			* * * * *	* * * * *			11
İletken ve Yalıtkan Maddeler											* *		2
Atmosferde Doğal Elektriklenme: Şimşek, Yıldırım												* * *	3
TOPLAM	2	2	2	1	1	2	1	2	5	4	2	3	27

APPENDIX C

FEN BİLGİSİ TUTUM ÖLÇEĞİ

YÖNERGE

Orta Doğu Teknik Üniversitesi Fen Bilimleri Enstitüsü'nde yapılmakta olan bir araştırma için İlköğretim II. kademede okuyan öğrencilerle ilgili birtakım kişisel bilgilere ve Fen Bilimlerine yönelik tutumlarına ilişkin bilgilere ihtiyaç duyulmaktadır. Bu amaçla düzenlemiş olduğum anket iki bölümden oluşmaktadır.

İlk bölümde kişisel bilgiler, ikinci bölümde Fen Bilimlerine yönelik tutumlar yer almaktadır. Lütfen her soruyu dikkatli okuyarak cevaplandırınız. Ankette verdiğiniz bilgiler yalnızca araştırma amaçlı kullanılacak olup, kesinlikle gizli tutulacaktır. Araştırmanın geçerliği açısından cevaplarınızın doğru ve eksiksiz olması zorunludur. Anketi doldururken lütfen atlanmış soru bırakmamaya ve tüm soruları eksiksiz cevaplandırmaya özen gösteriniz. Katkılarınızdan dolayı şimdiden teşekkür ederim.

Aydın AKBAŞ

I. KİŞİSEL BİLGİLER

Aşağıdaki sorularda size uygun gelen yanıtı yuvarlak içine alınız.

1. Adınız, soyadınız: .....
2. Cinsiyetiniz:
   A) Kız B) Erkek

3. Sınıfınız:

4. Hangi ilköğretim okulunda okuyorsunuz?
   A) İlköğretim B) Kolej

5. Anne ve babanızın durumu nasıldır?
   A) Anne sağ, baba ölü
   B) Anne ölü, baba sağ
   C) Anne ve baba ölü
   D) Anne ve baba sağ – birlikte
   E) Anne ve baba sağ – ayrı

6. Babanızın eğitim düzeyi nedir?
   A) Okur yazar değil B) İlkokul C) Ortaokul D) Lise
   E) Üniversite F) Yüksek lisans / Doktora

7. Annenizin eğitim düzeyi nedir?
   A) Okur yazar değil B) İlkokul C) Ortaokul D) Lise
   E) Üniversite F) Yüksek lisans / Doktora

8. Siz hariç kaç kardeşsiniz? (Sizden büyük ve küçük olanlar dahil)
   A) Kardeşim yok B) 1 C) 2-3 D) 4-5
   E) 6 ve üstü

9. Ailenizin aylık geliri ne kadardır?
   A) 500 milyondan az B) 500 milyon – 1 milyar
   C) 1 milyar – 2 milyar D) 2 milyardan fazla

10. Aileniz nerede yaşıyor?
    A) Büyük şehir B) Şehir C) Kasaba D) Köy

11. Siz nerede yaşıyorsunuz?
    A) Ailemle birlikte B) Yurtta C) Akrabalarımda D) Diğer

12. Kaldığınız yerde çalışmak için ayrı odanız var mı?
    A) Evet B) Hayır

13. Kendinize ait ders kitaplarınız dahil ortalama kaç kitabınız var?
    A) 0 – 10 B) 11 – 24 C) 25 – 100 D) 100'den fazla

14. Ders çalışmaya ve ödevlerinize hergün ne kadar zaman ayırıyorsunuz?
    A) Hemen hiç B) 1 saat ve daha az C) 2 – 3 saat
    D) 4 – 5 saat E) 6 saat ve daha fazla

II. FEN BİLİMLERİNE YÖNELİK TUTUM ÖLÇEĞİ

Aşağıda Fen Bilimlerine yönelik tutumlar ile ilgili 47 cümle bulunmaktadır. Lütfen cümleleri dikkatlice okuyarak size uygun olan tek bir yanıtı (x) ile işaretleyin.

		Kesinlikle katılıyorum	Katılıyorum	Hiçbir fikrim yok	Katılmıyorum	Kesinlikle
1.	Fen Bilgisini öğrenebileceğimden eminim.					
2.	Öğretmenlerim Fen Bilgisinde ilerlememle ilgilenirler.					

		Kesinlikle katılıyorum	Katılıyorum	Hiçbir fikrim yok	Katılmıyorum	Kesinlikle katılmıyorum
3.	Fen Bilgisini bilmek hayatta kazanmama yardımcı olacaktır.					
4.	Fen Bilgisinde ilerleyebileceğimi düşünmüyorum.					
5.	Fen Bilgisi iş hayatımda önemli olmayacak.					
6.	Erkekler Fen Bilgisinde bayanlardan daha başarılı değildir.					
7.	Fen Bilgisinde beni ciddiye alacak öğretmen bulmak zordur.					
8.	Fen Bilgisi benim için zordur.					
9.	Bayanların Fen alanında bir dahi olabileceğine inanmak çok zor.					
10.	İleri ki işlerimde Fen Bilgisine ihtiyacım olacak.					
11.	Bir bayan, bilimsel bir problem çözmek zorundayken, bir erkeğin yardımını almalıdır.					
12.	Fen Bilgisinde kendimden eminimdir.					
13.	Okuldan çıktıktan sonra Fen Bilgisini fazla kullanmayı beklemiyorum.					
14.	Fen Bilgisi öğretmenlerimle, bilimi kullanabileceğim bir gelecek hakkında konuşurum.					
15.	Fen Bilgisini bayanlar erkekler kadar yapabilirler.					
16.	Fen Bilgisi öğretmenlerimin bana saygı duymaları zordur.					
17.	Fen Bilgisi gerekli, faydalı bir konudur.					
18.	Fen Bilgisi dersinde bir problemin çözümü konusunda, erkeklere bayanlardan daha çok güvenirim.					
19.	Fen Bilgisinde başarılı olabilecek biri değilim.					
20.	Öğretmenlerim Fen Bilgisinde daha çok çalışmam konusunda beni cesaretlendirirler.					
21.	Fen Bilgisini öğrenmek zamanı boşa harcamaktır.					
22.	Öğretmenlerimle Fen Bilgisi ile ilgili ciddice konuşacak zamanım yok denecek kadar azdır.					
23.	Fen Bilgisi en kötü dersimdir.					
24.	Fen Bilgisi çalışmayı seven bayanlar biraz farklıdır.					
25.	Fen Bilgisinde daha zoruyla başa çıkabileceğimi düşünüyorum.					
26.	Öğretmenlerim ileri düzeyde Fen Bilgisi öğrenimini benim için zaman kaybı olarak görürler.					
27.	Fen Bilgisini, bir yetişkin olarak birçok alanda kullanacağım.					

		Kesinlikle katılıyorum	Katılıyorum	Hiçbir fikrim yok	Katılmıyorum	Kesinlikle katılmıyorum
28.	Bayanlar, Fen Bilgisinde erkekler kadar iyidirler.					
29.	Fen Bilgisini, okuldan çıktıktan sonra sık kullanmayacağım bir alan olarak görüyorum.					
30.	Fen Bilgisi öğretmenlerimin, ciddi bir şey hakkında konuştuğumda beni görmezden geldiklerini düşünüyorum					
31.	Bayanların, Fen Bilgisini yapabilmek için yetenekleri yeterlidir.					
32.	Her işle başa çıkabilirim, ancak Fen Bilgisi ile ilgili bir işte başarılı olamam.					
33.	Fen Bilgisi dersinde iyi notlar alabilirim.					
34.	Gelecekteki hayatımda Fen Bilgisini iyi anlamış olmam gerekir.					
35.	Öğretmenlerim Fen Bilgisinde yapabileceğimin en iyisini bekliyorlar.					
36.	Bilimle uğraşan bir bayanın, diğerlerinden daha güçlü bir birey olmasını beklerim					
37.	Fen Bilgisini iyi yapabileceğime inanıyorum.					
38.	Erkeklerde olduğu kadar bayanlar içinde Fen Bilgisine çalışmak iyidir.					
39.	Geleceğim için Fen Bilgisinde başarılı olmak önemli değildir.					
40.	Fen Bilgisi ile sadece kariyer için ilgilendiğimi söylersem öğretmenlerim beni ciddiye almazlar.					
41.	Fen Bilgisinde ileri düzeyde çalışabileceğimden eminim.					
42.	Fen Bilgisi hayatım için önemli değildir.					
43.	Fen Bilgisinde iyi değilim.					
44.	Fen Bilgisine faydalı olduğunu bildiğim için çalışıyorum.					
45.	Fen Bilgisi öğretmenlerim, Fen Bilgisinde ilerleyebilecek yeteneğe sahip olduğumu hissetmemi sağlarlar.					
46.	Önemli Fen Bilgisi problemlerini çözme konusunda erkeklere güvendiğim kadar bayanlara da güvenirim.					
47.	Fen Bilgisi öğretmenlerim, Fen Bilgisi dersini iyi yapabilecek biri olduğumu düşünürler.					

APPENDIX D

GÜNLÜK DERS PLANI ÖRNEĞİ I

ÇOKLU ZEKA TEORİSİNE DAYALI DERS PLANI - SINIF İÇİ AKTİVİTELER

SINIF **:** 6
DERS **:** Fen Bilgisi
ÜNİTE **:** Yaşamımızı Yönlendiren Elektrik
SÜRE **:** 40'
TARİH **:** .....
KONU **:** Çevremizdeki Elektrik, Elektrikle İlk Tanışma: Cisimlerin Elektriklenmesi

HEDEF VE DAVRANIŞLAR:

- Elektriklenme çeşitlerini gözlemlerle, uygulamalarla, deneylerle ve farklı etkinliklerle kavrayabilme.
    - Çevresinden elektrikle ilgili örnekler verir.
    - Sürterek cisimleri elektrikler ve elektriklenmeye çevresinden örnekler verir.

DERS ÖNCESİ HAZIRLIK:
Ebonit çubuk, şişirilmiş balon, yün kumaş, kağıt parçaları, musluklu lavabo, çalışma kağıtları.

ÖĞRENME-ÖĞRETME YAŞANTILARI:

Sözel / Dilsel Etkinlikler, Mantıksal / Matematiksel, Görsel / Uzamsal Etkinlikler:
DİKKAT ÇEKME:

ÇELİK'İN SERÜVENLERİ

1. Çelik Nasıl Doğdu?

   Elektrik hayatımızın vazgeçilmez bir parçasıdır. Elektrik kullanımı ülkemizde son 25-30 yıl içerisinde yaygınlaştı. Daha 30 yıl öncesine kadar ülkemizin çoğu bölgelerinde insanlar mum ile aydınlanırken, bugün elektrikler bir saat kesilse bile hayatımız felç oluyor.

Elektriğin kullanımı o kadar yaygınlaştı ki, yaşamımızın her alanında elektrikli aletler kullanıyoruz. Gelişen teknoloji sayesinde artık tüm işlemlerimizi yapabilecek, elektrikle çalışan robotlar bile üretiliyor. İşte 2000'li yılların başında üretilen robotların en sevimlisi: Adı ÇELİK!...

Çelik, geçtiğimiz yıl elektrikli alet üreten bir firma tarafından üretildi. Çelik, yürüyor, koşuyor, dans ediyor, fakat! Elektrik olmadan adım bile atamıyor!...

DERSE GEÇİŞ: Şimdi hep birlikte elektriğin önemini görecek, aslında her gün iç içe olduğumuz elektriği daha yakından tanıyacağız.

a) Öğrencilere,

- Elektrik kesildiği zaman hangi işlerimiz aksar?
- Elektrikle çalışan aygıtları listeleyiniz.
- Elektrik nereden gelir? gibi sorular sorunuz. Öğrencinin elektriği bir

gün içerisinde nasıl kullandıklarını anlatmalarını isteyiniz. Öğrencilere ***elektriğin günlük yaşantıdaki önemini*** ve ***yaygın kullanımını*** fark ettiriniz.

b) Şişirilmiş balonu yün kumaşa sürtünüz ve duvara yaklaştırınız. Elektriklenen balonun duvara yapışmasını sağlayınız ve öğrencilerin bu olayın nedenini düşünmelerini isteyiniz. Balonu tekrar elektriklendirerek masada önceden hazırladığınız kağıt parçalarına yaklaştırınız. Öğrencilerin kağıt parçalarının hareketlerini gözlemelerini sağlayınız. Öğrencilerden günlük yaşantılarından buna benzer örnekler vermelerini isteyiniz.
Öğrencilerin, elektriklenmiş balonun duvara yapışması, elektriklenmiş balonun kağıtları çekmesi etkinliklerinde gözlemlediklerini şekille göstermelerini sağlayınız.

Bedensel / Kinestetik, Müziksel / Ritmik, Kişilerarası Etkinlikler:
Öğrencileri dörderli gruplara ayırınız. Her gruba birer ebonit çubuk ve yün kumaş veriniz. Ebonit çubuğu, yün kumaşa veya saçlarına sürttükten sonra sicim gibi akan suya yaklaştırmalarını isteyiniz. Her grubun gözlemlediklerini birkaç cümle ile yazmalarını isteyiniz. Grupların yazdıklarını toplayarak birbirlerine okutunuz. Öğrencilerin elektriklenme sırasında çıkan sesleri taklit etmelerini isteyiniz. Öğrenciler çalışırken kısık sesle klasik müzik dinletiniz.

<u>Doğa Zekası Etkinlik:</u>
Öğrencilerden, doğada bildikleri cisimleri elektriklenebilen ve elektriklenemeyen olarak kategorilere ayırmalarını isteyiniz.

<u>İçsel Etkinlik:</u>
Ekteki çalışma kağıdını öğrencilere dağıtarak herkesin 10 dakika kendi kendilerine düşünerek alıştırmaları yapmalarını sağlayınız.

ÇALIŞMA KAĞIDI

1. Aşağıdaki cümleyi uygun şekilde tamamlayınız.
   "Basketbol oynadıktan sonra tokalaşmak isteyen iki arkadaşın elleri arasında elektriklenme olayı gerçekleşti. Çünkü ...

2. Laboratuarda elektriklenme olayını gözlemleyebilmek için farklı olarak ne gibi etkinlikler yapılabilir? Açıklayınız. (Şekil çizebilirsiniz.)

3. Sürtünme ile elektriklenme deneyini farklı cins demir çubukla yapsaydık nasıl sonuçlarla karşılaşırdık?

4. Elektriklenme olayı olmasaydı dünyada ne gibi değişiklikler olurdu?

GÜNLÜK DERS PLANI ÖRNEĞİ II

ÇOKLU ZEKA TEORİSİNE DAYALI DERS PLANI - SINIF İÇİ AKTİVİTELER

SINIF **:** 6
DERS **:** Fen Bilgisi
ÜNİTE **:** Yaşamımızı Yönlendiren Elektrik
SÜRE **:** 40'
TARİH **:** .....
KONU **:** Elektrik Yükleri Arasında İtme ve Çekme

HEDEF VE DAVRANIŞLAR:

- Elektrik yükleri arasında itme ve çekme kuvvetlerini gözlemlerle, uygulamalarla, deneylerle ve farklı etkinliklerle kavrayabilme.
    - Elektrik yüklü cisimlerin etkileşerek birbirlerini itip çektiklerini gösterir.
    - Elektrik yüklü iki cismin birbirini nasıl ittiğini yada çektiğini açıklar

DERS ÖNCESİ HAZIRLIK:
İp, döküm ayak, bağlantı parçası, plastik çubuk, plastik tarak, cam çubuk, yünlü kumaş, ipekli kumaş balon, kaset çalar, klasik müzik kaseti, çalışma kağıdı.

ÖĞRENME-ÖĞRETME YAŞANTILARI:

Sözel / Dilsel Etkinlikler, Mantıksal / Matematiksel, Görsel / Uzamsal Etkinlikler:
2- Çelik Bekçi Sırrı'yla Tanışıyor

Çelik üretildikten sonra fabrikada ona çeşitli görevler verilmişti. Robot Çelik, bu işleri gece gündüz çalışarak yapıyordu. Nasıl olsa bizim gibi enerji elde etmek için beslenme gibi bir sorunu yoktu. Elektrikle çalışan bur robot bir kez şarj edildi mi bu enerji ona bir ay yetiyordu. Kasları da yoktu. Bu nedenle, kaslarında laktik asit birikmesi söz konusu olamazdı ve Çelik hiç yorulmuyordu.

Çelik, hiç durmadan çalışmaya devam ederken fabrikanın güvenlik görevlisi Bekçi Sırrı ile karşılaştı ve aralarında hepimizin severek izlediği diyalog gerçekleşti:
------Canlandırma

Bir canlı, bir cansızla anlaşabilir miydi? Başlangıçta birbirlerinden korktular, ama sonra çok iyi dost oldular. Birbirlerinin can yoldaşı oldular soğuk fabrika gecelerinde.

İşte bir canlı bir cansızla yakınlaşmıştı. Tıpkı elektrik yükleri gibi! Zıt elektrik yükleri de birbirlerini böyle çekerler.
DERSE GEÇİŞ: Şimdi bu derste, zıt elektrik yüklerinin birbirini nasıl çektiğini hep beraber göreceğiz.

İp, döküm ayak, bağlantı parçası kullanarak plastik çubuk ve plastik tarağı asınız. Plastik çubuk ile plastik tarağı yün kumaşa sürterek elektriklendiriniz. Elektriklenen bu cisimleri birbirine yaklaştırınız. Aynı etkinliği cam çubuk ve deney tüpünü elektriklendirerek tekrarlayınız. Tahtaya çağırdığınız öğrencilerle aynı etkinliği cam çubuk ve plastik tarağı elektriklendirerek tekrarlayınız.
Öğrencilerden elektriklenen cisimlerden hangilerinin birbirini ittiğini, hangilerinin birbirini çektiğini şekille göstermelerini isteyiniz.
Öğrencilerden, aynı elektrik yükü ile yüklenen ve farklı elektrik yükü ile yüklenen cisimlerin arasındaki etkileşimin yazı ile ifade etmelerini isteyiniz.

Bedensel / Kinestetik, Müziksel / Ritmik, Kişilerarası Etkinlikler:
Öğrencileri dörderli gruplara ayırınız. Her gruba ikişer cam çubuk, yünlü kumaş, ipekli kumaş ve balon veriniz. Önce şişirilmiş balonları yün kumaşa sürterek elektriklendirmelerini birbirlerine yaklaştırmalarını isteyiniz. Aynı işlemi balon ve cam çubukla tekrarlamalarını isteyiniz. Her grubun gözlemlediklerini not etmelerini isteyiniz. Her grubun yazdıklarını toplayıp başka gruplara dağıtarak kendi yazdıkları ile karşılaştırmalarını sağlayınız. Öğrenciler çalışırken kısık sesle klasik müzik dinletiniz.

<u>Doğa Zekası Etkinlik:</u>
Doğada birbirini iten veya çeken varlıkların listelenmesi.

<u>İçsel Etkinlik:</u>
Ekteki çalışma kağıdını öğrencilere dağıtarak herkesin 5 dakika kendi kendilerine düşünerek alıştırmaları yapmalarını sağlayınız.

ÇALIŞMA KAĞIDI

1. Serap, aynı cins elektrik yüküyle yüklenmiş cisimlerin birbirini ittiğini göstermek için bir deney yapmak istiyor. Aşağıdaki seçeneklerde verilenlerden hangi ikisi bu deney için uygundur? Daire içine alarak gösteriniz.

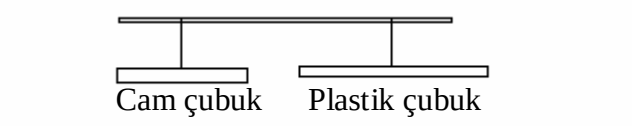
a) Beher bardağı - balon - deney tüpü - demir çubuk

b) Balon - cam çubuk - plastik çubuk - tahta

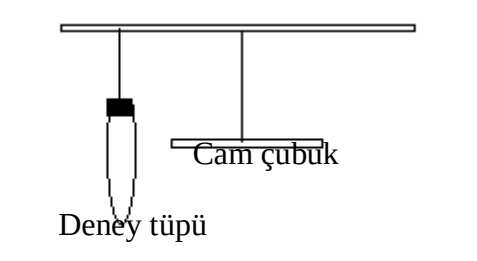
c) Plastik çubuk - cam çubuk - tahta - deney tüpü

2. Aşağıdaki cisimler elektriklenmiş olduğuna göre, bu cisimler arasındaki etkileşimi oklarla gösteriniz.

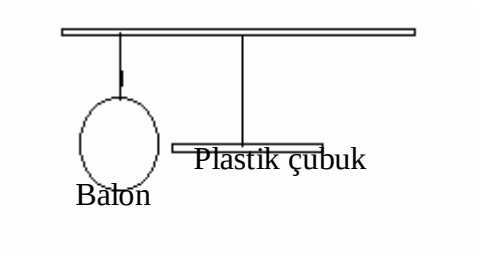
a)



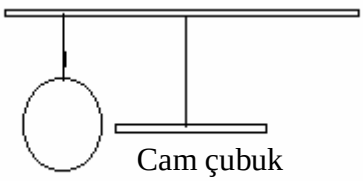
b)



c)



d)



GÜNLÜK DERS PLANI ÖRNEĞİ III

ÇOKLU ZEKA TEORİSİNE DAYALI DERS PLANI - SINIF İÇİ AKTİVİTELER

SINIF : 6
DERS : Fen Bilgisi
ÜNİTE : Yaşamımızı Yönlendiren Elektrik
SÜRE : 40'
TARİH : .....
KONU : Elektrik Yükleri Arasında İtme ve Çekme

HEDEF VE DAVRANIŞLAR:

- Elektrik yükleri arasında itme ve çekme kuvvetlerini gözlemlerle, uygulamalarla, deneylerle ve farklı etkinliklerle kavrayabilme.
    - Doğada zıt özelliklere sahip iki tür elektrik yükü olduğunu fark eder.
    - Bir cismin elektrik yüklü olup olmadığını ve elektrik yüklüyse yükün türünü belirler.

DERS ÖNCESİ HAZIRLIK:

Elektroskop, cam ve plastik çubuk, ipekli ve yünlü kumaş, asetat film, çalışma kağıtları

ÖĞRENME-ÖĞRETME YAŞANTILARI:

Sözel / Dilsel Etkinlikler, Mantıksal / Matematiksel, Görsel / Uzamsal Etkinlikler:
DİKKAT ÇEKME:
3- Çelik Aşık Oluyor!

Çelik, Bekçi Sırrı ile çok iyi anlaşıyordu. Fakat bir robot olarak da kendini dünyada yalnız hissediyordu. Bu durum Bekçi Sırrı tarafından yetkili kişilere iletildi. Yetkililer bu durumu gözden geçirerek bu sefer dişi bir robot ÇİLEK'İ ürettiler.

Çelik, Çilek'e bir anda aşık olmuştu. Fabrikada Bekçi Sırrı ile yalnızlığını paylaşacak, üstelik dişi bir robot olması onu çok çok memnun etmişti. Doğanın kanunu olan, dişi ve erkeklerin birbirlerine ilgi duyması cansız robotlar için bile geçerliydi.

Elektrik yükleri de işte böyledir. Dişi ve erkek gibi, elektrik türleri de iki türdür. Artı ve eksi. Artı yükler, eksi yüklere ilgi duyarlar, eksi yükler de artı yüklere.

Artı yükler artı yükleri iter, eksi yükler de eksi yükleri iter. Zıt yükler birbirlerini çeker.

DERSE GEÇİŞ: Şimdi artı ve eksi yükler arasındaki etkileşimleri hep birlikte öğrenelim!

Önceki derste yapılan etkinliklere dayanarak hangi cisimlerin birbirini itip hangilerinin birbirini çektiğini hatırlatınız. Cam çubuk ve plastik çubuğun zıt yüklerle yüklendiğini, cam çubuktaki yüke (+), plastik çubuktaki yüke (-) adlarının verildiğini açıklayınız. Artı ve eksi yükler arasındaki etkileşimi yazı ile ifade etmelerini isteyiniz.

Öğrencilere ilk defa elektriklendirecekleri asetat filmin yük türünü nasıl belirleyebileceğinizi tartışınız. Sonuç olarak yükü bilinen bir cisimden faydalanılması gerektiğini belirtiniz. Yükü bilinen bir cisim kullanılarak yükü bilinmeyen cisimlerin yük türünün belirlenebileceği ve elektroskopların bu amaç için kullanıldığını belirtiniz. Elektroskobu tanıtınız.

Bedensel / Kinestetik, Müziksel / Ritmik, Kişilerarası Etkinlikler:

Öğrencileri dörderli gruplara ayırınız. Her gruba elektroskop, cam çubuk, ipekli kumaş, plastik çubuk, yünlü kumaş, asetat film dağıtınız. Asetat filmi elektriklendirmelerini ve plastik çubuk ile yünlü kumaş kullanarak eksi (-) yükle yükledikleri elektroskoba dokundurmalarını isteyiniz. Sonuçları not etmelerini isteyiniz. Aynı işlemi cam çubuk ile ipekli kumaş kullanarak artı (+) yükle yükledikleri elektroskop ile tekrarlamalarını isteyiniz.

Gözlemler sonucunda grupların eksi ve artı yüklerle yüklü elektroskop kullanarak asetat filmin hangi tür yükle yüklendiğini bulmalarını isteyiniz. Her grubun yazdıklarını toplayıp başka gruplara dağıtarak kendi yazdıkları ile karşılaştırmalarını sağlayınız. Öğrenciler çalışırken kısık sesle klasik müzik dinletiniz.

Doğa Zekası Etkinlik:

Doğada, zıt olup birbirine uyan (zıtlıkların bütünlüğü, siyah - beyaz, erkek - dişi), aynı olup birbiri ile uyuşmayan (bazı hayvan türlerinde erkek bireylerin birbirlerini öldürmeleri) varlıkların listelenmesi.

İçsel Etkinlik:

Ekteki çalışma kağıdını öğrencilere dağıtarak herkesin 5 dakika kendi kendilerine düşünerek alıştırmaları yapmalarını sağlayınız.

ÇALIŞMA KAĞIDI

1. Aşağıdaki elektrik yükleri arasındaki etkileşim oklarla gösterilmiştir. Buna göre diğer seçeneklerdeki cisimler arasındaki etkileşimi aynı şekilde gösteriniz.

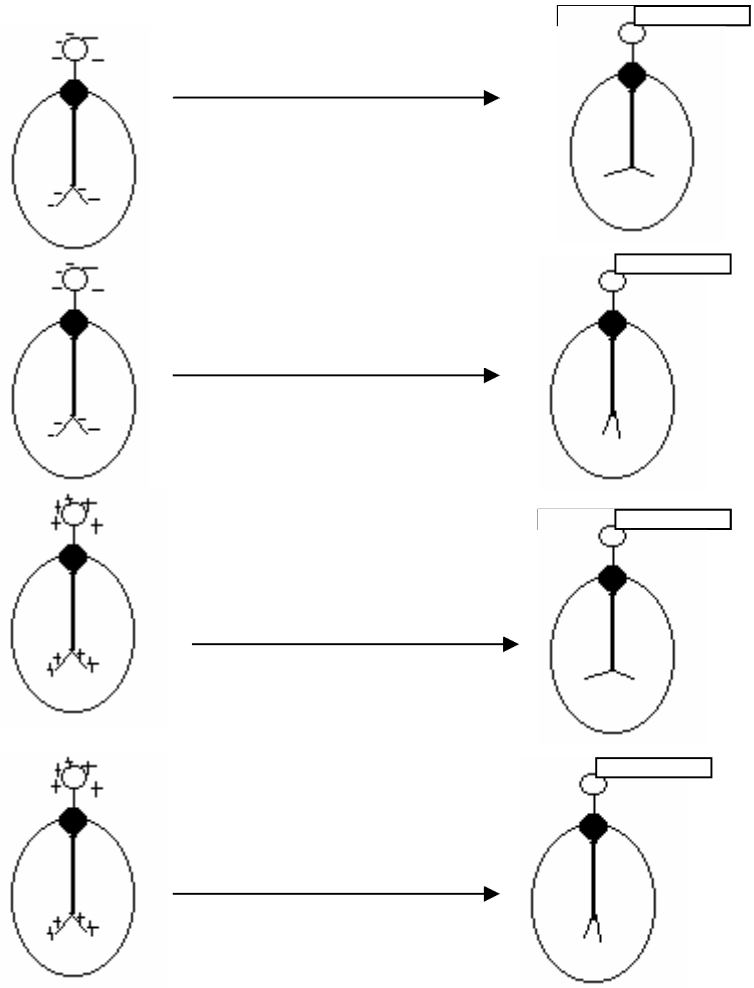
a) 

b) 

c) 

d) 

2. Aşağıdaki durumlarda elektroskoptaki değişimlerden yararlanarak yaklaştırılan cismin yükünün ne olduğunu bulunuz.



GÜNLÜK DERS PLANI ÖRNEĞİ IV

ÇOKLU ZEKA TEORİSİNE DAYALI DERS PLANI - SINIF İÇİ AKTİVİTELER

SINIF **:** 6
DERS **:** Fen Bilgisi
ÜNİTE **:** Yaşamımızı Yönlendiren Elektrik
SÜRE **:** 40'
TARİH **:** .....
KONU **:** Elektriğin Kaynağı: Maddenin Temel Taşı Atomlar

HEDEF VE DAVRANIŞLAR:

- Elektriğin kaynağının atom altı parçacıklar olduğunu gözlemlerle, uygulamalarla, deneylerle ve farklı etkinliklerle kavrayabilme.
    - Atomun yapısından hareketle elektriklenmede protonların ve elektronların oynadığı rolü açıklar
    - Cisimlerin artı elektrik yüklü, eksi elektrik yüklü ve yüksüz (nötr) olmalarının ne anlama geldiğini açıklar.
    - Sürtme esnasında cisimlerin nasıl artı yüklü yada eksi yüklü hale geldiklerini açıklar.

DERS ÖNCESİ HAZIRLIK:

İpekli ve yünlü kumaşlar, cam plastik çubuklar, asetat film (atomun yapısı), tepegöz, çalışma kağıtları.

ÖĞRENME-ÖĞRETME YAŞANTILARI:

Sözel / Dilsel Etkinlikler, Mantıksal / Matematiksel, Görsel / Uzamsal Etkinlikler:

DİKKAT ÇEKME:

4- Çelik Soruyor: Elektrik Nereden Geliyor?

Kahramanımız Çelik'in keyfi yerindeydi. Bekçi Sırrı ve Çilek ile güzel vakit geçiriyordu. Fakat bir şey kafasını çok fazla kurcalıyordu. Her gün elektrikle çalışan binlerce aletin üretildiği bir yerdeydi, hatta kendisi de elektrikle çalışıyordu. Fakat elektrik nereden geliyordu, nasıl bir şeydi?Elle tutulabilir miydi? Bu konuyu Bekçi Sırrı ile paylaşmak istedi:

Çelik: Sırrı! Bu kadar aleti çalıştıran elektrik nasıl bir şey? Nereden geliyor? Çok merak ediyorum.

Bekçi Sırrı: Vallahi Çelik Kardeş, ben bu işlerden pek anlamam. Okuldan hatırladığım kadarıyla elektrik barajlarda, elektrik santrallerinde üretiliyor. Ama nasıl ortaya çıkıyor? Pek bilmiyorum.

Çelik bunu öğrenmekte kararlıydı. Onu Mühendis Kemal şu sözlerle aydınlattı:

"Bak çelik, ben, sen, gördüğün ve göremediğin tüm maddeler atom dediğimiz taneciklerden oluşuruz. Bu atomların yapısında da proton, nötron ve elektron dediğimiz parçacıklar vardır. Artı yüklü protonlar ile yüksüz nötronlar atomun merkezindeki çekirdektedirler. Eksi yüklü elektronlar ise çekirdeğin etrafında çok hızlı bir şekilde dönerler. Aynı Güneş ve etrafında dönen gezegenler gibi. Proton ve nötronlar çekirdekten hiç ayrılmazlar. Elektronlar ise, atomdan kolayca ayrılıp başka atomlara geçebilirler. Böylece atomların yük dengesi bozulur, elektronların hareketi ile elektrik oluşur. Kısacası Çelik, elektrik madde olan her yerde, sende, bende içimizdedir!"

Çelik Mühendis Kemal'e teşekkür ederek oradan ayrıldı.

DERSE GEÇİŞ: Şimdi elektriğin kaynağı, atomları birlikte öğrenelim.

Bir parça bakır teli ikiye bölünüz. Bu işlemi çok küçük bir tel parçası elde edene kadar devam ettiriniz. Bu işlemi öğrencilerin düşüncelerinde devam ettirmelerini isteyiniz ve atom kavramına ulaşınız. Bakır atomundan hareketle her maddenin bakır gibi atomlardan oluştuğunu ve her atomun proton, nötron ve elektron denilen üç temel parçacıktan oluştuğunu açıklayınız.

Atomun yapısını tahtada (veya tepegözde) şekil ile gösteriniz ve öğrencilerin bu şekli defterlerine çizmelerini sağlayınız. Atomun yapısındaki parçacıkların kütlelerini ve yüklerini sayısal değer vermeden belirtiniz.

Bir cismin yükünü, atomların yapısında yer alan yüklü parçacıklardan proton ve elektronların toplam sayısının belirlediğini açıklayarak, sınıftaki erkeklerin atomun yapısındaki eksi yüklere, kızların atomun yapısındaki artı yüklere benzetilerek sınıfın yükünün hesaplanmasını sağlayınız. Proton fazlalığının (kızların fazla olması) cismi artı (+), elektron fazlalığının (erkeklerin fazla olması) cismi eksi yükle yüklediğinin, proton ve elektron sayısının eşit olması halinde (kız-erkek sayılarının eşit olması) cismin nötr (yüksüz) olduğunu benzetme yaparak açıklayınız. Kız-erkek sayılarına göre hangi sınıfların artı, hangilerinin eksi, hangilerinin yüksüz olarak düşünülebileceğini araştırmalarını isteyiniz.

Bedensel / Kinestetik, Müziksel / Ritmik, Kişilerarası Etkinlikler:

Öğrencileri dörderli gruplara ayırınız. Gruplardan bir kısmına cam çubuk ve ipekli kumaş, diğer kısmına yünlü kumaş ve ebonit çubuk dağıtınız. Daha önceki bilgilerine dayanarak, cam çubuğun artı (+), plastik çubuğun artı (+) yükle yüklendiğini hatırlatınız. Sürtünme sonucunda cisimlerde nasıl bir değişiklik gerçekleşebileceğini ve kumaşların hangi yüklerle yüklenebileceğini kağıda yazmalarını isteyiniz. Her grubun yazdıklarını farklı gruplara dağıtarak kendi yazdıkları ile karşılaştırmalarını isteyiniz. Öğrenciler çalışırken kısık sesle klasik müzik dinletiniz.

(Varsa) öğrencilerin yanlış bilgilerinin farkına varmalarını sağlayınız. Sürtünme sonucunda protonların yerlerini (çekirdeği) terk etmediklerini, fakat çekirdek etrafındaki elektronların bulundukları cisimleri kolayca terk edip başka cisimlere geçebildiklerini belirtiniz.

Bu durumda, eksi yükle yüklenen plastik çubuğun (ve ipekli kumaşın), artı yükle yüklenen cam çubuğun (ve yünlü kumaşın) elektron yitirdiği sonucuna tartışarak varınız.

Canlandırma: Kızlar artı yüklü protonu temsil ederler, merkezde toplanırlar. Erkekler de eksi yüklü elektronları temsil ederek kızların etrafında (çekirdek etrafında) dönerler.

Doğa Zekası Etkinlik:

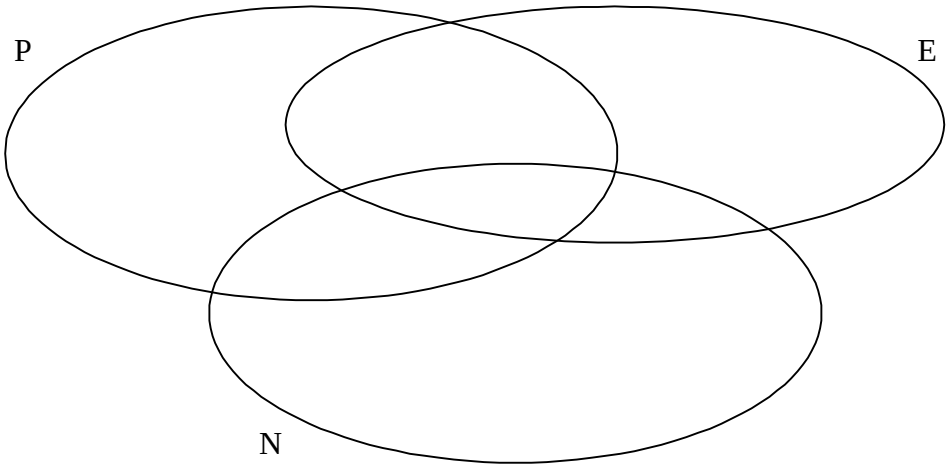
Doğada atomun yapısına benzetilebilecek yapıları listelemelerini isteyiniz. (Güneş Sistemi, dönme dolap, papatya...)

İçsel Etkinlik:

Ekteki çalışma kağıdını öğrencilere dağıtarak herkesin 15 dakika kendi kendilerine düşünerek alıştırmaları yapmalarını sağlayınız.

ÇALIŞMA KAĞIDI

1. Atomun yapısında yer alan temel parçacıklar, proton, nötron ve elektron arasında benzer ve farklı özelliklere göre verilen Venn şemasını doldurunuz.



2. Aşağıdaki boşlukları neden sonuç ilişkisine göre doldurunuz.
   Neden: Proton ve elektron sayısı aynı olan bir atomun elektron alması.
   Sonuç:

   Neden:
   Sonuç: Cismin sürtünerek artı yükle yüklenmesi.

   Neden: Cismin fazla elektronlarını vererek proton ve elektron sayılarını eşitlemesi.
   Sonuç:

3. Elektrik yüklü cisimler birbirlerini iter yada çeker. Çünkü, ...

4. Yüksüz cisim proton ve elektronu olmayan cisim değildir. Yüksüz cisim, ...

5. Sizin atom modeliniz nasıl olabilir?

6. Toplam parçacık sayısı (p, n ve e) 10 u geçmeyecek artı yüklü bir atom tasarlamak istersek, p, n ve e sayıları nasıl olabilir?

GÜNLÜK DERS PLANI ÖRNEĞİ V

ÇOKLU ZEKA TEORİSİNE DAYALI DERS PLANI - SINIF İÇİ AKTİVİTELER

SINIF **:** 6
DERS **:** Fen Bilgisi
ÜNİTE **:** Yaşamımızı Yönlendiren Elektrik
SÜRE **:** 40'
TARİH **:** .....
KONU **:** Dokunma ile Elektriklenme

HEDEF VE DAVRANIŞLAR:

- Dokunma ile elektriklenmeyi gözlemlerle, uygulamalarla, deneylerle ve farklı etkinliklerle kavrayabilme.
    - Cisimleri dokunmayla elektrikler ve dokunmayla elektriklenmenin nasıl olduğunu açıklar.

DERS ÖNCESİ HAZIRLIK:

Elektroskop, ipekli kumaş, cam çubuk, plastik çubuk, yün kumaş, çalışma kağıtları.

ÖĞRENME-ÖĞRETME YAŞANTILARI:

Sözel / Dilsel Etkinlikler, Mantıksal / Matematiksel, Görsel / Uzamsal Etkinlikler:
DİKKAT ÇEKME:
5- Fabrikada Panik

Bir sabah Çelik ile Sırrı fabrikada dolaşıyorlardı. Sırrı, makinelerden birinin gövdesine elini uzatarak yaslanmak istedi. Sırrı elini makineye elini uzatır uzatmaz elektriğe çarpıldı. Çünkü makinede elektrik kaçağı vardı.

Çelik ne yapacağını şaşırdı. Can dostu gözlerinin önünde ölüyordu. Elini uzatarak onu kurtarmaya çalıştı. Ancak oda çarpılmaya başladı. Yetişen bir görevli tahta yardımıyla ikisini de kurtardı. Bu olayı çok merak eden Çelik, Mühendis Kemal ile konuştuğunda elektriğin dokunma yoluyla maddelerden başka maddelere geçebileceğini öğrenmiş oldu. Ve "Elektrik hakkında bilmediğim ne kadar çok şey varmış!" demekten kendini alamadı.

DERSE GEÇİŞ: Şimdi hep birlikte dokunma ile elektriklenmeyi öğrenelim.

- Elektroskobu, topuzuna elektrik yüklü plastik çubuğu dokundurarak elektriklendiriniz. Dokunma sonucunda cisimlerin yük kazanabileceğini gösteriniz. Bu olay sırasında gerçekleşenleri öğrencilerle tartışınız. Öğrencilerle birlikte eksi (-) yüklü plastik çubuktan yüklerin elektroskoba geçtiğini, eksi yükle yüklenen yaprakların birbirini ittiği ve açıldığı sonucuna varınız.
- Bu deneyde gözlemlenenleri çizimle göstermelerini sağlayınız.
- Aynı işlemi artı yüklü cisimle yapsaydık nasıl bir sonuç alırdık? sorusuna neden sonuç çalışması yaparak cevap arayınız:
  Neden: Artı yüklü çubuğun, başlangıçta yüksüz çubuğun topuzuna dokundurulması
  Sonuç: ...

Bedensel / Kinestetik, Müziksel / Ritmik, Kişilerarası Etkinlikler:

* Öğrencileri dörderli gruplara ayırınız. Gruplara elektroskop, ipekli kumaş, cam çubuk dağıtınız. Plastik çubukla yapılan işlemleri tekrar etmelerini isteyiniz. Her grubun gözlemlediklerini ve gözlemledikleri olayın nedenini kağıda yazmalarını isteyiniz. Grupların yazdıklarını toplayarak başka gruplara dağıtınız ve yazdıklarıyla karşılaştırmalarını isteyiniz. Bu arada, öğrenciler çalışırken kısık sesle klasik müzik dinletiniz.

Doğa Zekası Etkinlik:

Öğrencilerin, doğada dokunma yoluyla gerçekleşen başka olaylara örnekler vererek listelemelerini isteyiniz. (Elektrik çarpması, sıcak cisimlere dokunarak elimizin ısıtılması...)

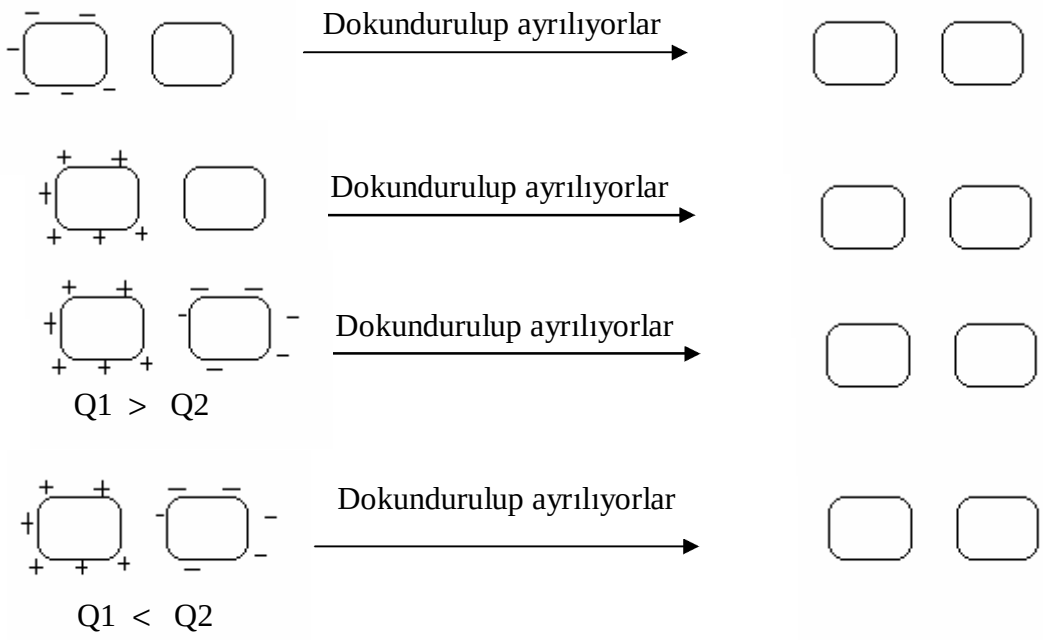
İçsel Etkinlik:

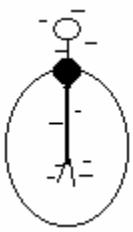
Ekteki çalışma kağıdını öğrencilere dağıtarak herkesin 15 dakika kendi kendilerine düşünerek alıştırmaları yapmalarını sağlayınız.

ÇALIŞMA KAĞIDI

1. Toprak bir elektron okyanusu gibi düşünülebilir. Elektrik yüklü bir cismi dokundurduğumuzda yükünü kaybeder. Bu durumda topraklanma olayın nasıl gerçekleşebileceğini aşağıdaki şekiller üzerinde yüklerin hareket yönünü çizerek gösteriniz.

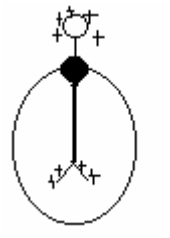
2. Aşağıdaki cisimler birbirlerini dokundurulup ayrıldıktan sonra kazandıkları yükleri şekil üzerinde gösteriniz:



3. 

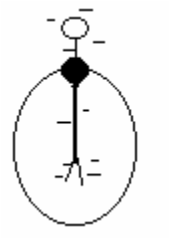
Yandaki şekilde gösterilen eksi (-) yüklü elektroskobun aşağıdaki durumlarda yapraklarındaki değişikliği ve elektroskop üzerindeki yük akışını şekil çizerek gösteriniz.

a) Eksi (-) yüklü cisim
b) Nötr cisim

4. 

Yandaki şekilde gösterilen eksi (-) yüklü elektroskobun aşağıdaki durumlarda yapraklarındaki değişikliği ve elektroskop üzerindeki yük akışını şekil çizerek gösteriniz.

a) Artı (+) yüklü cisim
b) Nötr cisim

5. 

Yandaki şekilde gösterilen eksi (-) yüklü elektroskobun yapraklarının önce kapanıp, sonra tekrar açılması için nasıl bir cisim dokundurulmalıdır? Açıklayınız.

GÜNLÜK DERS PLANI ÖRNEĞİ VI

ÇOKLU ZEKA TEORİSİNE DAYALI DERS PLANI - SINIF İÇİ AKTİVİTELER

SINIF : 6
DERS : Fen Bilgisi
ÜNİTE : Yaşamımızı Yönlendiren Elektrik
SÜRE : 40' + 40'
TARİH : .....
KONU : Etki ile Elektriklenme

HEDEF VE DAVRANIŞLAR:

- Etki ile elektriklenmeyi gözlemlerle, uygulamalarla, deneylerle ve farklı etkinliklerle kavrayabilme.
    - Cisimleri etkiyle elektrikler ve etkiyle elektriklenmenin nasıl olduğunu açıklar.

DERS ÖNCESİ HAZIRLIK:

Elektroskop, ipekli ve yünlü kumaş, cam ve plastik çubuk, çalışma kağıtları.

ÖĞRENME-ÖĞRETME YAŞANTILARI:

Sözel / Dilsel Etkinlikler, Mantıksal / Matematiksel, Görsel / Uzamsal Etkinlikler:
DİKKAT ÇEKME:
6- Bulutların Gizemi:

Yağmurlu bir geceydi. Her gök gürültüsünde Çelik yerinden zıplıyordu. Sırrı ile birlikte tüm ışıkları kapatmış, şimşek çakınca her yerin birkaç saniye de olsa müthiş bir şekilde aydınlanmasını izliyorlardı. Meraklı Çelik, bu kez yağmurlu havalarda gerçekleşen şimşek ve yıldırım olaylarına anlam veremedi. Sırrı ile çarpıldıklarında elektrik makineden kendilerine geçmişti. Ancak bu dokunma yoluyla gerçekleşmişti. Peki nasıl oluyordu da elektrik buluttan yere, arada mesafe olduğu halde geçiyordu?

Araştırmacı Çelik bunu da bir başka mühendis Sema'dan öğrendi. Sema ona şunları anlatmıştı:

"Sevgili Çelik, elektriklenmek için cisimlerin birbirlerine dokunmalarına gerek yok. Elektriklenmiş bir cisim, kendisine yakın olan bir cismi etkileyerek onu da elektriklendirebilir. Elektrik yüklü bulut yere yaklaşınca, kendisine yakın olan cismi elektriklendirir. Elektriklenmiş iki cisim arasında elektron atlaması gerçekleşir. İşte yıldırım, buluttan yere doğru gerçekleşen bir elektron atlamasıdır."

DERSE GEÇİŞ: Biz de dersimizde yüklü bir cismin nötr bir cismi etki ile nasıl elektriklendirdiğini öğreneceğiz.

Cam çubuğu elektriklendiriniz ve elektroskobun topuzuna dokundurmadan yaklaştırınız. Etki ile elektroskobun elektriklendiğini öğrencilerin gözlemlemelerini sağlayınız. Elektroskobun topuzuna artı (+) yüklü çubuk yaklaştırılınca eksi yüklerin topuza doğru hareket ettiğini, böylece topuzun eksi yükle yüklendiğini ve eksi yükleri kaybeden yaprakların artı yükle yüklendiğini tahtada şekille (veya tepegözle) gösteriniz. Bu şekli öğrencilerin çizmelerini sağlayınız.

Bedensel / Kinestetik, Müziksel / Ritmik, Kişilerarası Etkinlikler:

Öğrencileri dörderli gruplara ayırınız. Gruplara elektroskop, yünlü kumaş, plastik çubuk dağıtınız. Elektroskobu plastik çubuk kullanarak etki ile elektriklendirmelerini isteyiniz. Her grubun elektroskoptaki yük dengesinin nasıl değiştiğini, elektroskobun topuz ve yapraklarının hangi yükle yüklendiğini şekille göstermelerini isteyiniz. Grupların kağıtlarını toplayarak başka gruplara dağıtınız ve kendi yaptıklarıyla karşılaştırmalarını isteyiniz. Bu arada, öğrenciler çalışırken kısık sesle klasik müzik dinletiniz.

Doğa Zekası Etkinlik:

Öğrencilerin, doğada dokunma olmadan etki yoluyla gerçekleşen başka olaylara örnekler vererek listelemelerini isteyiniz. (Mıknatısların demir, kobalt gibi maddeleri etkilemesi, yerçekimi kuvveti...)

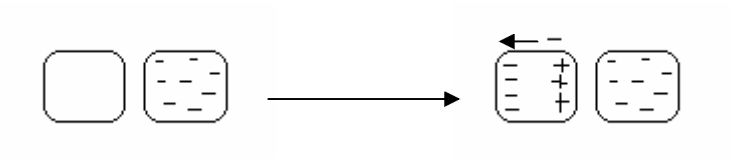
İçsel Etkinlik:

Ekteki çalışma kağıdını öğrencilere dağıtarak herkesin 15 dakika kendi kendilerine düşünerek alıştırmaları yapmalarını sağlayınız.

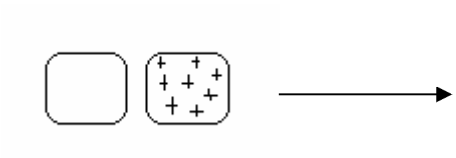
ÇALIŞMA KAĞIDI

1. Yüksüz bir cisme, dokundurulmadan yaklaştırılan eksi yüklü bir cisim bu cismi şekildeki gibi etki ile elektrikler. Buna göre, diğer şekli tamamlayınız.

a)

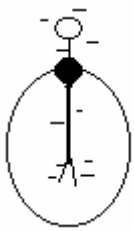


b)



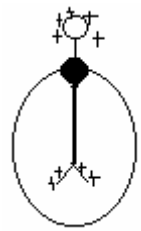
2. Aşağıdaki durumlarda elektrodkobun yük dengesinin nasıl değiştiğini, topuz ve yaprakların hangi yükle yüklendiğini ve yaprakların açılıp kapanma durumlarını şekille gösteriniz.

c) Eksi (-) yüklü cisim yaklaştırılması
d) Artı (+) yüklü cisim yaklaştırılması



3. Aşağıdaki durumlarda elektrodkobun yük dengesinin nasıl değiştiğini, topuz ve yaprakların hangi yükle yüklendiğini ve yaprakların açılıp kapanma durumlarını şekille gösteriniz.

a) Eksi (-) yüklü cisim yaklaştırılması
b) Artı (+) yüklü cisim yaklaştırılması



4. Aşağıdaki yüklü elektroskoplara, yüksüz cisimler yaklaştırılınca yaklaştırılan cisimlerin etki ile elektrikleneceğini ve elektroskopları nasıl etkileyebileceğini şekille gösteriniz.

?

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GÜNLÜK DERS PLANI ÖRNEĞİ VII

ÇOKLU ZEKA TEORİSİNE DAYALI DERS PLANI - SINIF İÇİ AKTİVİTELER

SINIF **:** 6
DERS **:** Fen Bilgisi
ÜNİTE **:** Yaşamımızı Yönlendiren Elektrik
SÜRE **:** 40'
TARİH **:** .....
KONU **:** İletken ve Yalıtkan Maddeler

HEDEF VE DAVRANIŞLAR:

- İletken ve yalıtkan maddeleri gözlemlerle, uygulamalarla, deneylerle ve farklı etkinliklerle kavrayabilme.
    - Elektrik yüklerinin hareketine bağlayarak maddeleri sınıflandırır, iletken ve yalıtkanlara örnekler verir.

DERS ÖNCESİ HAZIRLIK:

Bakır çubuk, ipekli ve yünlü kumaş, kağıt parçaları, plastik eldiven, çalışma kağıtları.

ÖĞRENME-ÖĞRETME YAŞANTILARI:

Sözel / Dilsel Etkinlikler, Mantıksal / Matematiksel, Görsel / Uzamsal Etkinlikler:
DİKKAT ÇEKME:
7- Çelik Zayıflama Derdinde:

Çelik, vücudunun ağır olmasından rahatsızdı. Yürümek için çok enerji harcıyordu. Çünkü metalden üretilmişti. Eğer daha hafif mir maddeden, örneğin tahtadan üretilmiş olsaydı, belki depoladığı enerji ona bir ay değil de bir yıl yetebilecekti. Her ay şarj makinesine bağlanıp doluncaya kadar beklemek onu çok sıkıyordu.

Çelik, nasıl olsa cansız bir varlıktı, bir makineydi. O halde vücudunun bazı bölümleri değiştirilebilirdi. Özellikle vücudunda enerjinin depolandığı bölümler çeşitli metallerden üretilmişti. Bu bölümlerin tahta ile değiştirilmesini istiyor, böylece daha çevik bir Çelik olmayı umuyordu. Bu isteğini dile getirdi, ama

imkansızdı! Bu ağır metallerle var olmak zorundaydı. Her zamanki gibi mühendis anlattı o dinledi:

"Çelik, sen elektrik enerjisi ile çalışıyorsun. Ancak iletken maddeler elektriğin akışına izin verirler. Yalıtkan maddeler ise elektriği iletmezler. Bu yüzden enerjinin depolandığı ve vücuduna yayıldığı kısımlar iletken olmak zorunda. Ancak diğer bölümler yalıtkan olabilir. Senin de ağırlığını azaltmak amacıyla gövden ve kollarında bazı bölümler yalıtkan olabilir. Hatta bu daha güvenli olur. En son yaşadığın çarpılma olayından sonra senin ellerini yalıtkan bir maddeyle değiştireceğiz."

Çelik, "O zaman insan vücudu da iletken midir?" diye sordu.

DRSE GEÇİŞ: Şimdi iletken ve yalıtkan maddeleri öğreneceğiz. Bu arada insan vücudunun iletken olup olmadığını da öğreneceksiniz.

Bakır çubuğu daha önce yaptığınız deneylerdeki gibi yünlü ve ipekli kumaşlara sürterek elektriklendirmeye çalışınız. Sürtünme sonucunda bakır çubuğun kağıtları çekmediğini, dolayısıyla elektriklenmediğini öğrencilere gösteriniz. Bu olayın nedenleri üzerinde öğrencilerin fikir yürütmelerini sağlayınız. Yapılan etkinlikle ilgili neden-sonuç çalışmasını yaptırınız.

Neden:

Sonuç: Elle tutulan bakır çubuk sürtünme sonucunda elektriklenmemiştir.

Yapılan etkinlikte bakır çubuk üzerinde yük akışını şekille göstermelerini sağlayınız.

Bedensel / Kinestetik, Müziksel / Ritmik, Kişilerarası Etkinlikler:

Öğrencileri dörderli gruplara ayırınız. Gruplara plastik eldiven, bakır çubuk, yünlü ve ipekli kumaş dağıtınız. Yapılan deneyi ellerine plastik eldiven takarak yapmalarını isteyiniz. Bu arada, öğrenciler çalışırken kısık sesle klasik müzik dinletiniz. Elde edilen sonucun öncekinden neden farklı olduğunu grup olarak yazmalarını sağlayınız. Grupların kağıtlarını toplayarak başka gruplara dağıtınız ve kendi yaptıklarıyla karşılaştırmalarını isteyiniz. . İletken ve yalıtkan kavramı üzerinde tartışma ortamı yaratınız

<u>Doğa Zekası Etkinlik:</u>

Öğrencilerin, doğada varolan iletken ve yalıtkan maddelere örnekler vererek listelemelerini sağlayınız.

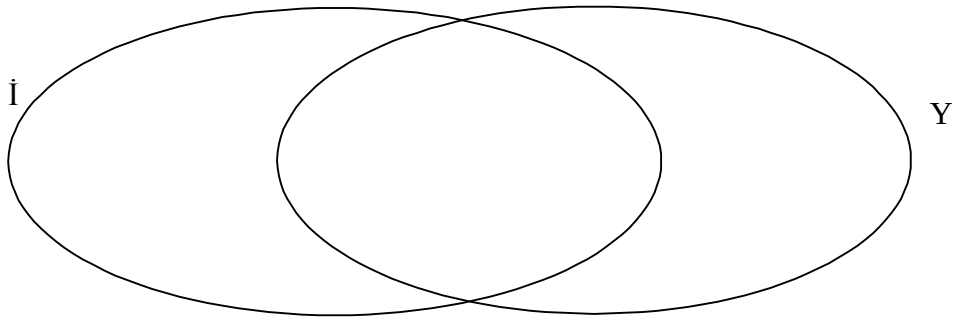
<u>İçsel Etkinlik:</u>

Ekteki çalışma kağıdını öğrencilere dağıtarak herkesin 15 dakika kendi kendilerine düşünerek alıştırmaları yapmalarını sağlayınız.

ÇALIŞMA KAĞIDI

1. Elektroskop kullanarak yaptığımız deneylerde, topuzu tahtadan yapılmış elektroskop kullansaydık nasıl sonuçlarla karşılaşırdık?

2. İletken ve yalıtkan maddeler arasındaki benzerlik ve farklılıkları aşağıdaki şemada gösteriniz.



3. İletken maddeler olmasaydı, ...

4. Yalıtkan maddeler olmasaydı, ...

5. İletken ve yalıtkan maddeler nerelerde kullanılır? Örnekler veriniz.

GÜNLÜK DERS PLANI ÖRNEĞİ VIII

ÇOKLU ZEKA TEORİSİNE DAYALI DERS PLANI - SINIF İÇİ AKTİVİTELER

SINIF : 6
DERS : Fen Bilgisi
ÜNİTE : Yaşamımızı Yönlendiren Elektrik
SÜRE : 40'
TARİH : .....
KONU : Atmosferde Doğal Elektriklenme: Şimşek, Yıldırım

HEDEF VE DAVRANIŞLAR:

- İletken ve yalıtkan maddeleri gözlemlerle, uygulamalarla, deneylerle ve farklı etkinliklerle kavrayabilme.
    - Şimşek ve yıldırımın atmosferdeki doğal elektriklenme olayları olduğunu fark eder; bunları şekil çizerek açıklar ve korunma yollarına örnekler verir

DERS ÖNCESİ HAZIRLIK:

Balon, yünlü kumaş, toprak dolu saksı, onluk çivi, çalışma kağıtları.

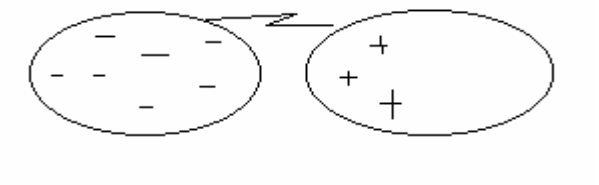
ÖĞRENME-ÖĞRETME YAŞANTILARI:

Sözel / Dilsel Etkinlikler, Mantıksal / Matematiksel, Görsel / Uzamsal Etkinlikler:

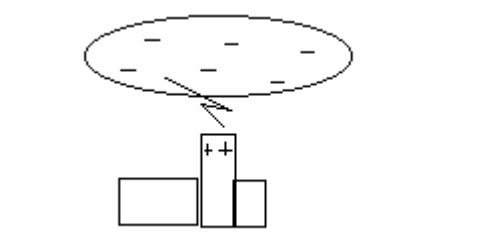
Sınıf içerisinde karanlık bir ortam sağlayarak, önceden elektriklendirdiğiniz balonlar arasında kızılcım oluşturunuz.

Şimşek ve gök gürültüsü oluşumu ile ilgili akış haritası yapınız.

Bulut → havanın sürüklemesi → elektrik yüklü bulut → etki ile başka bulutu elektrikler → iki bulut arasında elektrik atlaması olur.



Yıldırım oluşumu ile ilgili akış haritası yapınız.
Bulut ⟶ havanın sürüklemesi ⟶ elektrik yüklü bulut ⟶ etki ile yerde buluta en yakın bölgeyi (en yüksek bölgeyi) elektrikler ⟶ buluttan yere doğru elektrik atlaması olur.



Bedensel / Kinestetik, Müziksel / Ritmik, Kişilerarası Etkinlikler:

Öğrencileri dörderli gruplara ayırınız. Gruplara toprak dolu saksı içerisinde ucu yukarı gelecek şekilde saplanmış çivi, balon dağıtınız. Elektriklenen balon ile çivi arasında kıvılcım oluşturmalarını isteyiniz. Deneyde gözlemlediklerine yıldırım oluşumunu sınıfça tartışınız.

Sınıf içinde ses ve ritimle gök gürültüsü oluşturunuz.

Öğrencilerden gök gürültüsü sesini taklit etmelerini isteyiniz.

Doğa Zekası Etkinlik:

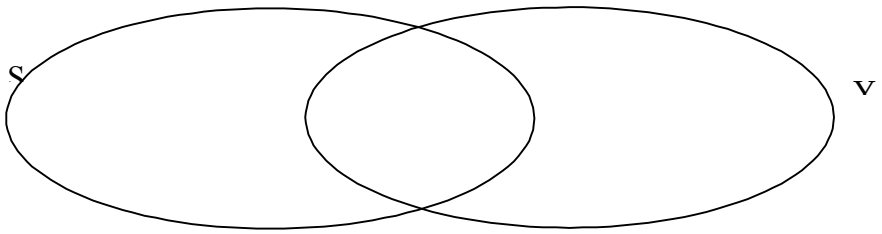
Yıldırımdan korunmak için alınabilecek tedbirleri kategorilere ayırmalarını isteyiniz.

İçsel Etkinlik:

Ekteki çalışma kağıdını öğrencilere dağıtarak herkesin 15 dakika kendi kendilerine düşünerek alıştırmaları yapmalarını sağlayınız.

ÇALIŞMA KAĞIDI

1. Şimşek ve yıldırım arasındaki benzerlik ve farklılıkları aşağıdaki şemada gösteriniz.



2. "Benimle dalga geçince, gözümde şimşekler çaktı." diyen bir neler hissetmektedir? Açıklayınız.

3. Yıldırım ve ejderha benzerdir. Çünkü.....

4. Şimşek çaktığını gördükten 3 saniye sonra gök gürültüsünü duyduğumuzu varsayalım. Bulutun bizden uzaklığını ne kadardır?

5. Aşağıdaki neden sonuç ilişkilerini yazınız.

   Neden: Bulut rüzgarın etkisi ile havayla sürtünüyor ve yanına yaklaşan başka bulutları etki ile elektriklendiriyor.
   Sonuç:

   Neden:

   Sonuç: Kuleye yıldırım düştü ve yangın çıktı.

6. Yağmurlu ve fırtınalı havalarda alınması gereken tedbirlerden uygun olanları A kutucuğuna, uygun olmayanları B kutucuğuna yerleştiriniz.

   (Çukur yerlere saklanmak, uçurtma uçurmak, arabaların içinde oturmak, ağacın altına sığınmak, şemsiye ile dolaşmak, denize girmek, evde oturmak, paratoner kullanmak.)

A	B