THE EFFECTS OF ACTIVITIES BASED ON ROLE-PLAY ON NINTH GRADE STUDENTS' ACHIEVEMENT AND ATTITUDES TOWARDS SIMPLE ELECTRIC CIRCUITS

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_____

Prof Dr. Canan ÖZGEN
Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science

_____

Prof. Dr. Ömer GEBAN

Head of Department

This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

_____

Assist. Prof. Dr. Ali ERYILMAZ

Supervisor

Examining Committee Members

Assoc. Prof. Dr. Safure BULUT _____

Assist. Prof. Dr. Ali ERYILMAZ _____

Assist. Prof. Dr. Jale ÇAKIROĞLU _____

Assist. Prof. Dr. Esen UZUNTİRYAKİ _____

Dr. Mehmet SANCAR _____

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last name: Yadikar Küçüker (Tunçer)

Signature :

ABSTRACT

THE EFFECTS OF ACTIVITIES BASED ON ROLE-PLAY
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ATTITUDES TOWARDS SIMPLE ELECTRIC CIRCUITS

Küçüker (Tunçer), Yadikar
M.S., Department of Secondary Science and Mathematics Education
Supervisor: Assist. Prof. Dr. Ali Eryılmaz
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This study intented to investigate the effects of activities based on role-play on ninth grade students' achievement and attitudes at simple electric circuits. In this study, Physics Achievement Test was developed to evaluate students' achievement on simple electric circuits and role-play activities about simple electric circuits were prepared. In addition, Physics Attitude Scale was administered to explore students' attitude towards physics.

The present study was conducted at one of the high schools in Acıpayam during 2003-2004 Spring Semester with a total number of 104 (51 female and 53 male) 9^{th} students from four classes of two physics teachers. One class of each physics teacher was assigned as experimental and instructed by role-play activities on the other hand the other classes of each physics teacher was as control group and instructed by traditional method. The teachers were trained for how to implement role-play activities in the class before the study began. Physics Attitude Scale and Physics Achievement Tests were applied twice as a pre-test and after a three-week treatment period as a post-test to both groups to assess and compare the effectiveness of two different types of teaching; role-play versus traditional teaching method.

Data were collected utilizing Physics Achievement Test and Physics Attitude Scale. Data of this study were analyzed utilizing descriptive and inferential statistics. The scores of the post-tests were analyzed by statistical techniques of Multivariate Analyses of Covariance (MANCOVA). Experimental group compared to control group tended to favor a significant difference in the achievement. However the statistical analysis failed to show any significant differences between the experimental and control groups' attitude towards physics at simple electric circuits.

Keywords: physics education, science education, interactive engagement methods, active learning, active learning strategies, simulation -games, role-play

ÖZ

ROL-YAPMA YÖNTEMİNE GÖRE HAZIRLANAN ETKİNLİKLERİN DOKUZUNCU SINIF ÖĞRENCİLERİNİN BASİT ELEKTRİK DEVRELERİNDEKİ BAŞARILARINA VE TUTUMLARINA ETKİSİ

Küçüker (Tunçer), Yadikar
Yüksek Lisans, Orta Öğretim Fen ve Matematik Alanları Eğitimi Bölümü
Tez Yöneticisi: Yrd. Doç. Dr. Ali Eryılmaz
Eylül 2004, 133 sayfa

Bu araştırma, rol-yapma öğrenme yöntemine göre hazırlanan etkinliklerin dokuzuncu sınıf öğrencilerinin basit elektrik devrelerindeki başarılarına ve tutumlarına etkisini belirlemek amacıyla yapılmıştır. Bu çalışma da, rol-yapma öğrenme tekniğine göre elektrik devreleri için etkinlikler ve elektrik devreleri konusundaki başarılarını ölçmek amacıyla hazırlanmıştır. Bu çalışmaya ek olarak öğrencilerin fizik dersine karşı tutumlarına belirlemek amacıyla Elektrik Devreleri Tutum Ölçeği uygulanmıştır.

Çalışma, 2003-2004 öğretim yılı ilkbahar döneminde Acıpayam ilçesinde yer alan bir devlet lisesinde gerçekleştirildi. Çalışmada 2 fizik öğretmenin 4 sınıfından toplam 109 tane (51 kız, 53 erkek) 9. sınıf öğrencisi yer almıştır. Her iki fizik öğretmenin birer sınıfı deney grubu olarak belirlenip rol-yapma öğrenme tekniğine göre hazırlanmış etkinliklerle desteklenmiş öğrenin görürken, diğer sınıfları kontrol grubu olarak belirlenip geleneksel öğretim yöntemi ile konular işlenmiştir. Her iki fizik öğretmeni, rol-yapma tekniği öğrenme yöntemine göre hazırlanan etkinlikleri

nasıl uygulayacağı hakkında çalışma başlamadan önce bilgilendirildi. Elektrik Devreleri (Fizik Tutum) Ölçeği ve Fizik Başarı Testi her iki gruba, iki farklı öğretim yönteminin etkisini karşılaştırmak için, ön test ve üç haftalık bir öğretim sonunda da son test olarak uygulanmıştır.

Veriler, Fizik Başarı Testi ve Fizik Tutum Ölçeği ile toplanmıştır. Araştırmanın sonuçları betimsel analiz tekniği ve hipotez test etme metodu kullanılmıştır. Çalışmanın son test verileri MANCOVA istatistiksel tekniği kullanılarak analiz edilmiştir. Analiz sonuçları rol-yapma öğrenme tekniğinin geleneksel öğrenme tekniğine göre öğrencilerin başarı açısından daha fazla etkili olduğunu, ama öğrencilerin fizik dersine yönelik tutumları açısından kontrol ve deney grupları arasında anlamlı bir fark bulunmadığını göstermiştir.

Anahtar kelimeler: fizik eğitimi, fen eğitimi, etkileşimli katılım metotları, aktif öğrenme, aktif öğrenme stratejileri, simulasyon-oyunlar, rol-yapma

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SYMBOLS

MANCOVA	:	Multivariate Analysis of Covariance
ANCOVA	:	Analysis of Covariance
PREACH	:	Students' Physics Achievement Pre-test Scores
PREATT	:	Students' Physics Attitude Pre-test Scores
PSTACH	:	Students' Physics Achievement Post-test Scores
PSTATT	:	Students' Physics Attitude Post-test Scores
PACHT	:	Physics Achievement Test
PATTS	:	Physics Attitude Scale
TM	:	Teaching Methods
MRC	:	Multiple Regression Correlation
IV	:	Independent Variable
DV	:	Dependent Variable
df	:	Degrees of Freedom
N	:	Sample Size
α	:	Significance Level

CHAPTER 1

INTRODUCTION

1.1 Nature and Significance of the Problem

Education has an important role in any time on the development of nations. The purposes of educational researches are to determine the problems and offer solutions to get efficiency in education and through the development of the society. Almost everyday technology's growing up rapidly and so new technological instruments, whether good or bad, are introduced to the society. Educators must meet the challenge of bringing knowledge to people which no longer has an attention, no longer reads, and no longer feels the need to use the learned material.

Educational research emerges as a means of determining new methods of instruction and ways to increase student learning. Research in education seems as a pendulum which swings perpetually in the education field. There are several questions that need to be addressed if we are to enhance student learning and determine the ways that the process of learning may be facilitated. How do students learn best? What needs to be done to enhance a learning environment? Some researches are for producing innovations for teaching and learning, many times reviving methods of the past.

The classroom which was organized as an environment supports learning in spite of its complex effort. The nature of relations and interactions within teachers and students as well as external factors such as administration, family and educational backgrounds conceives the classroom. Classrom is defined as a system of various components within which teachers and students live and it affects how they behave in class (Zabel & Zabel, 1996). Teachers are responsible for creating and maintaining an effective learning environment to achieve instructional goals.

In this setting, the goal of an instructional designer in the class, or a teacher is to produce a plan for instruction, whether for a complete course, a unit, or a single lesson, that stimulates and supports the learning of individuals (Ledford, 1996).

Learning involves the acquisition of knowledge that has implications for how to teach- such as presenting information to learners in books and lectures- and how to assess- such as testing to see how much of the presented material students can remember (Mayer, 2001).

There are educational goals; two of them are the most important ones in order to promote retention and to promote transfer. When both occur, meaningful learning exists. Mayer and Wittrock (1996) gave definition of retention as the ability to remember material at some later time in much the same way it was presented during instruction and the definition of transfer as the ability to use what was learned to solve problems, answer new questions, or facilitate learning new subject matter.

The fact that the students transfer information to long-term memory more when schemata already exists in which to place the new information are shown by researchers such as Gagne and other information processing theorists. Educators can notice that students will learn better and remember more when the lesson includes different type of learning activities and learning strategies. There are numerous studies which have researched various methods to help students' comprehension and learning material and concepts precisely (Ausubel, 1960).

Teachers and students are responsible for creating and maintaining an effective learning environment to achieve intended goals of the planned unit or subject. In this setting, the implementation of the chosen instructional strategies as methods, to follow up the objectives in a classroom is a complicated task in education. Although it is a complicated task, it appears easy to conduct in a well organized and well managed instruction and classroom in which the students are actively involved in given tasks for the instructional goals.

The selected procedures for instruction in order to increase the achievement of the intended objectives in learning the content are called methods. The general categories of methods are presentation, demonstration, discussion, drill and practice, tutorial, cooperative learning, gaming, simulation, discovery and problem solving. One of the methods; simulation is described as an abstraction or simplification of some real-life situation or process. The simulations for instruction consists of role-plays used for training in motor skills, developing social- human relations when

showing empathy or managing successfully in eliminating reactions and also developing the decision-making skills that is management simulations in business administration (Heinich, Molenda, Russell & Smaldino, 2002).

Many international studies have been made about increasing the science achievement. These studies focused on all educational level from elementary through graduate schools. Education and science education in particular, is believed to promote aims such as; democracy, development, equality, tolerance, creativity, critical thinking, scientific attitude, and so on.

Physics education is a very small part of general education. However, physics learning and teaching activities interact with many other social activities. Physics is the branch of science, studies forces, matter and energy. Knowledge of physics is fundamental to an understanding of the world around us. In teaching, the kind of method which is used in lectures is very important. One suggested means for this situation is to change the focus of classroom activity from teacher- centered to student- centered. Here, the role of the teacher is to organize information around conceptual sets of problems, questions and discrepant situations in order to engage the students' interest and active participation.

In the article of teaching and learning strategies ("Additional Teaching and Learning Strategies", 2002), interactive teaching strategies like role-playing and simulations work best when they're presented spontaneously to students. Role-playing and simulations require students to improvise using the information available to them. These teaching tools can be effective in helping students clarify attitudes and ideologies and make connections between abstract concepts and real world events.

Hake (1998b) stated that researches about interactive engagement methods has the indication of that students' conceptual understanding were significantly better than students in traditional methods. In this manner, a question arises: can an interactive engagement activity based on role-playing be planned to support teacher and students for the case of student-centered instruction?

Although there is large research base on teaching, learning and instructional strategies, research has yet to establish unequivocally the impact of the strategies.

The findings of this study will be useful for a large group of physics teachers who feel the need to change their instructional or teaching methods, but are in situations where they have little flexibility to induce change in their school systems. Finally this study will reflect whether the use of role-playing, the type of simulations would enhance students' attitudes toward physics and most importantly, reason proper conceptual understanding. However, role-playing in science education is seldom used, it is hoped that this work will inform the effect of role-play, a type of simulation on students physics achievement at electricity affirmatively.

The aim of this study is to demonstrate the educational impact of using role-play activities on the 9^{th} grade level students' physics achievement and attitudes towards simple electric circuits that is normally taught through more conventional lecture methods.

1.2 Main Problem

The main problem of this study is stated as follows;

Are the (a) attitudes of students towards physics and (b) students' physics achievement at simple electric circuits affected by the use of role-playing activities as opposed to a traditional methodology in a traditional classroom setting?

1.3 Hypotheses

The problem of this study above given was tested according to the hypotheses given in the null form below as follows;

Null Hypothesis 1

$H_{0\,[1,\,2]}$: $\mu_{RP} - \mu_{TTM} = 0$

1: scores on physics achievement posttest, 2: scores on physics attitude posttest

RP: Role-play activities, TTM: Traditional teaching method

There will be no statistically significant effects of teaching methods (role-play activities versus traditional teaching method) on the population means of common

dependent variables of ninth grade students' physics achievement posttest scores and physics attitude posttest scores when students' age, physics achievement pretest scores, physics attitude pretest scores, and gender are controlled.

Null Hypothesis 2

$H_{0\,[1]}$: $\mu_{RP} - \mu_{TTM} = 0$

There will be no statistically significant effects of teaching methods (role-play activities versus traditional teaching method) on the population means of ninth grade students' physics achievement posttest scores when students' age, physics achievement pretest scores, physics attitude pretest scores, and gender are controlled.

Null Hypothesis 3

$H_{0\,[2]}$: $\mu_{RP} - \mu_{TTM} = 0$

There will be no statistically significant effects of teaching methods (role-play activities versus traditional teaching method) on the population means of ninth grade students' physics attitude posttest scores when students' age, physics achievement pretest scores, physics attitude pretest scores, and gender are controlled.

1.4 Definition of Important Terms

- Simulation: is defined as an abstraction or simplification or some real-life situation or process (Heinich et al., 2002) is a teaching strategy that allows students to take on the roles of people who are "engaged in real life-situations" (Joyce & Weil as cited in Jenkins, p.47, 2000).
- Role-play: refers a type of simulation in which the dominant feature is relatively open-ended interaction among people (Heinich et al., 2002).
- The traditional teaching method: is a teaching method in which the instructor does all of the talking to present information to the students (Broadwell as cited in Keeling, p.13, 1999).
- Interactive engagement methods: The methods are "designed at least in part to promote conceptual understanding through interactive engagement of

students in heads-on (always) and hands-on (usually) activities that yield immediate feedback through discussion with peers and/or instructors" (Hake, p.2, 1998b).

- Traditional classroom setting: A classroom containing between 25 to 30 students seated at a table and all facing the blackboard, which is the only available teaching tool. Teacher make little or no use of interactive engagement methods, relying on passive lectures, lab recipes and algorithmic problem exams (Hake, 1998a).
- Attitudes toward physics: How students perceive their being in a physics classroom, how they assess the usefulness of physics as a discipline and how they relate the importance of what they learn in physics classes to their real life experiences and its importance in developing their ability to interpret everyday physical phenomena (Zoubeir, p.7, 2000).
- Gender: The fact or condition of being a male or a female human being, especially with regard to how this affects or determines a person's self-image, social status, or goals (Webster, 1994).
- Students' age: The information about the ages of students in years joined in this search was noted at the time of pretesting.
- Dependent Variables (DVs): Students' physics achievement posttest scores (PSTACH) and physics attitude posttest scores (PSTATT) are dependent variables.
- Independent Variables (IVs): Students' physics achievement pretest scores (PREACH), physics attitude pretest scores (PREATT), age, gender and teaching methods (TM; role-play activities and traditional teaching method) are independent variables.

1.5 Delimitations

The relevant delimitations of this study are as follows:

a) This study was limited to 109 students enrolled in four 9th grade physics classes at Acıpayam High School during the 2003-2004 academic year.

b) Teachers are volunteers.
c) The time span for study implementation and data collection was two months.
d) Any subjects and/ or variables not specified were considered beyond the field of this research study.

1.6 Assumptions

The following assumptions are made for the purposes of this study:

a) It was assumed that the subjects would respond to the measuring instruments in an honest manner and sincerely.
b) Role-play which is the type of simulations is considered to be interactive engagement methods to support the active learning of students.
c) The teachers, who will use the role-play in their lectures, will not be biased.
d) The teachers have the ability to implement the role-play activities about simple electric circuits from the physics curriculum.
e) The administration of the Physics Achievement Test and Physics Attitude Scale were under standard conditions.

CHAPTER 2

REVIEW OF RELATED LITERATURE

2.1 Learning, instruction, teaching methods

The development of new knowledge, skills or attitudes by means of the interaction with environment and information by the learner or individual is defined as learning (Heinich, Molenda, Russell and Smaldino, 2002). Learning involves the acquisition of knowledge. This leads to some implications for how to teach that is presenting information to learners are books and lectures. In addition the other point is that how to assess how much of the information or presented material can be remembered by the learners (Mayer, 2001).

In any area of education, instructors aim to promote retention and transfer. When both occur, meaningful learning exists. Mayer and Wittrock (1996) gave definition of retention as the ability to remember material at some later time in much the same way it was presented during instruction and the definition of transfer as the ability to use what was learned to solve problems, answer new questions, or facilitate learning new subject matter.

There are three conditions in learning; no learning, rote-learning and lastly meaningful learning. In no learning condition, when the information about electrical circuits is read. After some time when if key points of the subject is asked the learner, the learner can not list the major elements of a simple circuit with their goals. And also when a problem about circuits asked, no answer is given. This indicates that no learning exists. In another situation the learner reads the subject carefully and the main points are focused, the learner revises the material memorizing the facts. Then if she or he is asked to recall the information, she or he can list all the elements and remember the facts. But when she or he is given a problem, she or he can not answer it, because of rote-learning. In the third situation when students build the

knowledge and cognitive processes needed for successful problem solving and use in real life, meaningful leaning outcome can exist (Mayer, 2002).

Learning and instruction are highly related each other. In learning environment includes the physical facilities, the psychological atmosphere, instructional methods, media, and technology. In any time learning occurs such as watching television, listening to the music, talking with one or by observing the things, events happened around us. It is thought that, people learn and understand information when they are actively involved in their learning process. Not learning the information is enough, how to use the information actively in life is important. Heinich et al. (2002) stated that learning includes selection, arrangement and delivery of information in a suitable environment and learners interact with the information. In this manner, instruction is defined as the arrangement of information and environment to facilitate learning. In instruction, the instructor mentions the environment not only the place where the learners interact and the instruction exists but also the methods, media and technology which are necessary for the conveyance of the information and counseling the learner's study.

Paulson and Faust (no date) summarizes that active learning and cooperative learning form groups for the teaching methods variously. Active learning involves anything that students do in a classroom. Such as listening practices are helpful for the absorption of the information heard by them. And short writing exercises, complex group exercises in which students apply course material to real life situations. Cooperative learning includes the subset of active learning activities in which students do formally structured groups of three or more for research projects, presentations or multiple-step exercises.

In the study of Teaching Methods Resources (no date), it is told that there are numerous satisfactory ways of studying how the intended objectives and behavioral changes take place in students. Active learning has the components of listening, talking, manipulating, writing, reading, active directed activities related to text (such as text completion, diagram completion, table completion...etc) that is cycling. In Figure 2.1, some active learning strategies are given. In this study, role-play is

chosen to determine the effect of role-play activities on students' achievement as an instructional strategy.

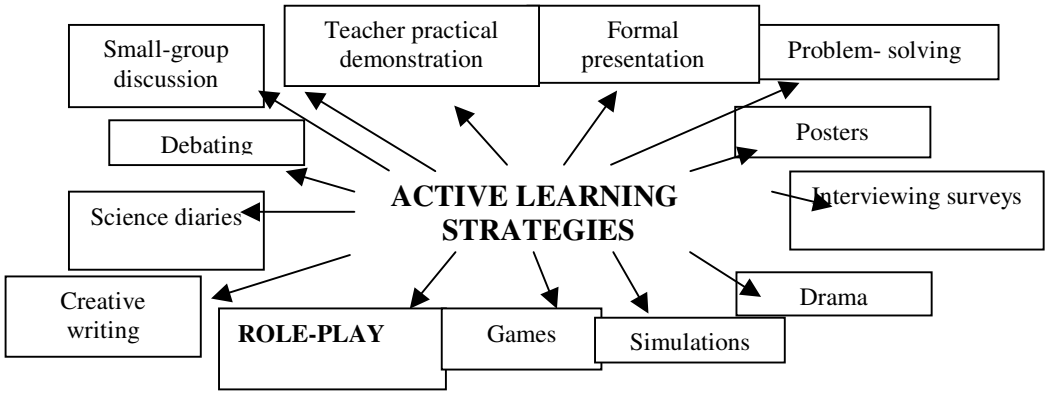


Figure 2.1: Active Learning Strategies

Giving examples to link new learning with what the students already know, is useful. Teachers can ask a variety of types of questions, analogies that link to students' lives, use personal experiences, similes to help students in the creation of the situations, form the groups of students to organize and translate sources. Gredler (1992) mentions that there are some useful types of interactive exercises applied in the classroom. Games and simulations are the ones which are useful. Others include role-playing, micro worlds and individual or group problem-solving exercises with simulated materials.

2.2 Traditional Science Teaching

The basis for the instructors is making classrooms dynamic learning environments. Giving the importance of traditional classroom settings such as classroom management, variety of used strategies in successful teaching, teachers ought to be equipped with effective management principles and strategies that enable them to cope with inappropriate student behavior and sustain student interactive engagement in learning activities.

Lecture is commonly used and sometimes overused strategy in high school classrooms. It is a strategy that is teacher oriented and controlled. Students are directed in guided practice with the introduction of an objective. Teachers explain a concept or skill during the lecture. Jenkins (2000) states that, lessons are structured in a sequential manner, usually with a direct oral presentation by the teacher and students are responsible for note taking, discussion, worksheets or drill activities.

During the process of learning there is necessity of active involvement of students. Brigham stated that in the lecture method, there isn't actively engagement of students in the learning process and lecture method does not help students to develop critical thinking skills (as cited in Toth, 1996).

McCarty (1992) examined that lecture method has some limitations. Students are passive, learning is difficult to gauge, and communication exists in one way.

Yates (1997) observed that classroom instruction is synonymous with the lecture method. The teacher stands behind a table and talks to students. No interruption exists due to the students. Today, literature offers that there are more suggestions and ideas for instructional gain than the traditional lecture. Bonwell and Eisin (as cited in Yates, 1997) have the suggestions of use of role-playing, simulations as active learning strategies to enhance the classroom instruction.

Simulation-role-play encourages the students to improve their opinions and comprehend abstract science concepts. Lecture method is informing anything more than grasping. Francis and Byrne write (no date), "lectures are highly effective method of transferring information from the notes of the lecturer to the notes of the students. A large body of educational research, however has shown that very little of this information is lodged in the minds of the students en route".

2.3 Simulation and Gaming

One possible solution for making classrooms environment dynamic is to change the focus of classroom activity from teacher-centered to student- centered. In this manner the role of the teacher is to organize information around conceptual clusters of problems, questions and discrepant situations in order to engage the students' interest, motivation and active participation. Teachers support the students in

developing new insights and connecting these with their previous learning. When we look around we see children or students engaging in searching the world around them. It may be pleasant and sometimes having results in changed behavior them, lets the students to have a better control of the event or the case. This is a kind of learning experience what we try to provide in our traditional classroom settings. Unfortunately like the boy or girl who easily remembers his or her favorite football team's score averages but fails science or a branch of science; physics, students are not always motivated to learn that what the instructors like them to learn. The questions of how to provide experiences that facilitate student motivation is the base for searches.

Simulation was introduced into training to bridge the gap between theory and practice. The simulations have been of the role-play which have been found useful by students and have caused teachers to rethink their expectations of students. Also simulations puts a student into the role of the teacher facing a class to let him or her make decisions and then allows discussion of the decisions and the reasons why they are made (Tansey & Unwin, 1969). Simulation is defined as " a special type of game, based upon an abstract, limited model of some real phenomenon, usually a decision–making or conflict- resolution situation, and designed to teach the operation and interaction of principles that operate in the situation" (Clegg, 1991, p. 523). There are distinctions between simulations and games. The structured learning model which is designed to teach a specific concept or concepts about a certain system are simulations but the games are not usually tightly structured and are not preoccupied with the given certain concepts, depend on more the participants' actions and reactions (Gillispie, 1973).

Simulation is technique in which to obtain quantitative evaluations of the effectiveness. It is felt that if it motivates a student to the extent that he wants to come to school and enjoys the classroom experiences that are measure enough for the teacher (Tansey & Unwin, 1969).

Why simulation game is used? This technique has two important educational qualities stated by Gillispie (1973). Taking the positive features of group dynamics and focus a group's energies on a particular task or a specific concept of social

change as an ability is the first quality. There takes place human interaction and human understanding within a group is both inspiring and educational. The latter one provides a context in which all members in group can be teachers and learners simultaneously. Many of the structured learning environments plan one or a few person as teachers or learners. In the gaming context, the members teach one another, learn one another. Providing a context in which the students can learn from each other is the role of the teacher. Due to this, gaming provides not only motivation but also gives chance of participant equally in the educational process.

When the student plays a game or a simulation that is simplified, operational method of real life in the classroom he or she assumes a role and participates in the decision- making process. The characteristics of a game to operate in the classroom are a small fixed set of players, set of roles for reasonable actions and a time limitation. When the students individually involve, they are able to solve problems. They are satisfied when his or her senses, a new sight as the concepts are formulated. A high degree of interest is generated through realistic participation by means of games. These are the advantages for the games and simulations. On the other hand, there are some limitations of the games and simulations. While attempting a social context students may fall in false confidence. They are time-consuming activities. Many games are lasting for hours or for several days. Most games are played by only a few people. How can all the classes be involved in a simulation may be a problem (Gerlach & Ely, 1971).

In science education, interaction of these three elements (play, games and simulation) may be accepted as role-play which results in students' learning outcomes for their performed activity. Use of derived techniques from drama may be adapted in science education. Because of the adaptation, role-play in science education is the result of the drama, simulation and game (McSharry & Jones, 2000).

2.4 Role-play

The main goal of teaching is to convey the knowledge to the students and researches have indicated that effective teaching strategies are an area of concern to teachers. Role-playing is just one of the many educational tools; instructors have been available to achieve this challenge.

Role-playing refers a type of simulation requires to play or dramatize a given situation in which the dominant feature is relatively open-ended interaction among people. Being an effective method in the development of social skills, especially empathy; putting oneself in someone else's position and in the motivation of students has been proven. Counseling, interviewing, sales and customer services, supervision and management are the kinds of tasks lending them particularly to role-playing (Heinich et al., 2002).

In 2001 Orbik studied definitions of role-play in two categories. One is the clinical definitions and the other one is educational definitions of the role-play. Research and applied psychology and social psychology are the fields that are related with the role-play theory.

Yardley- Matwiejczuk (as cited in Orbik, 2001) described role-play as

> A range of activities characterized by involving participants in "as if" or "simulated actions" and circumstance. In brief, role-play or simulation techniques are way of deliberately constructing an approximation of aspects of a "real life" episode or experience, but under "controlled" conditions where much of the episode is initiated and /or defined by the experimenter or therapist (p.1).

Van Ments (as cited in Orbik, 2001) gave a definition which reflects the use of role-play in clinical area. "The idea of role -play is that of asking someone to imagine that they are either themselves or another person in particular situation".

Mc Sharry and Jones (2000) outlined that role play is a product of 'play', 'games' and 'simulation'. In science education it may be seen that there is an interaction between them. They showed the interaction in which the students who perform the activity resulting in learning outcome shown in Figure 2.2.

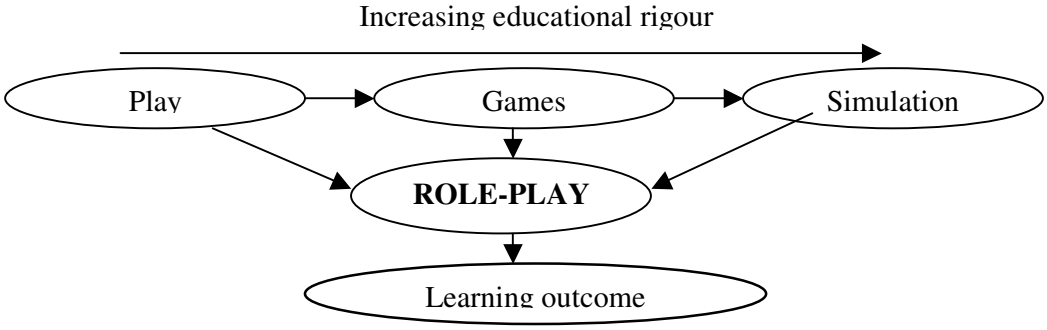


Figure 2.2 Role-play as the medium of interactive/experiential learning

Upright (2002) studied role-play a strategy to increase the empathy in the elementary school child. Schulman and Mekler (as cited in Upright, 2002), explains that the process of imaging that you are someone else, seeing the world through his or her eyes and then behaving as that person behaves is defined as role-play.

2.4.1 The place of role-play in teaching

The main question that a teacher may ask when considering the use of determined teaching method is why used or wanted to use. The main point is that how the teaching method fits into the all learning process. The teacher will organize the process with the help of number of activities and resources planned to be used in particular order to achieve a series of objectives. For this case, an appropriate teaching method or appropriate methods must be determined to meet the objectives. Conventional methods such as lectures, reading, discussions and writing are used successfully in order to help students gain the knowledge of factual material and the essential theoretical framework on the other hand they lack in two major respects. They are not effective to help to change the student's attitude or behavior is the first one. Reading or hearing in the lectures is not same as the experiencing. When they have experienced in the disappointment of being in similar situation whatever they

feel, they will have more sympathy and understanding towards it. Role-play is one of the experiential techniques that help the student to manage the idea of uncertainty

Taylor (as cited in McSharry and Jones, 2000) examined that theory behind the use of role-play in science teaching and learning is that students are reinforced to involve physically and intellectually which allow them to understand the concepts and express themselves in the context.

Van Ments (no date) states that conventional methods have to be supported by interpersonal and communication skills. The way to develop these skills is to use them in actual interpersonal situations. Counseling, interviews, customer service, personal relationships, committees, negotiations, public meetings or team working are individual and group situations to develop interpersonal skills. The role-play is ideally coping with the development of interpersonal skills.

The interpretations of Walters (as cited in Jackson, 1998) about role-playing are as following. It is a teaching device or technique in education which is used for a variety of reasons. Here are just given a few:

- To illustrate principles from the course.
- To avoid any prerequisites for performing various functions.
- To give students practice in using and applying what they have learned.
- To maintain and arouse interest.
- To increase ownership over ideas, concepts and experiences.
- To develop student insight and experience with human relations, both intra and interpersonal.
- To provide safe area in which to express feelings and share experiences.

This struggles to extend the traditional scientific experiences into an interdependent, people-oriented, small group, learning environment. The working of the role-play in scheduled course which focuses on learning new chemistry, analytical methods,

instrumentation, computer software developing management and leadership skills can be thought as a dynamic activity performed by a community of learners reflects much a community. He states his desire about the integration of science into an adventure that people together learn and like.

2.4.2 Subject areas

In 2001 Orbik stated that role-play as a distinct training event is fairly common in the literature of the fields of medicine, psychology, sociology and education.

Fadali, Robinson and McNichols (no date) state that there are documentaries about the use of role-play in the sciences in literature. The examples cover some areas and science may be the main one. They are public policy issues in sciences, interdisciplinary curricula consisting the sciences basically environmental sciences as one part, the traditional sciences of biology, chemistry, physics and environmental problems and or issues based on environmental sciences' knowledge.

Furthermore, role-playing can be implemented through the use of all kinds of suitable materials as props and ways to increase the real life- situations. Some examples to which role-playing can be put in, business education class, geography class, civics class, physics class and history class. In physics class, students are divided into groups or a student committee is formed. This group dramatizes the work of selected great scientists, stressing the contributions each has made toward improving our way of life. Each acting student of the scientists talks about his benefit effect of his contributions to today' life as though he was looking back on the world. Students compare the results and come to an agreement on their contributions (Brown, Lewis & Harcleroad, 1959, p.304).

2.4.3 Running the role-play

In the article about role-playing ("Role -playing simulations improve writing", 2002), it is reported that the components of a successful role-playing simulation game are; issue for the problem to be solved, players for the participants in the issue,

context for the information provided for the participants, rules for as guidelines, enactment for activities and products in which players engage and the outcome for the end of the activity.

There may exist some problems growing out of concerned with people, their actions and their opinions during the instructing the role-play. Organization of the class members and role-playing skills to involve in such kind of exercise will be developed by the considerate practice. In order to put into practice the designed role-playing activities, some steps are necessary for the intended objectives in a lesson period. The first one is to set the atmosphere. For this, putting the class members in a receptive mind, and then preparing them to join in learning as the objective mind. After setting atmosphere, setting the stage for the problem is necessary what problem or event you have assigned to be role-played. If there is no problem you determined, allow students to define a problem. During this, ask students the kinds of roles to perform the problem sufficiently. After the designation of the roles, select the persons for roles from the class. Choosing the students who has knowledge about the subject earlier can be useful. Later the role-playing can be carried out. The last step is discussing the presentation (Brown, Lewis & Harcleroad, 1959, p.304).

2.4.4 Debriefing

In the study of Enhancing Education (2002), it is stated that interactive teaching strategies like role-playing and simulations work best when they're presented spontaneously to students. Effective use of role-playing however requires preparation, a well defined format, clearly defined goals and outcomes and time to debrief after the simulation. Role-playing and simulations require students to improvise using the information available to them. In the process they encourage critical thinking and cooperative learning. These teaching tools can be effective in helping students clarify attitudes and ideologies and make connections between abstract concepts and real world events.

There are three main parts to any simulation: the briefing, the action and the de-briefing. At the briefing, a participant is given information and explanations about

the mechanics and procedures and the topical context in which subsequent action will occur. During the action phase, the participant has to play a specific role. Once the action has concluded the de-briefing and discusses outcomes (Jones, 1980). In the evaluation of role-playing de-briefing is usually preferred. It has four stages, de-compressing (feelings), describing (facts), drawing comparisons (transfer) and deriving lessons (application) (Heinich et al., 2002).

Following a role play activity Van Ments (as cited in Orbik, 2001) claimed the importance of debriefing. He summarized what should be in debriefing part;

> "Bringing p layers out of role, clarifying what happened (on factual level), dissipating tension/ anxiety, bringing out assumptions, feelings and changes which occurred during run, giving players opportunity to develop self-observation, relating outcome to original aims, analyzing why thing happened that way, drawing conclusions about behavior, reinforcing or correcting learning, drawing out new points for consideration, deducing ways of improving behavior, applying to other situations, linking with previous learning, providing plan for future learning".

2.4.5 Advantages and Disadvantages of role-play

Van Ments (no date) summarized the advantages of role-play on attitudes and feelings of the students as follows;

- Enables students to express hidden feelings.
- Enables student to discuss private issues and problems.
- Enables student to empathize with others and understand their motivations.
- Gives practice in various types of behavior.
- Portrays generalized social problems and dynamics of group interaction, formal and informal.
- Gives life and immediacy to academic descriptive material (history, english, economics, geography).

- Motivational and effective because it involves activity.
- Provides feedback for teacher and student.
- It is student- centered.
- Closes gap between training and real life situations.
- Change attitudes.
- Permits training in the control of feelings and emotions.

Johnson (1999) used role-plays to examine the effectiveness in teaching the role of the kidney to 15 year old double award science GSCE pupils. The ideas of the pupils were studied before and after the implementation of two role-plays related about the functions of the kidney in excretion and osmoregulation. After carrying out the role-plays the pupils' responses to questions suggested that role-play were effective in promoting learning. Many pupils enjoyed planning the role-plays and the role-play were found easier to recall how systems worked. There existed in maximum involvement, excellent atmosphere.

Bolton and Heathcote's extensive years of experience are collected in the book of 'So you want to play role-play?" They summarized all that in the book by describing six different kinds of learning can be resulted from role-play as concrete learning, acquiring information, going beyond information, training how to inquire, showing attention to detail that is learning to read signs or perceive change in values or attitudes (as cited in McCammon, 2001).

Role-play has potentional open to unruly behavior, it is quite hard to implement. It needs a great deal of judgment, skill and sensitivity to group dynamics. The teacher has to give new rules for the acting. These may lead confusion in learning. Teacher who is acquainted with role-play new may feel the situation unusual. Many of the students find role-play activities quite easy and full of enjoyment and satisfaction. It is time-consuming exercise (McSharry & Jones, 2000).

Sutcliffe (no date) summarizes the disadvantages of using role-play. According to his paper, the teacher gives up a high degree of control over the learning process, not only what is learned but also the sequence which is learned. When control is lost, there exists minimum usage of knowledge and fail ness to make use of knowledge effectively. A question arises that will the students simply play the role in an

ineffective manner? Paying attention to this point, a good and successful role-play depends upon the quality of the students involved and seriousness which is shown by the students acted in the role-plays. Role-plays need time in preparation, playing, the assessment part and the debriefing. So role-plays can be time consuming.

2.5 Definition of Misconception and Misconceptions about Simple Electric Circuits

Chambers and Andre (1997) reported that there was increase in the search of misconceptions in science. Students having ideas about natural phenomena that are inconsistent with scientific conceptions are called alternative conceptions or misconceptions.

Researches about students' conceptions relating various fields of physics are concluded. Simple electric circuits are one of the areas actively studied. The studies have identified a number of misconceptions about this subject (Chambers & Andre, 1997). Why electricity? Stocklmayer (as cited in Lochart, 2000) stated that electricity may be the most requiring effort and demanding unit for high school students to learn physics. Some reasons cause difficulty in learning the concepts of electricity. The one is that electricity can not be seen or observed when compared to other areas of physics. Because of presenting electricity as an element to be feared in the home, the cause of getting feared may lead inhibition of classroom learning.

The widespread misconceptions are summarized according to many researches as follows:

Weakening Current Model: There is an idea that electrical current flows in one direction but that current continuously weakens due to using of some of current by each device. In this circuit which comes later as a device uses less current than the earlier one is believed. That is the bulb which is close to the battery brightens more than the others. The brightness is proportional to the amount of current flowing (Chambers & Andre, 1997; Heller & Finley, 1992)

Sink Model: Students consider that a single wire connection allows electricity to sink from the power source to the electrical device, in that way this connection powers the device. In another words, students holding this misconception believe that

for bringing current to the bulb, only one terminal of the bulb is necessary. The students are not aware of necessity of closed circuit (Chambers & Andre, 1997; McDermott & Shaffer, 1992).

Clashing Current: Students holding this misconception believe that there exist two current which are positive and negative current. They think that positive current moves from positive terminal and negative current moves from negative terminal meet at a device and clash to power the device (Chambers & Andre, 1997; Heller & Finley, 1992).

Shared Current: Students believe that current is shared by the elements of the circuit equally and also is spent equally by the elements of the circuit (Chambers & Andre, 1997; Heller & Finley, 1992).

Power Supply as a Constant Current Supply: The idea of that the concept of current is more concrete than the concept of voltage let students to believe that the voltage is formed by the current. This idea causes in perceiving of students that a simple battery is not a voltage source but a current source. Students believe that battery releases the same amount of current to every circuit. It is regarded as a constant current source rather than a potential source (Cohen, Eylon & Ganiel, 1983; Dupin & Johsua, 1987; Heller & Finley, 1992).

Local and Sequential Reasoning: Students holding this misconception adopt that point. Whenever any part of the circuit is changed, other part of the circuit does not change; no attention may be given to possible changes. They tend to analyze the circuit as in two parts, the part before the changed device or the part after the changed part. They believe that change made at the, first part of the circuit affects all the circuit however the change made at the end of the parts in the circuit does not affect the complete circuit (Cohen et al., 1983; Heller & Finley, 1992).

Short Circuit Misconception: Students have the belief that a wire connected without any device has no effect in a circuit (Shipstone, Jung & Dupin, 1988).

Parallel Circuit Misconception: There is confusion in the understanding of series and parallel connected circuits. In this misconception students believe that adding a resistance is increased regardless of connection style, the equivalent resistance increases. Therefore adding a resistance in a parallel path in a circuit increases the

total resistance of the circuit due to this shining of bulbs in parallel would be less than shining of single bulb (Cohen et al., 1983; Dupin & Johsua, 1987).

Lochart (2000) had the purpose of to analyze the student misconceptions in the understanding of electricity and methods and suggestions to improve teaching in his study. The study consisted of charge transfer, electric field, difficulties distinguishing voltage and current, conceptions about circuits and current flow. The above given misconceptions and his study may help to understand the electricity more easily.

2.6 Studies about role-play

There are researches about interactive engagement methods which there are used in traditional classroom settings display that students' conceptual understanding was noticeable better than traditional methods (Hake, 1998b).

As the technological revolutions raise hopes that the teachers of science instructors of future will act as a facilitator of student-initiated, student directed learning. Technological innovations such as printing press, chalkboard, lantern slide, filmstrip, television, and computers have yet to displace the instructor or teacher from the center of the classroom (Knox, 1997).

Role-play which is one of the instructional strategies falls under the theory behind it is as using active learning device. It helps students develop values by modeling and using real life examples, employment of role-play and simulation strategies to help development of empathy, compassion, communication and other valuable affective and social skills (Hartman, 1997).

In order to teach and reinforce concepts, the variety of methods of instruction is used by the teachers in their classrooms. Carilli (2001) emphasizes that in her classroom, she had her students to use role-playing activities in the process of photosynthesis, the rotation and revolution of the earth around the sun and the interaction of organisms in a food chain. These activities let students to take an active role and demonstrate understanding of hard or abstract science concepts. In addition to this, Stencel and Barkoff (as cited in Mcsharry and Jones, 2000) thought protein

synthesis with the participation of Tchaikocsky's "Dance of the Sugar Plum Fairy" in their classroom to help students' understanding of biological concepts.

Wyn and Stegink (2000), a science teacher and PhD a professor of Science Education, introduce a role-playing about mitosis at biology applied at tenth grade high school and freshman-level college students with a sample of 52 students. During the instruction, the teacher mentored the tenth-grade biology students, after the application quiz scores from different biology classes were correlated with differences in method of instruction used. On identical scores, students that role-played performed better than students who did not use the role-play as an instructional strategy. Although the sampling was small, a summary of research findings has identified that role-play mitosis had a positive effect on students' understanding and their enthusiasm.

Following Rudolph's (2002) work, in attempt to investigate attitudes toward classroom management and effectiveness of classroom management practices based on traditional classroom management compared to a role-playing approach for preservice teachers with 36 interns of 2001-2002 secondary education core curriculum cohorts. The interns consisted of five areas including math, science, social studies and English and foreign language. The study was quasi-experimental study in which significant main effects were found for the attitudes and effectiveness variables. Attitudes of the interns toward classroom were found to be more positive also could be related to more classroom experience. In addition to this control's group attitude means showed an increase between the posttest and follow-up score. On the contrary, there have been significant differences as decrease time by time.

In a research to compare two methods to teach effective delegation decision-making, Keeling (1999) found that there was not a significant difference in control and experimental group posttest scores, because of the lack of support for role-playing with selected sample. It is effective and more supportive as a teaching method for delegation decision-making when replicating this study with a larger sample size and a more structured role-play.

In her study, Toth (1996) administered Critical Thinking Skills Test to a sample of 781 practicing college students during the 1989-1990 academic year in order to

examine the effectiveness of various instructional strategies (lecture, computer assisted instruction, role-playing, questioning, gaming...etc). According to statistical results, exposition of critical thinking abilities in freshman nursing students was supported for the concept of utilizing a variety of teaching strategies.

In order to improve multicultural education, Fischer and Laan (2002) had the aim to teach their students ways to extend their empathy into other societal situations with the help of practicing through role-playing. With the scenarios, role-playing allows the students to place themselves without any risk or threat in which they live the situations as a life experience.

Reichman and Weaver-Mayers (as cited in Keeling, 1999) decided to help nursing students to get better understanding about the problems and the feelings of cataracts and glaucoma patients. The sample size was not stated. If a student firstly acted in cataract patient situation, later acted in glaucoma patient situation. The result of these acting situations were reported as the better understanding of the problems faced by patients, the increase care in the clinical setting preparation.

In extending to further understanding of role-playing activities' effect, Resnick and Wilensky (1998) organized two role-playing activities to examine its role in mathematics and science education. These activities are designed to explore the behaviors of complex systems. For the development of understanding the casual mechanisms at work in complex system, role-playing provides a path. And also they give an example used in science classroom activities. By acting out the motions of the planets, the students learn about the solar system.

Moreover, Francis (2003) designed role-playing exercises for teaching astronomy and physics. Many of these exercises were successful to 10-12 high school students. He prepared them to teach students how solar systems form. While preparing the students for the situations, he describes some of the clues to the formation of the solar system. Then divide the class into groups and they are given the briefing papers. All the exercises have goals about the related subject. For example, in Captain Cook exercise, the aim is to allow students to think about long term benefits of space travel. Some of the arguments for and against this idea are given then the class is divided into groups. The members of the group have the role of the members

of the cabinet which decide whether to send Captain Cook to explore the South Seas. Once the player agreed with this argument, the players are asked to move forward some years and exchange the issues into space exploration.

A following example for social-role-play is stated by Hopkins (2003) can clarify the influence of its use to encourage empathy and profound comprehension of imposed societal roles is a role-play about discrimination. The teacher or instructor groups the class into at least two according to arbitrary variables such as taking eye color, hair color as critics. This group is threaded prefentially for an entire school day or class duration with special threats or special privileges. On the other hand the other groups who aren't complimented or favored are left out the activities. At the end of the period, the members of the groups argued their feelings. The teacher can widen this exercise and allow the students to experience the lives of famous historical people, such as Dr. Martin Luther King. With this exercise the students deal with reasonable sides of his life for the dominant culture.

Role-playing mitosis had a positive effect on students' comprehension of biological concept, mitosis. Although there exists a little loss of classroom management when some students get out of their seats and join hand-to hand, teacher can eliminate this with humor and encouragement, the students do the activity and experience the role-play as a problem-solving view (Wyn & Stegink, 2000).

In the study of Jackson and Walters (2000), role-play was used as the cooperative learning format in order to report the usage as means within the science education especially analytical chemistry. Role-playing is seen as a bridging educational model for the sciences. Here developing technical expertise at an individual level while simultaneously stressing and developing the communication and collaborative skills necessary to the profession is the goal of role-playing used. There were 238 graduates during the years 1987-1997 who completed the role-playing analytical class and laboratory as taught by Walters. Ninety-four surveys which were mailed to individuals were returned. As a result, it is reported that role-playing experiences not only affects the chemistry curriculum but also provides sudden attacks into other areas of study. The course which has offered analytical chemistry via formal cooperative-group structure predicated on role-playing has been implemented during

the last 15 years at St. Olaf College. This strategy has laid a base for continuation of evolutionary effort.

Some teachers prefer students' listening, watching during the instruction instead of taking part in the physical and intellectual activity, materialized by role-play (Lawrence, 1997). This happens because teachers get used to watching, listening or maybe they are in trouble to understand the needs of the students who have passed through the Piagetian stages of development in which the teachers are trying to encourage them. Lawrence (1997) states that "unless the teaching methodology embraces a variety of techniques, any student whose style does not match is likely to be disadvantaged".

Role-playing can be an ideal teaching strategy. Unfortunately it has some disadvantages. Webb (2002) argues that if the students in the class were not self-motivated learners or having strict discipline problems then it might be difficult for an inexperienced teacher to administer such kind of a role-play exercise.

Turner (1995) tried to determine whether a gender equity workshop intervention with searchers through in service would result in altered teacher behavior toward boys and girls during mathematics instruction. She used an outline consisting introduction to the in-service, setting the purpose of the in-service, giving information and creating awareness, participant involvement and summary to reduce gender differential through mathematics instruction. In the participant involvement part, role-play scenarios and character descriptions were used. Frequency of teacher interactions with boys and girls, types of teacher interactions with boys and with girls and the amount of wait time given to boys and girls were the areas of teacher behavior to possible gender differences in instruction to be examined. There existed ten teachers. In the summary of the research, one significant difference appeared in the area of types of student/teacher interaction. Boys started more conversation with teachers post in- service than pre in-service.

Jarrett (1997) suggested ways in which elementary school children can learn science and math through role-playing centers. They are common in preschool and kindergarten classrooms. This kind of playing around can encourage creativity. This will allow the students to try out future career roles and let them to construct their

understandings of the world by experiencing. To increase the effect of role-playing centers for the students' motivation and learning, providing initial props for them to use to make the play realistic, challenging them to use the skills they are learning, entering into the students' play to incite to think more deeply and play the roles realistically, providing enough time for them for interacting with the materials, giving chance to make real applications from the students' play. When if they are favored to have input and given opportunity to verify what they do at the centers will be more intrinsically motivating. Doctor's Office, Supermarket, Post Office, Veterinary Clinic, Museum are some of the role-play centers.

Sutcliffe (no date) tried to explore role-play as one dimension of active learning approach to teaching and learning. He used role-play to teach undergraduate business students: challenging the teacher supporting the learner. He wished to investigate the simplest form of role-play, where an individual is playing himself or herself placed in a specified situation. How that individual would behave as a result of what is happening around her or him.

Lehtela (no date) researched that teaching structure of matter in the science classroom that aims at supporting seventh graders' learning processes through the use of experiential teaching and role-playing seldom used in science education. The hypothesis of this study was that role-playing supports the reconstruction of the student's knowledge. Resnick and Wilensky (1998) asserted that role-playing activities in spite of being rarely used, they play an important role in the help of learning complex topics. This research is a part of larger project in attempting to develop alternative methods for the teaching of chemistry and physics. As a pilot study, a group of 15 students in November 1998 from the University Practice School in Joensuu, Finland conducted the study. Then the instruction consisted of eight lessons, was carried out at the Joensuu Secondary School in February 1999 with 18 students. The observations and students' reflective writing were the ways of data collection. Data were analyzed qualitatively and the results showed that the students gave positive feedback about role-playing activities in thought of help of role-playing activities. These activities had positive impact in monitoring learning process.

After the second part of the 20th century, great efforts dealing with science education have been suffered in determining the factors effecting the achievement in science courses. So many factors, such as socio-economic status, gender roles, thinking ability, problem solving ability, logic, fair, attitudes and especially teaching methods used through lectures and so forth have been studied.

Regarding attitudes and achievement, several studies have been reviewed. They show that students' achievement is affected by many variables. Simpson and Oliver (1990) studied to examine school, home and individual influences on attitude toward science and achievement in science among adolescent students. Class climate, other students, curriculum, physical environment, teacher, school, friends and best friend's attitude toward science are defined as school variables. School variables were the strongest impact on attitude toward science. Oliver and Simpson (1988) had the longitudinal study that is named influences of attitude toward science, achievement motivation, and science self concept on achievement in science. The main idea of the study is that student achievement is influenced by the constructs of attitude toward science, science self concept and achievement motivation in science. The degree to which a student likes science might be called as attitude toward science. Having interest in science is not enough to achieve at a high level in science. The self-concept is the factor to what extent does the student believe being successful is possible in science. What extents does the student try to do as well as possible when engaging in science is the motivation factor? Jenkins (2000) reported that role-playing invited students physically act out the actions of a person or object to learn or clarify a concept.

Elms (as cited in Patterson, 1996) reported that researchers begin to think that a possible attitude change has been caused by role-playing. Renaud and Suissa (as cited in Patterson, 1996) used role-playing simulations to teach traffic safety rules. They claimed that behavior was changed by means of role-playing. But they found some problems in terms of fully explaining student reaction to role-playing.

Zoubeir (2000) aimed to explore the impact of computer simulations guided by interactive engagement techniques within a traditional classroom setting on students' understanding of Newtonian Mechanics and on attitudes towards physics. Attitude

towards physics was defined as students' being in physics classroom is how perceived, usefulness of physics as a discipline is how assessed, the importance of what they learned in classes and its importance in developing the ability to interpret everyday physical phenomena are how related with the real life experiences.

Physics branch is one part of the education. Physics learning and teaching activities interact with many other social activities. In teaching, the kind of method used in lectures is very important. Because the responsibility to attend the interaction of physics with society is important in school science. Physics must be taught as human activity which has relevance to the individual in his social, physical and biological environment. However, the students think that physics is more difficult than the other subjects. The impression of difficulty is one aspect of a generally unattractive image of physics that young people have acquired. Physics does not appear to deal with real things which can be seen and handled, but rather with abstract entities. Because teachers present subjects rather than encouraging involvement in physics as an activity, students think that they can not contribute their own ideas on the physics subjects.

Students think that physics is the most difficult lesson to learn and understand among all lessons they take. Teaching physics can be more enjoyable and encouragable to learn. Teachers are the important factors of increasing the interest of students in physics. Their characteristics are effective for increasing the student interest in physics. And also they can provide enjoyable learning in some ways such as; using different educational techniques, using different teaching methods, motivating students with the educational techniques. In addition to this, the government has an important role in learning physics in the raising and enjoyment of students in physics by the curriculum development, supplying materials for schools.

A simple question must be answered; what is wrong with the ordinary lecture in teaching physics or another branch? Most critics note that the lecture is a passive way of learning for students (Knox, 1997). There are many teaching methods, it is difficult to choose which one is available for this lecture or subject for teachers. In this study role-playing is used versus lecture method in a traditional classroom

setting. The purpose is to examine the effect of role-play on the students' school physics achievement and attitude at 9th grade level at electricity.

2.7 Summary of the Literature Review

1. The development of new knowledge, skills or attitudes by means of the interaction with environment and information by the learner or individual is defined as learning (Heinich et al., 2002).
2. The influences on attitude and achievement in science among adolescent students has been questioning in many studies. Home, school and individual characteristics have been addressed main categories affecting achievement and attitude (Simpson & Oliver, 1990).
3. Traditional teaching method; lecture connected with textbooks is a useless method to teach and it makes students passively engaged in learning, prevents them from doing or performing science activities (McDermott, 1990; Saha, 2001). Direct instruction/lecture is strategy in which objectives of the subject, explanations of concepts are introduced by a teacher. It is teacher-oriented (Jenkins, 2000).
4. Role-playing has many definitions. It covers ranging from simple-make believe and play-acting to sociodrama (Wittich & Schuller, 1973). Role-play is defined as a type of simulation in which the noticeable properties is relatively open-ended interaction among people (Heinich et al., 2002).
5. In the literature, role-play is commonly used as a training method in the fields of medicine, psychology, sociology, business and education (Orbik, 2001).
6. Most effective role-plays grow out of problems related with people, their actions and their beliefs. In classroom, setting the atmosphere, setting the stage for the problem, selecting persons/students for roles, role-playing the situation then discussing the presentation are the steps for the role-play application (Brown, Lewis & Harcleroad, 1959).

7. Role-play activities make science vivid, meaningful and fun for the most of the students (Wyn & Stegink, 2000; Johnson, 1999; McSharry & Jones, 2000).
8. The major obstacles to role-play activities are; relinquishing a high degree of control over the learning, lack of giving seriousness to the activities by the students, time in preparation, playing and debriefing (Sutcliffe(no date); McSharry & Jones, 2000).
9. In the study of Rudolph (2002) summarized that the role-play has positive effect on attitudes towards classroom management.
10. The studies of Johnson (1999), Lehtela (no date), Wyn and Stegink (2000) were qualitatively analyzed studies about role-play. The results of these studies showed that students' reactions to use of role-play activities were positive.
11. We could not find experimental studies about role-play. Hake (1998b) listed role-play as one of the interactive engagement methods. However, he used role-play as simulation.
12. There are some studies analyzing the effect of role-play on biology concepts (Johnson, 1999; Wyn & Stegink, 2000). However, they are all qualitative studies.

These summary results indicate that there should be studies to obtain some educational goals in the area of physics. The goals are: 1) to improve and make valid Physics Achievement Test, 2) to develop role-play activities concerning objectives of the research, role-play activity-criteria, and misconceptions of the students considering simple-electric circuits, and 3) to analyze the effects of role-play activities on ninth grade students' achievement and attitudes towards simple-electric circuits.

CHAPTER 3

METHODS

In the previous chapters, the problem and hypotheses of the study were given, the related literature was reviewed, and the significance of the study was presented. This chapter includes population and sampling, description of variables, development of measuring tools and teaching/ learning materials, procedure, methods used to analyze data.

3.1 Population and Sample

The target population of this study is the ninth grade high school students in Acıpayam. There are 5 high schools in this town. According to our appropriateness of the study the accessible population is determined as ninth grade students from high schools in Acıpayam.

One of the high schools is chosen. There are 6 ninth grade classes in this school. There were 104 ninth grade students from four classes of two physics teachers. These were chosen as a sample of convenience. Both teachers have one control and one experimental class. The experimental classes were instructed by role-play activities on the other hand the control classes were instructed by traditional method. These teachers allowed the researcher to observe their physics classes. There were 55 students in experimental and 49 students in control group.

The ages of students range from 14 to 17. Distribution of ages of the students who were administered the pretests and posttest with respect to gender is given in Table 3.1. Most of the students involved in this study are 15 years old.

Table 3.1 Characteristics of the Sample

Gender			
Age	Female	Male	Total
14	1	-	1
15	41	37	78
16	6	13	19
17	3	3	6
All	51	53	104

3.2 Variables

There are seven variables which were classified as dependent and independent variables. Two of them are dependent variables (DVs) and the other ones are independent variables (IVs). Group membership and covariates are determined as IVs. Table 3.2 shows the characteristics of the variables

Table 3.2 Identification of the Variables

TYPE OF VARIABLE	NAME	TYPE OF VALUE	TYPE OF SCALE
DV	PSTACH	Continuous	Interval
DV	PSTATT	Continuous	Interval
IV	AGE	Continuous	Interval
IV	PREACH	Continuous	Interval
IV	PREATT	Continuous	Interval
IV	GENDER	Discrete	Nominal
IV	TM	Discrete	Nominal

3.2.1 Dependent Variables

The DVs are Students' Physics Achievement Posttest Scores (PSTACH) and Students' Physics Attitude Posttest Scores (PSTATT). Simple electric circuits' concepts are measured by Physics Achievement Test (PACHT) and Physics Attitude Scale (PATTS). The PSTACH and PSTATT are continuous variables and measured on interval scales. Students' possible minimum and maximum scores ranges from 0 to 25 for the PSTACH and 24 to 120 for the PSTATT.

3.2.2 Independent Variables

The IVs are divided into two groups; Group 1 consists of Students' age, Physics Achievement Pretest Scores (PREACH), Physics Attitude Pretest Scores (PREATT) and gender as covariates. They are considered as continuous variables and measured on interval scales. Group 2 is composed of Teaching Methods (TM) (role-play activities and traditional teaching method) as group membership. These variables are considered as discrete variable and measured on nominal scale.

For gender variable, female students were coded as 1 and male students were coded as 2. Minimum and maximum scores range from 24 to 120 for the PREATT, 0 to 25 for the PREACH and 14 to 17 for age, respectively.

3.3 Measuring Tools

In this study Physics Achievement Test (PACHT), Physics Attitude Scale (PATTS) concerning simple electric circuits and observation checklist were administered as measuring tools.

3.3.1 Physics Achievement Test

In order to assess the students' achievement about simple electric circuits, the instrument: PACHT was developed by the researcher. The content of simple electric circuits according to the curriculum in the ninth grade are composed of circuit

elements, potential difference, electric resistance, OHM'S Law, electric current, electric current in series connected circuits and electric current in parallel connected circuits, compound circuits and short circuits. There are 25 questions in the test. Students have the possibility of taking scores ranging from 0 to 25.

An objective list (See Appendix A) of the simple electric circuits was prepared before the development of the PACHT. There were totally 33 objectives for the simple electric circuits. Afterwards, many searches of different wide range of sources (physics books, University Entrance Exam Questions, review of the related literature, other researchers' instruments) are done to develop physics achievement test. Each question was prepared by considering the objective list. A table of specification (See Appendix B) was prepared in which all questions are settled in terms of cognitive domain of Bloom's Taxonomy.

Three physics teachers helped the researcher in controlling the appropriateness of the questions to the objectives and the curriculum. The researcher prepared 20 questions by this way. Five of the items were true-false, three were matching, and twelve of them were multiple-choice questions. Furthermore five questions of the test were ordered according to the study of Sencar (2001) to cope with the misconceptions concerning simple electric circuits. The PACHT consisting of 25 questions (See Appendix C) was administered to both control and experimental group students before the treatment and after the treatment.

3.3.2 Physics Attitude Scale

PATTS (Physics Attitude Scale) was developed by Taşlıdere (2002). The items used in the scale are to be rated on a 5-point likert type response format (absolutely disagree, disagree, neutral, agree, absolutely agree). It consists of 24 items. The possible scores ranges from 24 to 120 in which getting higher scores indicates positive on the other hand getting lower scores indicate negative attitudes towards simple electric circuits.

The scale contains five sub categories; Enjoyment, Self-efficacy, Importance of Physics, Achievement-Motivation, Interest Related Behavior. For this study, in

each category, one of the items is written in the negative form. The item numbers written in negative form are 4, 8, 13, 17, and 24 given in Appendix D. Enjoyment category includes the items which are 1, 2, 3, 4, 5, Importance of Physics category includes the items which are 6, 7, 8, 9, 10, Interest Related Behavior category includes the items which are 11, 12, 13, 14, 15, Achievement-motivation includes the items which are 16, 17, 18, 19, and the items 20, 21, 22, 23, 24 are in Self-efficacy category. Enjoyment which is measured with five items, relates with students' personal interest toward simple electric circuits. The belief in one's capabilities to organize and execute the sources of action required to manage prospective situation is called as self efficacy measured by five items. Importance of Physics is related with the importance given to simple electric circuits and measured by five items. Achievement motivation measured by four items is explained as the combination of psychological forces which start, direct and sustain behavior toward successful attainment of some goal, providing a sense of significance. The last sub category is Interest Related Behaviors measured by five items. It answers what degree that students' like to do out of the class activities concerning simple electric cir cuits. The PATTS is given in Appendix D.

Reliability analyses were performed for the post attitude scores. The value of α was 0.83 for the PSTATT. This implies that scores obtained on the PATTS are reliable.

3.3.3 Observation Checklist

The instrument Observation Checklist is taken from the study of Hardal (2003). It was developed for the verification of the treatment. It consists of 12 items. Ten of the items were rated on five-point response format. The other items were designed to be rated four-point response format. One shows whether if the activities were done alone, in pairs or in groups of three. The other indicated how much time is spent by the students on doing role-play activities. "No activity" choice is included in all items to discover whether any activity or not is performed by the teacher in groups. There are twelve observations. Six of them are for experimental and the

others are for control groups. Ten of observations were made by the researcher and two of them were made by a physics teacher from one of high school in town (See Appendix E).

3.4 Teaching and Learning Materials

Objective list, Table of Specification, role-play activities, objective-activity table, criteria-activity table, misconception-activity table, daily lesson plan and handouts were used as materials in this study.

During the preparation of the role-play activities, the objective list about the simple electric circuits, activity criteria and misconceptions concerning this physics subject were taken into consideration. Due to this, five role-play activities (See Appendix F) were developed to manage the students' active engagement in simple electric circuits by use of wide range of educational sources (Jackson &Walters, 2000; Johnson, 1999; McSharry & Jones, 2000; Wyn & Stegink, 2000;). The names of the activities are; hand on hand is used to understand the concept of closed-open circuits and simple circuit; way with obstacles is used to grasp the resistance and the factors affecting resistance; the world of Mr. Ohm is used to comprehend the Ohm's Law and its usage; landing-leaving is used to understand the voltage difference and the direction of current, and also it is prereadiness activity for the activity of the world of Mr. Ohm; business world is used to explain the series and parallel connected circuits. Every activity consists of subject, purpose, method, roles, materials used in this activity and things to do in the activities parts. After doing the activity, there is an assessment part which is named as "what things did we observe, are you ready to share them?" The materials used in the activities are simple materials and can be easily found which are beads, and film boxes. In addition to make clear the knowledge more, simple materials such as ammeter, bulb, socket, battery, switch, voltmeter and connection wires were used.

Objective-activity table (See Appendix G) was prepared to explore that whether these role-play activities were properly developed. It is a table showing that which role-play activities matches with objectives. Then the items of the criteria-

activity table (See Appendix H) were taken from the study of Hardal (2003) to indicate which activity is related with role-play activities. However one of its items was changed. In her study, 7th item was: "Activity is done individually", but in this study 7th item was: "Activity is done in groups". Lastly, misconception -activity table (See Appendix I) was prepared to show that which activity is prepared to take into consideration of misconceptions about simple electric circuits.

After preparing tables, daily lesson plans were prepared to follow the lesson regularly during the instruction (See Appendix J). Then some handouts (See Appendix K) concerning about the subjects in simple electric circuits for this study were also prepared. In these handouts, some of the necessary definitions, symbolic representations and unit of the circuit elements and also some figures (See Appendix L) were given only the students in the experimental group to show the relationship between the concepts.

3.5 Treatment Implementation

In teaching, how teaching materials are used effectively is important. The steps in the lecture were clearly explained in daily lesson plan as seen in Appendix J. This section clarifies how teaching and learning materials were used. Objective list, table of specification, role-play activities, objective-activity table, misconception-activity table, daily lesson plans, figures and handouts are teaching and learning materials for this study.

Daily lesson plans were prepared for the experimental group to follow up the instruction in the lesson. For example, to teach the factors affecting resistance, daily lesson plan 4 was developed.

In the lecture, teacher wanted the students to define potential difference and current and also to explain the relationship between them. By doing this, resistance was defined. Teacher listened all the answers of the students without saying "It is correct or it is wrong". Afterwards, teacher answered the questions. Then teacher asked "What factors can affect the resistance?"

For this lesson, a figure consisting of the definition, unit, symbol in a circuit, factors affecting resistance and the relationship between the factors of the resistance used as a slide on over-head projector. Teacher put the slide on the over-head projector. Teacher explained the usage of the figure. For instance, teacher gave the unit of resistance as in; "The unit of the resistance is Ohm." After explaining the figure, the photocopies of the figure were distributed to the students. And also the handouts were given them.

After explaining the factors, teacher told that activity 4 would be done. The roles of the activity 4 were distributed to the students in the previous lesson. The copies of the activity 4 were given the students. Teacher made some explanations. Teacher told the students to read the instructions about the activity carefully. The activity was approximately done in ten minutes by following the instructions. Then the questions in activity 4 were answered.

3.6 Procedure

A detailed review of the literature search was done at the beginning of the research. Educational Resources Information (ERIC), International Dissertation Abstracts (DAI), Social Citation Index (SSCI), Ebscohost, Science Direct, Kluwer and Internet (Google, Altavista) were searched systematically after determining the keywords. Previous studies made in Turkey about this subject were searched from the YÖK, Hacettepe Eğitim Dergisi and Eğitim ve Bilim. The photocopies of journals, books or documents which are obtainable were taken from the libraries of METU and Bilkent and also from Tubitak Ulakbim. The related documents from the Internet (Google, AltaVista) were downloaded and printed. Then all the papers were read and useful notes were taken. Researches were compared with each other. In order to prepare role-play activities the researcher benefited especially from the articles; Role-playing Mitosis (Wyn & Stegink, 2000) Kidney role-plays (Johson, 1999) and Role-play in science teaching and learning (McSharry & Jones, 2000). Incase of new recent articles on this topic the literature was checked continuously.

Furthermore, the measuring instrument (PACHT) and teaching/learning materials as stated in Section 3.3 and 3.4 were developed. The materials which are objective list, table of specification, objective-activity table, criteria-activity table, misconception-activity table, role-play activities, handouts and PACHT were checked by three instructors, a research assistant from Pamukkale University in Denizli. Before the implementation necessary changes and updates in all materials were arranged. Then in order to administer them, necessary permission has been granted from Denizli İl Milli Eğitim Müdürlüğü (See Appendix M).

This study was a quasi-experimental research design. Before the treatment application, two physics teachers having both a control and an experimental group were trained by the researcher. They were informed about the role-play activities and how to teach the simple electric circuits by using the role-play activities. The administration and application procedures were implemented regularly after getting promision from the teachers in standardizing the procedures.

The PACHT and PATTS were administered to both experimental and control groups by the teacher's one -week as a pretest before the treatment. The students were informed that taking the grades from this test would have no effect on the students' physics grades. The students were remembered to complete the information part related to their age and gender. To complete the PACHT and PATTS, one class hour was given and it was enough to complete the instruments.

A traditional teaching method was used in the control group students. Note-taking strategy was generally used. Important concepts, problems related with the concepts were explained by the teacher and if necessary or when the teacher said, the students took notes, wrote the things written on the blackboard. When necessary, teacher explained the concepts with demonstrations made by simple materials such as ammeter, voltmeter, battery, bulbs and connection wires. After some time, students asked their questions about incomprehensible parts during the lecture. On the other hand, the students in the experimental group were taught with role-play activities which are individually or in pairs. Before doing role-play activities, teacher explained subjects briefly and gave handouts to them. Then the students were given role-play activities sheets with a part 'what did we observe? Are you ready to share

them?" They followed the procedure and answered the questions. Later they discussed their observations. Here the teacher mostly acted as a guide and helped them. In some cases, for example while completing observation part, they got in trouble to answer the sides of similarity and unsimilarity of the activity with the real life event. Teaching the definitions of simple electric circuits' elements is the one subject that can not be taught by role-play activities. This subject is briefly summarized by the teachers to the experimental groups.

During all lessons, for both groups observation checklists were used to compare the experimental and control groups in terms of the treatments used in their classes. After three weeks treatment time, both experimental and control groups administered the PACHT and PATTS as a posttest again. Pretests and posttests were scored and data was entered to the computer using Excel.

3.7 Analyses of Data

Raw data of students' gender, age, PREATT, PSTATT, PREACH, PSTACH and TM were taking place in data list (See Appendix N). It was prepared by the use of Excel. Columns show variables where as rows show the students engaging in the study in this Excel program. Excel and SPSS were used to analyze the data statistically.

Multivariate analysis of covariance (MANCOVA) was used as a statistical technique because it incorporates two or more than dependent variables in the same analysis (Fraenkel & Wallen, 1996). Covariates of age, gender, the PREATT and PREACH was firstly entered in the MANCOVA model, then group membership was entered in the analysis. Thirdly interactions between covariates and group membership were determined.

In the analysis section, the probability of rejecting true null hypothesis (probability of making Type 1-error) was set to .05 mostly used value in educational studies. The study was analyzed with a sample of 104 high school students. Students' age, gender, pretest and posttest of physics achievement and physics attitude scale and also teaching methods used in the study were defined as variables. Effect size

was set to small in this study (f^2 =0.3 for mean difference and 0.08 for variance). Power of this study with that sample size and small effect size was calculated as 0.8. Therefore, the probability of failing to reject the false null hypothesis (probability of making Type 2-error) was found as 0.2 (i.e., 1-0.8). The effect size was calculated by the formula as follows;

$$L = f^2 (n-k-1)$$

n: sample size

k: the number of independent variables

Then using table given in the book (Cohen & Cohen, 1983), the value of effect size was determined.

CHAPTER 4

RESULTS

This chapter consists of three sections; descriptive statistics section which is associated with the data obtained from the implementation of physics achievement and physics attitude posttests is given firstly. The second section is related with the inferential statistics in which data is produced from analyzing the three null hypotheses. At the end of this chapter, there is a summary of the findings of the study.

4.1 Descriptive statistics

Descriptive statistics related to the Physics Achievement Pretest Scores (PREACH), Physics Achievement Posttest Scores (PSTACH), Physics Attitude Pretest Scores (PREATT) and Physics Attitude Posttest Scores (PSTATT) of students for both experimental and control groups are given in Table 4.1

The scores of students on achievement change from 0 to 25 with higher scores meaning greater achievement. As seen from Table 4.1, the mean of the PREACH is 11.02 and the PSTACH is 14.22 for the experimental group on the other hand the mean of the PREACH is 9.20 and the PSTACH is 12.57 for the control group. There is a mean increase of 3.2 in the experimental group and the change for control group is 3.37 points on the Physics Achievement Test (PACHT).

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

Group		PREACH	PSTACH	PREATT	PSTATT
Experimental (N=56)	Mean	11.02	14.22	83.56	81.07
	Std. Deviation	2.65	2.65	10.19	12.28
	Skewness	-.250	-.251	-.186	-.325
	Kurtosis	-.169	.013	-.670	.285
	Range	11	12	42	62
	Minimum	2.65	7	61	45
	Maximum	5	19	103	107
Control (N=53)	Mean	9.20	12.57	83.08	84.04
	Std. Deviation	2.77	2.40	10.15	8.35
	Skewness	-.565	-.045	-.541	.407
	Kurtosis	.056	-.498	-.234	-.129
	Range	12	12	43	36
	Minimum	3	6	59	70
	Maximum	15	18	102	106

Students' attitude scores range from 24 to 120 where higher scores show more positive attitude towards simple electric circuits on the other hand lower scores show negative attitudes towards simple electric circuits. As seen from Table 4.1, experimental group shows decrease of 2.49 where as there is mean increase of 0.96 for the control group for the Physics Attitude Scale (PATTS). When compared the change, it is less for control group.

Moreover, Table 4.1 shows some other basic descriptive statistics like standard deviation, skewness, kurtosis, range, minimum and maximum values. The value of skewness for the PREACH was –0.250 and changed to –0.251 for the experimental group, this value was –0.565 and changed to –0.45 for the control

group. As Table 4.1 indicates, the value for the PREATT was –0.186 and changed to –0.325 for the experimental group on the other hand the value of skewness for the PREATT for the control group was –0.541 and changed to –0.407. Kunnan (as cited in Ağazade, 2001) states that the skewness and kurtosis values between –2 and +2 can be assumed as approximately normal. By considering this, the values of skewness for the PREACH, PSTACH, PREATT and PSTATT can be accepted as approximately normal

As Table 4.1 shows that, effect size for the treatment on achievement and attitude were calculated as 0.69 and 0.36 respectively. These values are obtained by dividing the difference between the means of the two groups by the standard deviation of the control group.

The histograms with normal curves related to the PSTACH and PSTATT for the experimental and control group were shown in Figure 4.1 and Figure 4.2

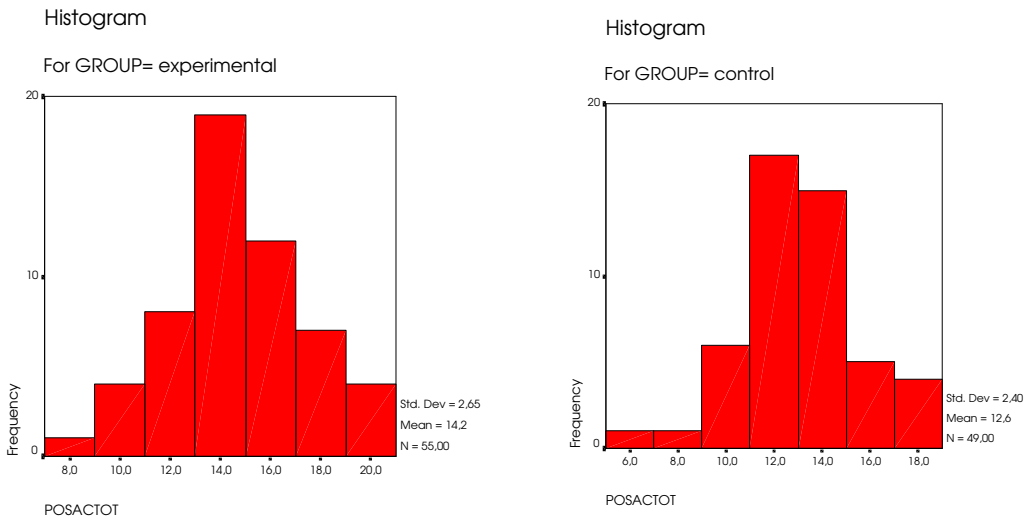


Figure 4.1 Histograms with normal curves related to the PSTACH for the experimental and control groups

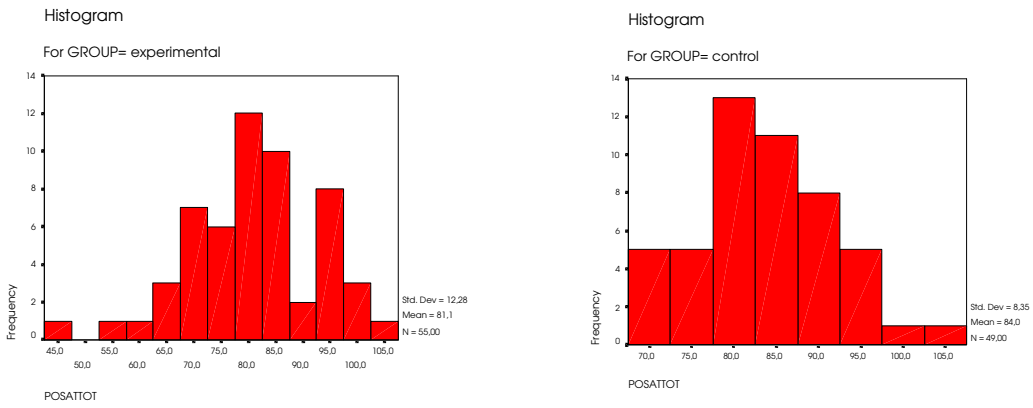


Figure 4.2 Histograms with normal curves related to the PSTATT for the experimental and control groups.

4.2 Inferential Statistics

This section includes analysis of missing data, determination of covariates, verification of MANCOVA assumptions, statistical model of MANCOVA, analysis of hypotheses and the results of classroom observations.

4.2.1 Missing Data Analysis

Before the inferential statistics, the missing data analysis was carried out. Initially, pretests were applied to 109 students. However five students who had been pretested were absent on the date of posttests. Missing data constitutes a range smaller than 5 % of the whole data. Therefore, the data of these five students were excluded from statistical analysis of the study completely. Then the statistical analyses were done with the sample of 104.

4.2.2 Determination of Covariates

Four IV's students' ages, gender, PREACH and PREATT wer e determined as potential factors for the study. These variables were addressed as covariates in order to equalize the differences among the experimental and control groups statistically. These variables have been correlated with the dependent variables of the PSTACH and PSTATT. Table 4.2 indicates the correlations and level of significance. The PREACH has significant correlation with the dependent variable of the PSTACH. The PREATT has significant correlation with dependent variable of the PSTATT. But the other IVs did not have significant correlation with DVs. Hence; PREACH and PREATT were determined as covariates for the following inferential analyses. None of the correlation value between the covariates is greater than 0.8 therefore there is no multicollinearity among covariates as seen from Table 4.2.

Table 4.2 Significance Test of Correlations the Dependent and Independent Variables

	Gender	Age	PREACH	PSTACH	PREATT
Age	.122				
PREACH	-.011	.152			
PSTACH	.099	.092	.311*		
PREATT	.023	.100	.149	.156	
PSTATT	-.078	.056	.037	.137	.517*

*Correlation is significant at the level 0.05 level (2-tailed)

4.2.3 Assumptions of Multivariate Analysis of Covariance

This analysis model has the assumptions of normality, homogeneity of regression, equality of variances, multicollineriaty and independency of observations.

As seen from Table 4.1, skewness and kurtosis values of the PSTACH and PSTATT were in approximately acceptable range in order to verify the normality assumption for this study.

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 4.3 shows the results of Multivariate Regression Correlation (MRC) analysis of homogeneity of regression for the DV of the PSTACH. Table 4.4 indicates the results of MRC analysis of homogeneity for the DV of the PSTATT. For this analysis, interaction terms were produced. These interaction terms were prepared by multiplying the group membership with the pre-achievement and pre-attitude variables.

Table 4.3 Results of the MRC Analysis of Homogeneity of Regression for the PSTACH

	Change Statistics				
Model	R Square Change	F Change	df1	df2	Sig. F Change
1	.109	6.173	2	101	.003
2	.051	6.102	1	100	.015
3	.037	2.288	2	98	.107

Table 4.4 Results of the MRC Analysis of Homogeneity of Regression for the PSTATT

	Change Statistics				
Model	R Square Change	F Change	df1	df2	Sig. F Change
1	.269	18.570	2	101	.000
2	.022	3.033	1	100	.085
3	.003	.230	2	98	.795

As seen from Table 4.3 and Table 4.4, there is no significant interaction between the covariates and group membership. The values are (F (2, 98) = 2.288, p=.107) for the PSTACH and (F (2, 98) = 0.230, p= .795 for the PSTATT. So the homogeneity of regression assumption is validated.

Table 4.5 shows the Box's Test of Equality of Covariance Matrices. It indicates that the observed covariance matrices of the DVs are not equal across groups. This assumption is not validated.

Table 4.5 Box's Test of Equality of Covariance Matrices

Box's M	8.648
F	2.821
df1	3
df2	3321560
Sig.	.037

As seen from Table 4.6, Levene's Test of Equality of Error Variances was used to determine the equality of variance assumption. The error variance of the PSTACH dependent variable across groups was equal, but the error variance of the PSTATT dependent variable across groups was not equal.

Table 4.6 Levene's Test of Equality of Error Variances

DV	F	df1	df2	Sig.
PSTACH	.004	1	102	.951
PSTATT	5.564	1	102	.020

The other assumption for this study is that observations should be independent of one another. The researcher coped with the observations during the lectures. The observations indicated that all students did the post and pretests by themselves.

4.2.4 Multivariate Analysis of Covariance Model

Dependent variables of this study are post achievement (PSTACH) and post attitude (PSTATT). Pre achievement (PREACH) and pre attitude (PREATT) are the covariates of the study. As seen below, Table 4.7 indicates the results of MANCOVA. By looking at Table 4.7, teaching methods (TM) presents 9.4 % variance of model for the collective DVs of the PSTACH and PSTATT.

Table 4.7 MANCOVA Results

Effect	Wilks' Lambda	F	Hypothesis df	Error df	Sig	Eta Squared	Observed Power
Intercept	.742	17.243	2.000	99.000	.000	.258	1.000
PREACH	.953	2.445	2.000	99.000	.092	.047	.482
PREATT	.728	18.496	2.000	99.000	.000	.272	1.000
TM	.906	5.166	2.000	99.000	.007	.094	.816

4.2.5 Null Hypothesis 1

In this study, "There will be no statistically significant effects of teaching methods (role-play activities versus traditional teaching method) on the population means of common dependent variables of ninth grade students' physics achievement posttest scores and physics attitude posttest scores when students' age, physics achievement pretest scores, physics attitude pretest scores and gender are controlled" is the first null hypothesis. As Table 4.7 indicates, the first null hypothesis was rejected (λ= 0.906, p= .007). There were significant differences among role-play activities and traditional teaching method on the common dependent variables of the PSTACH and PSTATT.

An analysis of covariance (ANCOVA) as follow-up test to the MANCOVA was conducted to test the impact of independent variable of the TM on each DV. In Table 4.10, the results of the ANCOVA can be seen.

Table 4.8 Tests of Between-Subjects Effects

Source	DV	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared	Obs. Power
Corrected Model	PSTACH	116.232	3	38.744	6.357	.001	.160	.962
	PSTATT	3402.563	3	1134.188	13.640	.000	.290	1.000
Intercept	PSTACH	105.146	1	105.146	17.253	.000	.147	.984
	PSTATT	1836.619	1	1836.619	22.087	.000	.181	.996
PREACH	PSTACH	29.882	1	29.882	4.903	.029	.047	.592
	PSTATT	.855	1	.855	.010	.919	.000	.051
PREATT	PSTACH	9.922	1	9.922	1.628	.205	.016	.244
	PSTATT	3087.550	1	3087.550	37.131	.000	.271	1.000
TM	PSTACH	37.186	1	37.186	6.102	.015	.058	.687
	PSTATT	252.164	1	252.164	3.033	.085	.029	.407
Error	PSTACH	609.422	100	6.094				
	PSTATT	8315.351	100	83.154				
Total	PSTACH	19518.000	104					
	PSTATT	719073.000	104					
Corrected Total	PSTACH	725.654	103					
	PSTATT	11717.913	103					

4.2.6 Null Hypothesis 2

"There will be no statistically significant effects of teaching methods (role-play activities versus traditional teaching method) on the population means of ninth grade students' physics achievement posttest scores when students' age, physics achievement pretest scores, physics attitude pretest scores and gender are controlled" is the second null hypothesis for this study.

Table 4.8 indicates that the second null hypothesis was rejected ($F(1, 100) = 6.102$, $p = .015$). That is; role-play activities were effective in increasing the PSTACH.

Higher physics achievement scores were taken by the students instructed by role-play activities than the students instructed by traditional teaching method.

4.2.7 Null Hypothesis 3

The third null hypothesis was posed: 'There will be no statistically significant effects of teaching methods (role-play activities versus traditional teaching method) on the population means of ninth grade students' physics attitude posttest scores when students' age, physics achievement pretest scores, physics attitude pretest scores and gender are controlled".

As conducted in Table 4.8, the third null hypothesis is not rejected ($F(1, 100) = 6.102$, $p = 0.85$). That is, there is no significant difference in the means of the PSTATT between the experimental and control groups.

4.2.8 Non-parametric Analysis

The assumptions of the inferential analyses were not established. Due to this, the non-parametric analyses were done in addition to the parametric analyses.

Table 4.9 shows the results of the Mann-Whitney U Test. The effect of role-play activities was significant ($p = .001$) on high school students' physics achievement but it was not significant ($p = .249$) on the attitudes of students.

Table 4.9 Non-parametric results of the analysis; Mann-Whitney U Test

	PSTATT	PSTACH
Mann-Whitney U	1170.500	850.000
Wilcoxon W	2710.500	2075.000
Z	-1.153	-3.264
Asymp. Sig. (2-tailed)	.249	.001

4.2.9 Classroom Observations

During lectures, the researcher observed all lessons due to comparison of the experimental group with the control group with respect to the treatments

administered. There was a total of 12 observations done for the aim of this verification. Six of them were completed for the experimental and the other ones were for the control group.

For the data obtained from the observation-checklist, Mann-Whitney U test was done for 12 observations. These analyses show that the treatments applied in the experimental and control groups are significantly different from each other. In addition to this, basic descriptive analysis for each item including means and standard deviations are given in Table 4.10. Table 4.10 represents that means of positive items' values were greater in experimental group than the means of the control group. On the other hand, the means of negative items' values (items 5 and 10) were lower in experimental group than the means of control group. As a result, in experimental group classes, lectures were supported with the role-play activities however in control group classes, traditional teaching method was implemented. So treatment verification is supported.

Table 4.10 Basic Descriptive Statistics Related to Items of the Observation Checklist

Item number	Experimental		Control		Mann-Whitney U Test p values
	Mean	Std. Dev.	Mean	Std. Dev.	
1	3.50	0.55	1.00	0.00	.002
2	4.17	0.41	2.67	0.52	.002
3	4.50	0.84	2.83	0.75	.012
4	3.00	1.10	1.00	0.00	.007
5	1.50	0.55	4.33	0.82	.003
6	3.50	1.05	2.00	0.00	.007
7	4.00	0.89	2.00	0.00	.002
8	3.83	0.75	2.83	0.41	.019
9	3.83	0.75	1.00	0.00	.002
10	1.67	0.52	3.83	0.75	.003
11	2.67	0.82	1.00	0.00	.005
12	2.83	0.41	1.00	0.00	.001

4.3 Summary of the Results

According to the findings gained by the statistical analyses, the followings are the summary of the results:

1. As expected, there was positive significant correlation between the PREACH and PSTACH about simple electric circuits.
2. Contrary to the expectations, there was not significant correlation between the PREACH and PSTATT.
3. There were not significant correlations between gender and PREACH, similarly gender and PSTACH. In addition to this, there were not significant correlations between age and PREACH, similarly age and PSTACH.
4. There was significant correlation between PREATT and PSTATT. However, no correlation was found between PREATT and PSTACH, and between PSTATT and PSTACH.
5. The role-play activities were effective to improve students' physics achievement about simple electric circuits. The instruction with the role-play activities showed increase in students' achievement more than the instruction with the traditional teaching method did.
6. There was no significant difference between the experimental and control groups' attitude towards physics about simple electric circuits. In other words, the role-play activities did not increase the students' attitude towards physics more than the traditional teaching method. But, when the students were asked, how about teaching simple electric circuits with the role-play activities was, the answer was that it is enjoyable. The students stated that the role-play activities made subjects simpler than before.

CHAPTER 5

CONCLUSIONS, DISCUSSION AND IMPLICATIONS

The purpose of this study was to explore the effects of role-play activities on student's achievement and attitudes towards physics about simple electric circuits. This chapter is organized into six sections. The first section introduces the conclusions. The second one includes discussion of the results. The third and fourth sections outline the internal and external validities of the study, respectively. Implications of the study are given in the fifth section. The last section includes the recommendations for further studies.

5.1 Discussion of the Results

The results of this study were consistent with the literature mainly in the area of science achievement. The increased posttest scores demonstrated that there is increase in achievement of the students instructed by the improved role-play activities. The experimental group demonstrated lower posttest attitude scores mean however the post attitude scores mean of the control group showed increase. But no significance difference was found between the treatment and control groups' attitude towards simple electric circuits.

Before comparing the results of this study with the previous studies in the literature, some problems about this study were discussed.

For this study, effect size was set to small. When compared the post scores of the achievement for the experimental and control group, the scores of the experimental group were more than the scores of the control group. However, this difference was approximately in small size. In this context, our expectations were fulfilled. When looking at the pre and post achievement scores of the experimental

and control groups from the Table 3.1, there was an increase in the achievement scores from pre-test to post-test. The pre-test scores were 40 out of 100. The post-test scores were 55 out of 100. The post test scores were too low. This could be resulted from the date of the implementation of the PACHT. This unit was taught lastly in the education year. The physics grades for that semester were already taken by the students. So they did not give intended importance to the post-test.

When comparing the scores of the pre and post scores of the PATTS. The value of the pre-test scores for the experimental and control were approximately 83 and the value of the pos-test scores were 81 and 84, respectively. In the scores of experimental group there was a small decrease on the other hand there was a small increase in the scores of control group. The increase and decrease in the scores were not large. Inferential statistics revealed that there was no significant difference in the attitude scores between the groups. What could be causes for this? The time duration for teaching simple electric circuits may not have been long enough to determine the difference in attitude of the students between the two teaching methods. The treatments were applied at the last three weeks of the semester. Our sample was from ninth grade students. In tenth class, the students would choose science or social study. This could be another reason. Moreover, after the lectures I asked the students in the experimental group how you found the lectures supporting by role-plays. They gave positive answers. They found the lectures enjoyable. They thought that they were actively engaged the lectures.

Considering the power of the study, the power was set to 0.8 before the study. The calculated powers for the post achievement and post attitudes were 0.68 and 0.41, respectively. Both calculated values were less than the preset value. This was not an expected result. This resulted from the effect size values. Both calculated effect size values for the post achievement and post attitudes were less than the preset effect size. One can fix this by establishing treatment fidelity and treatment verification procedures. This could be a suggestion for further researches.

Odegaard (2003) studied with groups of upper secondary students (18-19 years olds). These were given a realistic but hypothetical role-play situation involving prenatal genetic testing. Each student took a role-card with information.

Audiotapes of the role-play were taken and transcribed later. Analysis of the role-play about genetic testing lighted up educational values of imagination, collaborative action, and critical reflection. Moreover, analyses give examples of how role-play may serve these interests. During the application, role-play dialogues were partly structured by the teachers. Direction of the discussion and the type of arguments used were determined by the students. It is concluded that when if the teachers are willing to see their role as a facilitator of ethical discussion, role-play activities may be helpful in the teaching-learning process. The learning of the students may be based on the experiences of the roles taken by the students. Due to this, these may lead increase of empathy.

Livingstone (1999) used role-playing to plan public inquiries. Public inquiries are the one of the process of democratic consultation found in many countries. For this study, firstly scenario as an issue was chosen then twelve roles were determined. The roles were shared among the students. Afterwards the necessary inquiries were done by the students. Maddrell (as cited in Livingstone, 1999) stated that the main purpose of the public inquiries is to gain an understanding of how land development decisions are made. Role-play activities help students to engage with the planning process and begin to grasp that decisions are made by individuals or groups. With the study of Livingstone, there was high level of commitment and enjoyment of students undertaking roles. There were some gains from the role-play; some with geographical understanding and some with key skills. These results are in agreement with this current study of the researcher.

Appelget, Matthews, Hildreth and Daniel (2002) aimed to present a lesson template designed to engage students in a specific science event from the past in manner that relates to the students' lives and experiences. A historical role-play is planned to assign for the students to play. Some time to read materials and to create costumes for the play was given to students. The role-play activities were assessed by means of the reporters' stories using rubrics. It was concluded that historical science activities were available for students to realize that science is something to be done and understood and also provided them a situation to have fun.

There were researches about role-play in clinical area and educational area mostly told in the review of literature section of this study. Toth (1996) investigated the effectiveness of various instructional strategies on developing critical thinking abilities in freshman nursing students. Analysis of covariance was used. The findings supported the concept of using a variety of teaching strategies to manage critical thinking abilities in freshman nursing students.

In the study of Rudolph (2002), the purpose of the study was to explore attitudes towards classroom management and effectiveness of classroom management practices based on traditional classroom management course compared to a role-playing approach for preservice teachers. Attitudes survey and rated videotapes of interns teaching were used to collect data. According to the analysis there is an increase in the means of attitudes variable. The attitudes towards classroom management became more positive than before. This finding is not in agreement with our study. In our study there was not any significant difference in attitude. Some probable reasons for this result might be determined. The subject of simple electric circuits was taught for three weeks. Duration of the teaching unit was very short. This is a short period for the students to show any difference in their attitudes towards simple electric circuits. Moreover, a longer time period may have been provided for the identification of the value of role-playing activities over traditional teaching method. Having prejudice such as simple electric circuits are difficult unit in physics may have been another reason. The use of role-play activities may affect the mean scores of the post achievement scores. It is not significant. However role-play activities showed no positive impact on attitudes towards simple electric circuits, the use of role-play activities in teaching was supported in this study.

In the literature, there were researches which were qualitatively analyzed. Lehtela (no date) conducted that concerning learning processes through the use of experiential teaching and role-playing in science education. Students gave positive feedback about role-playing activities and thought that those were helpful in their learning process. Wyn and Stegink (2000) summarized that role-playing mitosis showed difference in class scores which was encouraging and positive effect on

students' understanding of mitosis. In the study of Johnson (1999), students' reactions were positive to use of role-play activities. Many of them were enjoyed in planning and in participating.

When the students participating in role-play activities were asked whether they enjoyed and actively engaged in the lessons, their answers were positive and thought that the activities were easier way to grasp the concepts. The students were interested in lectures based on role-play activities and joined the lessons more willingly than the students instructed by the traditional teaching method.

5.2 Conclusions

The sample chosen for this study was a sample of convenience. There is limitation about the generalizability however conclusions conducted can be applied to a broader population of similar high school students.

Role-play activities had the positive impact on increasing of physics achievement about simple electric circuits. There was more success in students instructed by role-play activities than that of students taught by traditional teaching method. However, no significant change was seen in attitude towards physics between the experimental and control group students. So, role-play activities had no effect in the increase of students' attitude towards simple electric circuits.

5.3 Internal Validity

Fraenkel and Wallen (1996) express that internal validity of the study as the degree to which observed differences on the dependent variable are directly related to the independent variable not to some other (uncontrolled) is the degree defined as the internal validity of the study. This section includes the possible methods to eliminate the possible threats to internal validity.

The internal validity threats for this study are subject characteristics, data collector characteristics (physics teachers for the application of treatments); data

collector bias, background, location and mortality. These are controlled by the design of the study.

Age, gender, physics achievement pretest scores (PREACH) and physics attitude pretest scores (PREATT) are composed of subject characteristics which may affect students' physics achievement posttest scores (PSTACH) and physics attitude posttest scores (PSTATT). Age, gender, PREACH and PREATT are defined as covariates. After the statistical analyses PREACH and PREATT were covariates.

There are some other factors assumed to have impact on internal validity. They may be students' cognitive development, mathematical skills, students' previous electricity knowledge and problem solving skills. However, these factors were assumed to be equal for all students.

Characteristics and bias of data collector should not be threat for this study because the teachers had the training to provide ordinary procedures in the collection of data. Background and location threats were controlled by means of application of tests at the same time and location. No specific differences were found in locations which may affect students' performance.

Implementation of the treatments may be threat to the internal validity. This threat results due to difference in the experiences of the teachers. One of the teachers had 14 years experience; the other one had 18 years experience. By means of training the teachers, the researcher intended to control the threat. Moreover, the researcher observed how the prepared treatments were implemented in experimental groups and traditional teaching method is used in control groups.

The teachers and the students names are not given in the study, the names were secret. By doing this, confidentiality for this study was not a problem.

5.4 External Validity

This section is organized into two parts. The first part introduces population generalizability and the second one includes ecological generalizability. Population generalizability is defined as degree to which shows a sample of the population

interest whereas ecological generalizability is defined as degree to which the results of a study can be extended to other settings or conditions (Fraenkel & Wallen, 1996).

There were 109 ninth grade students from four classes of two physics teachers. The students were from one of public high schools in Acıpayam in Denizli. These were chosen as a sample of convenience. This condition limits the generalizability of this study. The socio-economic statuses of the students joined in this study were middle from the status. This may lead acceptance of generalizations to other similar schools.

Application of the treatments was done in ordinary classroom for both of experimental and control groups during the school time so classroom environments are similar and administration time can be generalized to similar cases.

5.5 Implications

The implications based on the conclusions of this current study are classified according to teachers, students, government, and education faculties' members:

To teachers and students;

1. It was highly noticed that workshops related with role-plays in which teachers participate should be prepared by themselves. The ways of encouraging students in science classes and making science more exciting for them should be improved. How to administer role-play activities effectively in classrooms by the students should be known for the gain of achievement.
2. The students impressed with the role of the teacher as a facilitator of knowledge and managing the way of learning process. Therefore, teachers should promote active engagement in their classes and the classroom environment should be changed from teacher-centered to student-centered.
3. Teachers should engage personnel development seminars to provide alternative thinking. This may lead them to organize productive lessons for the students.

4. School managers should investigate the use of role-play activities in their schools and encourage the teachers to apply and provide opportunities for the participation of the students in role-play activities.
5. A group which prepares role-plays about physics subjects should be formed in schools.
6. Educators must give importance active learning more than the rote-learning. They should replace teaching methods with interesting experiences.

To government;

7. There may be role-play centers like laboratories to get the experiences with the role-play activities learning.
8. The learning environment can be provided with the low-cost materials and simple apparatus easily found. This case will be explained to the students because they should understand that they do not need special conditions to comprehend the concepts and facts in physics. They may learn by doing in such kind of role-play centers.
9. To implement role-play activities, there may be necessity of more time. Because of this, curriculum developers should revise the curriculum and be aware of necessity of the role-play activities in science education.
10. The curriculum content may be decreased and extra lesson hours can be added to programs.
11. Teachers should be informed about new approaches in education with the educational seminars during the education year.

To Education Faculties;

12. Education faculties in universities should determine the deficiencies within their curriculum then try to explore the effect of role-play activities and provide environments to improve role-play activities. The pre-service teachers should be given chance to apply such kind of role-play activities.
13. Education faculties should give creative drama courses to pre-service teachers. These courses can help them to get confidence. Then they will manage their lessons theatrically.

14. A booklet consisting of various teaching methods and the ways of how implementing them in learning environment effectively should be prepared by one of expert commission.

5.6 Recommendations for Further Research

The findings of this current study led to the following recommendations for further researches.

1. More researches could be done on what factors affect may increase students' curiosity and eagerness to know more about physics concepts. Development of physics teaching methods should be focused on to increase the achievement and attitude towards physics and physical phenomena.
2. Further research could be repeated for other subjects in physics.
3. A replication of this current study could be done for a longer time and with a larger sample.
4. In teachers' training there should be courses concerning role-play in the curriculum. Further research could examine the effects and deficiencies of role-play. Then some solutions could be produced to eliminate the drawbacks.
5. Elimination of misconceptions concerning simple electric circuits by means of role-play activities could be another research subject to be investigated.

REFERENCES

Appelget, J., Matthews, C.E., Hildreth, D.P., & Daniel, M.L. (2002). Teaching the history of science to students with learning disabilities. Intervention in School and Clinic 37(5), 298-303.

Ausubel, D.P. (1960). The use of advance organizers in the learning and retention of meaningful verbal material. Journal of Educational Psychology, 51, 267-272

Brown, W.J. & Lewis, R.B. & Harcleroad, F.F. (1959). A-V Instruction Materials Methods (295-307). Toronto, New York, London: McGraw- Hill Book Company Inc.

Carilli, L. (2001). Methods inventory. [On-line] Available: |http://www.persons.marlboro.edu/~lcarilli/pedagogy/methods.html., last accessed 2004, February.

Chambers, S. & Andre, T. (1997). Gender, prior knowledge, interest, and experience in electricity and conceptual change text manipulations in learning about direct current. Journal of Research in Science Teaching, 34(2), 107-123.

Clegg, A. A., Jr. (1991). Games and simulations in social studies education. In J.P. Shaver (Ed.), Handbook of research on social studies teaching and learning (pp. 523-529). New York, NY: Macmillan.

Cohen, J., & Cohen, P (1983). Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences. (2nd Ed.). Hillside, NJ: Lawrence Erlbaum Associates.

Cohen, R., Eylon, B. &Ganiel, U. (1983). Potential differences and current in simple electric circuits: A study of students' concepts. American Journal of Physics, 51(5), 407-412.

Currents in Electronic Literacy, Role-playing simulations improve writing. [On-line] Available: |http://www.cwrl.utexas.edu/currents/spring02/syverson.html., last accessed 2004, February.

Dupin, J.J., Johsua, S. (1987). Conception of French pupils concerning electric circuits: structure and evolution. Journal of Research in Science Teaching, 24(9), 791-806.

Enhancing Education (2002). Additional teaching and learning strategies [On-line] Available: http://enhancied.wgbh.org., last accessed 2003, December.

Fadali, M.S., Robinson, M., & McNichols, K. (undated). Teaching engineering to K-12 students using role-playing games. [On-line] Available: asee.org/conferences/search/20603.pdf., last accessed 2004, February.

Fischer, J. & Laan, V.S. (2002). Improving Approaches to Multicultural Education: Teaching empathy through role-play. Multicultural Education 9(4), 25-6.

Fraenkel, J.R., & Wallen, N.E. (1993). How to design and evaluate research in science education. (3rd ed.). N.Y: McGraw-Hill, Inc.

Francis, P. J. (2003). University role-playing exercises for teaching astronomy and physics: copies. [On-line] Available: http://mso.anu.edu.au/~pfrancis/roleplay_copies.html., last accessed 2003, June.

Francis, P.J. & Byrne, A.P. (no date). The Use of Role-Playing Exercises in Teaching Undergraduate Astronomy and Physics. [On-line] Available: http://www.atnf.csiro.au/pasa/16_2/francis/paper/node2.html., last accessed 2003, December.

Gerlach, V.S & Ely, D.P. (1971). Teaching and media, A systematic approach (340-343). Englewood Cliffs, New Jersey: Prentice-Hall Inc.

Gillispie, M., (1973). Learning through Simulation Games (3-7). New York, N.Y., Paramus, N.J., Toronto, Canada: Paulist Press.

Gredler, M., (1992). Designing and Evaluating Games and Simulations A process Approach (13-25). London, Houston, Paris, Zurich, Tokyo: Gulf Publishing Company.

Hake, R.R. (1998a). Interactive-engagement methods in introductory mechanics courses. Journal of Physics Education Research. Available in PDF form at http://carini.physics.indiana.edu/SDI/., last accessed 2004, January.

Hake. R.R. (1998b). Interactive-engagement vs. Traditional methods: A six thousand-student survey of mechanics test data for introductory physics courses. American Journal of Physics, 66, 64-74. Available at http://carini.physics.indiana.edu/SDI/., last accessed 2004, January.

Hardal, Ö. (2003). The effects of hands-on activities on ninth grade students' achievement and attitudes towards physics. Unpublished master thesis, Middle East Technical University, Ankara, Turkey.

Hartman, H. (1997) Human Learning & Instruction [On-line] Available: http://cityonline.ccny.edu/courses/EDUC_0500/

Heinich, R., Molenda, M., Russell. & Smaldino, S (2002). Instructional media and technologies for learning. 7th Edition. Merrill Prentice Hall Upper Saddle River, New Jersey, Columbus, Ohio.

Heller, M.P. &Finley, N.F. (1992). Variable uses of alternative conceptions, a case study in current electricity. Journal of Research in Science Education, 29(3), 259-276.

Hopkins, G. (2003). More activities to celebrate Martin Luther King Day. [On-line] Available: http://www.education-world.com/a_lesson046.shtml., last accessed 2004, March.

Jackson, P. T. & Walters, J. P. (2000). Role-playing in analytical chemistry: the alumni speak. Journal of Chemical Education 77(8), 1019-1025.

Jackson, P.T (1998). Role-playing in Analytical Chemistry. [On-line] Available: http://www.stolaf.edu/people/jackson/roleplay/roleply1.html., last accessed 2004, February.

Jarrett O.S. (1997) Science through Role-play Centers in the Elementary School Classroom. Science Activities 34(2), 13-20.

Jenkins, E. D. (2000). A Comparative Study Teaching Strategies Reported by North Carolina High School Teachers in Block and Traditional Schedule Schools. Doctoral Thesis. UMI Prorequest Dissertation Publication No: AAT 9960712.

Johnson, G. (1999). Kidney role-plays. School Science Review 80(292), 93-97

Keeling, E. B. (1999). A comparison of two methods to teach effective delegation decision-making to hospital RNS. Doctoral Thesis. UMI Prorequest Dissertation Publication No: AAT 9932893.

Knox, J.A. (1997). Reform of the College Science Lecture through Storytelling. Journal of College Science Teaching 26(6) 388-92.

Lawrence, M.V.M. (1997) Secondary school teachers and learning style preferences: action or watching in the classroom? Educational Psychology, 17(1&2) 157-170.

Livingstone, I. (1999). Role-playing planning public inquiries. Geography in Higher Education, 23(1), 1-13.

Lochart, J. (2000). Student misconceptions in the understanding of electricity and methods and suggestions to improve teaching. [On-line] Available: http://ddhs.ddouglas.k12.or.us/staff/science/ lockhart/professional/electricity_misconceptions.pdf., last accessed 2004, March.

Mayer, R.E (2001). Changing conceptions of learning: A century of progress in the scientific study of learning. In L. Corno (Ed), Education across the century: The centennial volume—One hundredth yearbook of the National Society for the Study of Education (pp. 34-75). Chicago: National Society for the Study of Education.

Mayer, R.E (2002). Rote versus meaningful learning. Theory in Practice, 41, 4, 226-32.

Mayer, R.E., & Wittrock, M.C (1996). Problem -solving transfer. In D.C. Berliner & R.C Calfee (Eds), Handbook of educational psychology (pp. 47-62). New York

McCammon, A. (2001). So you want to use role-plays. Stage of the art 12(3), 23.

McCarty, P. (1992). Common Teaching Methods. [On-Line]. Available: http://www.honolulu.hawaii.edu/intranet/committees/ FacDevCom/guidebk/teachtip/comteach.html., last accessed 2004, January.

McDermott, L.C. & Shaffer, P.S. (1992). Research as a guide for curriculum development: An example from inductory electricity. Part I: investigation of student understanding. American Journal of Physics, 60(11), 994-1003.

McDermott, L.C. (1990). A perspective on teacher preparation in physics and other sciences: the need for special science courses for teachers. American Journal of Physics, 58(8), 734-742.

McSharry, G & Jones, S. (2000). Role-play in science teaching and learning. School Science Review 82 (298), 73-82.

Odegaard, M. (2003). "What will our baby say?" Biotechnology, role -play and the ethics of caring. [On-line] Available: www1.phys.uu.nl/esera2003/programme/pdf., last accessed 2003, December.

Oliver, J.S., & Simpson, R.D. (1988). Influences of attitude toward science, achievement motivation, and self concept on achievement in science: A longitudinal study. Science Education 72(2), 143-155.

Orbik, J. M. (2001). A case study of role-players and role-playing in constructive simulations. Doctoral Thesis. UMI Prorequest Dissertation Publication No: AAT 3013796.

Patterson, J.R. (1996). Model United Nations Simulations: an inquiry into active learning, role-playing, and role identification as they impact participants' sense of political efficacy. Doctoral Thesis. UMI Prorequest Dissertation Publication No: AAT 9710831.

Paulson, D. R., & Faust J.L. (undated). Active Learning the College Classrooms. [On-line] Available: http://www.calstatela.edu/dept/chem/chem2/Active/main.htm., last accessed 2004, November.

Resnick, M and Wilensky, U. (1998). Diving into complexity: developing probabilistic centralized thinking through role-playing activities. The Journal of the Learning Sciences 7(2) 153.

Rudolph, A. M. (2002). The effects of the abductive reasoning processes of pre-service elementary education students in a role-playing setting concerning a mock senate hearing on global climate change. Doctoral Thesis. UMI Prorequest Dissertation Publication No: AAT 3055344.

Saha, G.C. (2001). Implementing the science assessment standards. Doctoral Thesis. UMI Prorequest Dissertation Publication No: AAT 9997996.

Sencar, S. (2001) The effect of gender on different categories of ninth grade students' misconceptions concerning simple electric circuits. Unpublished mater thesis, Middle East Technical University, Ankara, Turkey.

Shipstone, D.M., Jung, W. & Dupin, J.J (1988) A study of students' understanding of electricity in five European countries. International Journal of Science Education, 10(3), 303-316.

Simpson, R.D., & Oliver, J.S. (1990). A summary of major influences on attitude toward and achievement in science among adolescent students. Science Education 74(1), 1-18.

Sutcliffe, M. (no date). Using role-play to teach undergraduate business students: challenging the teacher, supporting the learner. [On-line] Available: http://www.business.ltsn.ac.uk/events/BEST%202002/Papers/Sutcliffe.PDF., last accessed 2004, March.

Tansey, P.J & Unwin, D. (1969). Simulation and gaming in education (pp. 8-95). London, Toronto, Sydney, Wellington: Methuen Educational Ltd.

Taşlıdere, E. (2002). The effect of conceptual approach on students' achievement and attitudes toward physics. Unpublished master thesis, Middle East Technical University, Ankara, Turkey.

Teaching Methods Resources (no date), Role-playing. [On-line] Available: http://www.mhhe.com/socscience/education/methods/resources.html#strategies., last accessed 2003, September.

Toth, M. H. (1996). An Experimental Approach in Evaluating Instructional Strategies to Teach Critical Thinking To Freshman Nursing Students. Doctoral Thesis. UMI Prorequest Dissertation Publication No: AAT 9701171

Turner, S. E. (1995). Attempting to achieve gender equity in mathematics instruction through teacher in-service. Doctoral Thesis. UMI Prorequest Dissertation Publication No: AAT 9536049.

Upright, R. L. (2002). To tell a tale: The use of moral dilemmas to increase empathy in the elementary school child. Early Childhood Education Journal, 30(1), 15-20.

Van Ments, M. (no date). The effective use of role-play. [On-line] Available: http://www.therapeuticresources.com/2422sample.html., last accessed 2004, March.

Webb, D., (2002). Role-playing: A teaching strategy. [On-line] Available: http://condor.admin.ccny.cuny.edu/~cb6879/spring2002/davidpaper.htm., last accessed 2003, December.

Wittich, W.A., & Schuller, C.F. (1973). Instructional Technology Its Nature and Use. 5th Edition. Harper & Row Publishers, New York, Evanston, San Francisco, London.

Wyn, M. A., & Stegink, S. J. (2000). Role-playing mitosis. The American Biology Teacher 62(5), 378-381.

Yates, T. S. (1997). Implementing A Classroom Teaching- Learning Model Into Community College Classrooms. Doctoral Thesis. UMI Prorequest Dissertation Publication No: AAT 9818242.

Zabel, R.H & Zabel, M.K (1996). Classroom Management in context: Orchestrating positive learning environment. Boston: Houston Mifflin Company.

Zoubeir, W. F. (2000). Grafting computer projected simulations and interactive engagement methods within a traditional classroom setting: the influence on secondary level students' understanding of Newtonian mechanics and on attitudes towards physics. Doctoral Thesis. UMI Prorequest Dissertation Publication No: AAT 9988370.

APPENDIX A

OBJECTIVE LIST

Students will be able to;

1. Define the simple electric circuit. (Knowledge- K)
2. State that there must be a closed circuit for the flow of electric current. (K)
3. Explain the difference between the closed circuit and an open circuit. (Comprehension- C)
4. Name the elements of a simple electric circuit. (K)
5. Identify the functions of the elements in a simple electric circuit. (K)
6. Describe the usage of the elements and the way connection of the measuring instruments in a simple electric circuit. (K)
7. State the symbols for measuring instruments and the elements in a simple electric circuit. (K)
8. Define the concept of resistance in a simple electric circuit. (K)
9. describe the concept of resistance in terms of insulators and conductors' properties.(K)
10. Define the potential difference in a simple electric circuit. (K)
11. explain the relationship between current, potential difference and resistance.(C)
12. name the units of current, potential difference and resistance.(K)
13. Apply Ohm's Law in simple electric circuits' problems. (Application -App.)
14. Diagram the relationship between resistance, electric current and potential difference. (Comprehension-C)
15. explain the effect of length, cross-sectional area, temperature and material from which the wire is made on resistance of a wire.(C)
16. relate the factors each other that affect the resistance.(Application-App.)

17. explain that there is only one path for current flow to complete the series connected circuits.(C)
18. explain that electric current is the same at each point of series connected circuits.(C)
19. State that battery's potential difference is distributed directly proportionally to the resistances in series circuit. (C)
20. state that the potential difference of the electric circuit equals to the sum of potential differences on each resistors in the
21. Explain that there are different paths for electric current to complete parallel circuits. (C)
22. State that total electric current is divided on each parallel branch according to their equivalent resistance depending on Ohm's Law relation. (C)
23. explain that each parallel branch in circuit has the same potential difference.(K)
24. calculate the equivalent resistance in series and parallel connected circuits.(App.)
25. Explain that electric current is just flow of free charges in a medium. (K)
26. State the direction of electric current in a circuit. (K)
27. Infer that as the number of series connected resistors (electric bulbs) increase, the equivalent resistance of a circuit increase. (C)
28. State that as the number of parallel connected resistors (electric bulbs) increase, the equivalent resistance of a circuit decrease. (C)
29. relate the brightness of electric bulbs with potential difference, electric current and resistance in series and parallel connected circuits (C)
30. Solve problems about series and parallel circuits. (App.)
31. explain short circuit (C)
32. solve problems about short circuits.(App.)
33. solve combined circuit problems (App.)

Table B.1 TABLE OF SPECIFICATION

Objective / Level / Content	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Total	Percentage
Elektrik devreleri	1 (13) 2	3					3 (1)	9.1 (4)
Devre elemanları	4, 5(23,24,25) 6 7 (15)						4 (4)	12.1 (16)
Potansiyel farkının ölçülmesi	8 (9) 9						2 (1)	6.1 (4)
Direnç ve ölçülmesi	10 12 (16)						2 (1)	6.1 (4)
OHM Yasası		11 (2,22) 14	13				3 (1.5)	9.1 (6)
İletkenlerin direncinin bağlı olduğu faktörler		15 (1) 16 (2,21)					2 (2.5)	6.1 (10)
Seri devrede akım		17 (7,8,10) 18 (11,19) 19 (12) 20					4 (6)	12.1 (24)
Paralel devrede akım	23 (18)	21 22					3 (1)	9.1 (4)
Seri- paralel devrede akım			24 (4)				1 (0.5)	3 (2)
Elektrik devrelerinde akım	25 26 28 (20)	27 31(14)	29 30 (3,5,6) 32 (17) 33 (4)				9 (6.5)	27.2 (26)
Total	14 (9)	13 (11)	6 (5)				33 (25)	100 (100)
Percentage	42.4 (36)	39.4 (44)	18.2 (20)				100 (100)	100 (100)

The numbers indicate the number of the objectives prepared for the PACHT
The other numbers in parenthesis are the number of the questions in the PACHT

APPENDIX C

PHYSICS ACHIEVEMENT TEST

ELEKTRİK DEVRELERİ BAŞARI TESTİ

Adı Soyadı:
Sınıfı- no:

Sevgili Öğrenciler,

Bu başarı testi Madde ve Elektrik Ünitesindeki Elektrik Devreleri konusu ile ilgili olarak ÖSS sorularından, test ve ders kitaplarından derlenerek hazırlanmış 25 sorudan oluşmaktadır.

Test ünite amaçlarına uygun olarak hazırlanmış olup, sonuçları sizlere daha iyi ve anlaşılır fizik dersi hazırlanmasına katkıda bulunabileceğinden bu çalışma için önem taşımaktadır. Aldığınız notlar kesinlikle ortalamanızı etkilemeyecektir. Sınav süresi 45 dakikadır. Lütfen soruları dikkatlice okuyup, cevaplamaya çalışınız. Katılımınız için teşekkür ederim.

Açıklama: Aşağıdaki çoktan seçmeli soruları okuyup, doğru seçeneğin önündeki harfi daire içine alınız.

1. Bir iletkenin direnci aşağıdakilerden hangisine bağlı değildir?

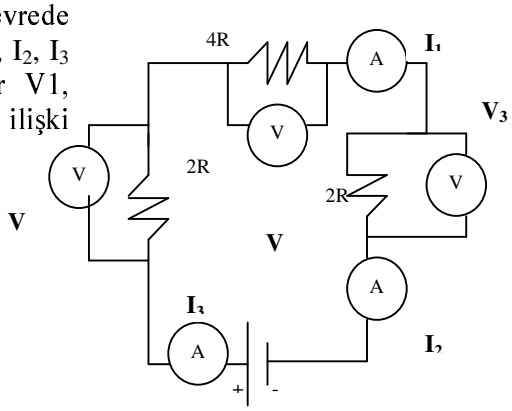
a) Kesit alanına b) Cinsine c) Sıcaklığına d) Uzunluğuna e) Sertliğine

2. Bir telin üzerinden geçen akımı azaltılmak isteniyor. Bunun için telle ilgili değişikliklerden hangisi ve hangileri yapılabilir?

I- Telin boyu uzatılmalı
II- Telin kesiti büyütülmeli
III- Telin uçları arasındaki potansiyel fark düşürülmeli

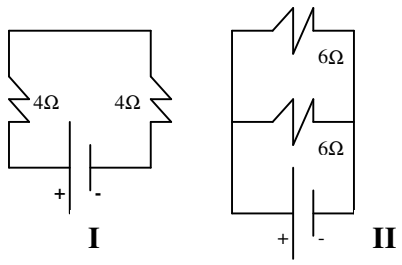
a) yalnız I b) yalnız II c) I ve II d) II ve III e) I, II, III

3. Şekilde gösterilen devrede ampermetrenin okuduğu değerler I_1, I_2, I_3 ve voltmetrenin okuduğu değerler V1, V2, V3 değerlerinin arasındaki ilişki nedir?



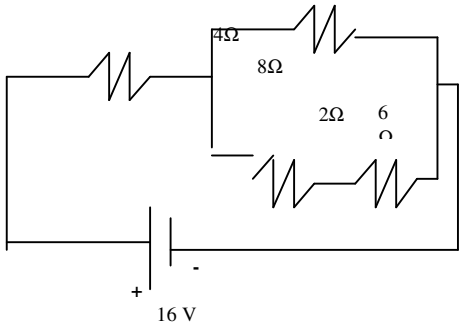
a) $V_1 > V_2 > V_3$ $I_1 = I_2 = I_3$
b) $V_1 = V_3 < V_2$ $I_1 = I_2 > I_3$
c) $V_2 > V_1 = V_3$ $I_1 = I_2 = I_3$
d) $V_2 > V_1 > V_3$ $I_3 > I_1 > I_3$
e) $V_1 = V_2 = V_3$ $I_2 > I_1 = I_3$

4. Şekildeki özdeş üreteçlerden kurulmuş I ve II devrelerin eşdeğer dirençleri R1 ve R2'dir. R2 / R1=?



a) 2 b) 8/3 c) 4 d) 3/8 e)1/2

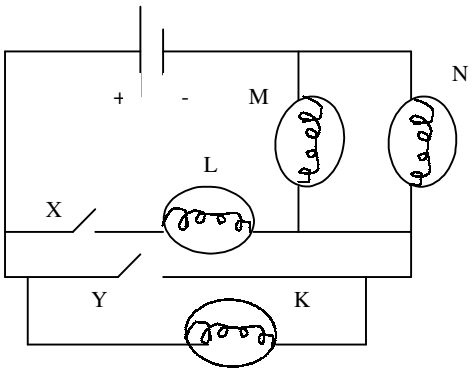
5. Şekildeki devrede 8Ω'luk direncin uçları arasındaki potansiyel fark kaç volttur?



a) 2 b) 4 c) 6 d) 8 e)10

6. Şekildeki devrede X ve Y anahtarları kapatıldığında hangi lambalar ışık verir?

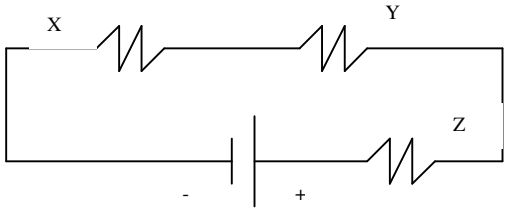
a) L ve M
b) M ve N
c) N ve K
d) M, N ve K
e) L , N ve K



7. Seri bağlı elektrik devresinden geçmekte olan akım şiddetinin artırılması için aşağıdakilerden hangisi yapılmalıdır?
I. Potansiyel farkı artırmalı
II. Toplam direnç azaltılmalı
III. Toplam direnç artırılmalı

a) yalnız I
b) I ve II
c) II ve III
d) I, II ve III

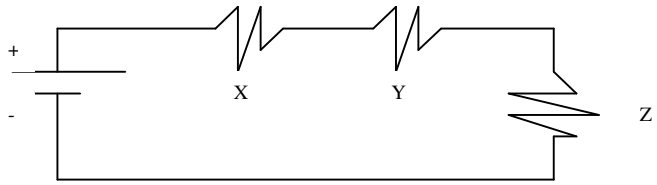
8. Şekilde görülen devrede oluşan akımın özdeş dirençler üzerinde dağılımı nasıldır?



a) Akım dirençler tarafından harcandığı için, X direnci üzerinden geçen akım Y ve Z özdeş dirençler üzerinden geçen daha az akımdır.
b) Z direnci güç kaynağına diğerlerinden daha yakın olduğundan üzerinden diğerlerine göre daha fazla akım geçer.
c) Devrede oluşan akım dirençler tarafından eşit olarak paylaşıldıktan sonra, azalarak güç kaynağına döner.
d) Akım güç kaynağının bir ucundan çıkıp dirençlerin üzerinden eşit değerde geçerek güç kaynağının diğer ucuna ulaşır.

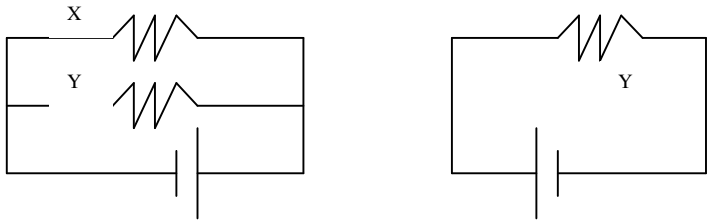
9. Aşağıda verilen ifadelerden hangisi bir elektrik devresindeki direncin görevini doğru olarak açıklar?
a) Elektrik devrelerinin enerji ihtiyacını karşılar.
b) Devre elemanlarının uçları arasındaki potansiyel farkını ölçer.
c) Devrede akım geçişini zorlaştırır.
d) Bir elektrik devresinde oluşan akım şiddetini ölçer.
e) Devreden geçen akımı kesmeye ve devreye akım verilmesini sağlar.

10. Şekilde görülen devrede X ve Y dirençleri aynı değerde olup, Z direnci diğerlerine göre yüksek dirençlidir. Buna göre devrede oluşan akımın dirençler üzerindeki dağılımı nasıldır?



a) X, Y ve Z dirençleri üzerinden geçen akım miktarları birbirine eşittir.
b) X ve Y dirençler üzerinden geçen akım, Z direncinden geçen akıma göre daha fazladır.
c) Z direnci akım güç kaynağına daha uzak olduğundan, X ve Y direnci üzerinden geçen akımdan daha fazladır.
d) X ve Y dirençleri üzerinden geçen akım miktarı eşit olup, Z direnci üzerinden geçen akım değeri düşüktür.

11. Şekilde görülen paralel bağlı X ve Y direncinden, X direncini çıkartırsak Y direncinden geçen akımda nasıl bir değişiklik gerçekleşir?

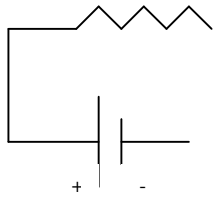


a) Y direncinden geçen akım azalır çünkü devreye bağlı direnç sayısı azaltılınca, toplam akımın azalmasına neden olmuştur.
b) Y direncinden aynı miktarda akım geçmeye devam eder çünkü devreden paralel bağlanan direnç sayısı azaltılınca, potansiyel farkta artış gerçekleşir.
c) Y direncinden geçen akım artar, çünkü güç kaynağı sabit bir akım kaynağıdır ve eşdeğer direnç azalınca devrede oluşan akım artar.
d) Y direncinden geçen akım değişmez çünkü ilk devrede akım dağılırken bu devrede oluşan akım aynen akım kaynağına geri döner.

12. R_1 ve R_2 dirençleri bir üretecin uçları arasına seri olarak bağlanmıştır. R_1nin büyüklüğü artırılacak olursa, aşağıdakilerden hangisi doğru olur?

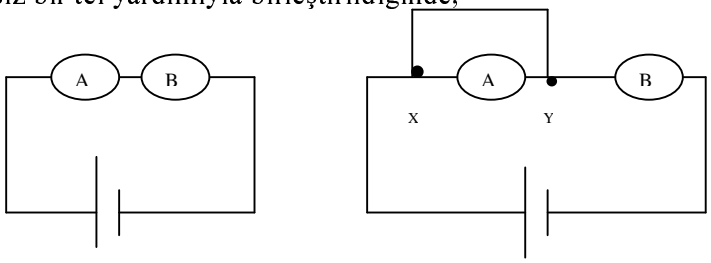
a) R_2 den geçen akım şiddeti sabit kalır.
b) Devreden geçen akım şiddeti azalır.
c) R_1 nin uçları arasındaki potansiyel fark azalır.
d) R_2 nin uçları arasındaki voltaj azalır.
e) R_1den geçen akım şiddeti artar.

13. Şekilde görülen direnç üzerinden akım geçer mi?



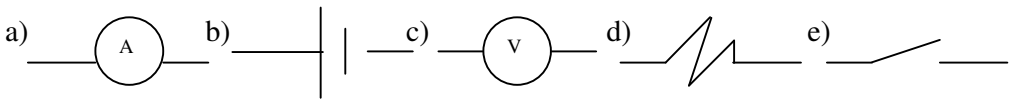
a) Evet geçer çünkü elektrik akımı güç kaynağından dirence doğrudan geçebilir.
b) Evet geçer çünkü güç kaynağı ile direnç arasındaki tek bir tel dirençten akım geçmesi için yeterlidir.
c) Hayır geçmez çünkü elektrik akımı direncin bağlı olduğu uçtan değil diğerinden çıkar.
d) Hayır geçmez çünkü devre tamamlanmamıştır.

14. Şekildeki devrede özdeş A ve B lambaları yanmaktadır. X ve Y noktaları dirençsiz bir tel yardımıyla birleştirildiğinde,



a) A lambası söner, B lambası ilk duruma göre daha parlak yanmaya başlar çünkü devredeki toplam akım artmıştır.
b) A ve B lambaları aynı parlaklıkta yanmaya devam eder çünkü bağlanan telin devreye hiçbir etkisi yoktur.
c) A lambasının parlaklığı ilk duruma göre azalır çünkü ikinci durumda elektrik akımı X noktasında ikiye ayrılmaktadır.
d) B lambasının parlaklığı değişmez çünkü devrenin herhangi bir bölümünde yapılan bir değişiklik sadece o bölgeyi etkiler.

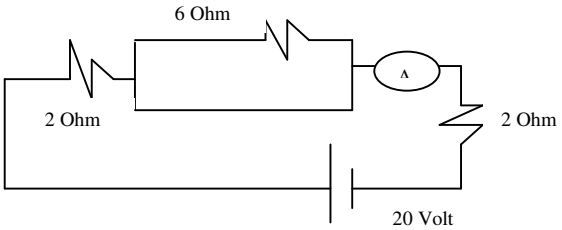
15. Aşağıda verilen sembollerden hangisi bir elektrik devresindeki üreteci gösterir?



16. Bir elektrik devresinde oluşan akım şiddetinin birimi aşağıdakilerden hangisidir?

a) Ohm b) Volt c) Amper d) Coulomb.Saniye e) Joule

17. Şekildeki devrede verilenlere göre, ampermetrenin gösterdiği değer kaç amperdir?(Üretecin iç direnci önemsizdir)



a) 2 b) 4 c) 5 d) 6 e) 10

Açıklama: Aşağıdaki cümleleri okuduktan sonra doğru olduğunu düşündüğünüz cümlelerin önündeki "D" harfini, yanlış olduğunu düşündüğünüz cümlelerin önündeki "Y" harfini parantez içine alınız

D **Y** 18. Paralel bağlı devrelerde, her bir kolun uçları arasındaki potansiyel fark, üretecin uçları arasındaki potansiyel farka eşittir.

D **Y** 19. Seri bağlı devrelerde dirençlerin her birinden aynı miktarda akım geçer.

D **Y** 20. Paralel bağlı devrelerdeki lamba sayısı arttıkça devrenin eşdeğer direnci azalır.

D **Y** 21. Bir iletkenin direnci iletkenin kesit alanıyla ters orantılıdır.

D **Y** 22. Bir iletkenin uçları arasındaki potansiyel farkının, iletkenden geçen akım şiddetine oranı sabittir.

Açıklama: Aşağıdaki "A" sütununda devre elemanları, "B" sütununda ise devre elemanlarının tanımları yer almaktadır. Her bir elemanın solundaki boşluğa o elemanın tanımının önündeki harfi yazınız.

	"A" Sütunu	**"B" Sütunu**
----------	23. Üreteç	A. Devreye akım vermeye ve devredeki akımı kesmeye yarayan devre elemanıdır.
----------	24. Ampermetre	B. Bir devre elemanının uçları arasında oluşan potansiyel farkını ölçmeye yarayan, devreye paralel bağlanan araçtır.
----------	25. Anahtar	C. İletken içinden geçmek isteyen yüklü parçacıklara iletkenin temel parçacıklarının karşı koymalarının ölçüsüdür.
----------		D. Bir elektrik devresinden geçen akım şiddetini ölçmeye yarayan, devreye seri bağlanan iki uçlu araçtır.
----------		E. Elektrik devrelerinin enerji ihtiyacını karşılayan, devrenin ana elemanıdır.

Cevap Anahtarı		
1.	11.	21.
2.	12.	22.
3.	13.	23.
4.	14.	24.
5.	15.	25.
6.	16.	
7.	17.	
8.	18.	
9.	19.	
10.	20.	

APPENDIX D

PHYSICS ATTITUDE SCALE

ELEKTRİK DEVRELERİ TUTUM ÖLÇEĞİ

Adı-soyadı:

Sınıfı-no :

Sevgili Öğrenciler

Bu ölçek Madde ve Elektrik Ünitesindeki Elektrik Devreleri konusu ilişkin tutum cümleleri ile her cümlenin karşısında KESİNLİKLE KATILIYORUM, KATILIYORUM, KARARSIZIM, KATILMIYORUM ve KESİNLİKLE KATILMIYORUM olmak üzere beş seçenek verilmiştir. Her cümleyi dikkatle okuduktan sonra kendinize uygun olan seçeneği işaretleyiniz.

Ölçeğin sonuçları sizlerin bu konulara olan tutumunuzun ne ölçüde olduğunu göstereceğinden, tutumun olumlu yönde geliştirilebilmesi yönünde katkıda bulunabileceğinden önem taşımaktadır. Katılımınız için teşekkür ederim.

GENEL AÇIKLAMA: Bir görüş veya yargı bildiren aşağıdaki cümleleri dikkatlice okuyunuz. Bu görüşe ne ölçüde katılıp katılmadığınızı sağ taraftaki sütunda yanıt olarak verilen beş seçenekten birini X işareti yazarak belirtiniz. Seçenekler 'kesinlikle katılıyorum", "katılıyorum", "kararsızım", "katılmıyorum", "kesinlikle katılmıyorum" dur.

ELEKTRİK DEVRELERİ A) Bir elektrik devresinde devre elemanları B) Potansiyel farkının ölçülmesi C) Direnç ve ölçülmesi a. Akım, potansiyel farkı ve direnç arasındaki bağıntı (OHM Yasası) b. İletkenlerin direncinin bağlı olduğu faktörler ve özdirenç D) Elektrik devrelerinde akım a. Seri devrelerde akım b. Paralel devrede akım c. Ana kol ve paralel kollarda akım	**Kesinlikle katılıyorum**	**Katılıyorum**	**Kararsızım**	**Katılmıyorum**	**Kesinlikle katılmıyorum**
1. "Elektrik devreleri" konularını severim.					
2. "Elektrik devreleri" konularına karşı olumlu hislerim vardır.					
3. "Elektrik devreleri" konularından öğrendiklerimin hayatımı kolaylaştıracağına inanıyorum.					
4. "Elektrik devreleri" konularının gelecekte öneminin artacağına inanmıyorum.					
5. "Elektrik devreleri" konularının, ileride ki çalışmalarımda bana yararlı olacağına inanıyorum.					
6. "Elektrik devreleri" konularında başarılı olmak için elimden geleni yaparım.					
7. "Elektrik devreleri" konularında elimden gelenin en iyisini yapmaya çalışırım.					
8. " Elektrik devreleri" konularında başarısız olduğumda daha çok çabalamam.					
9. "Elektrik devreleri" konularını öğrenebileceğimden eminim.					
10. "Elektrik devreleri" konularında başarılı olabileceğimden eminim.					
11. "Elektrik devreleri" konularının kullanıldığı zor problemleri yapabileceğimden eminim.					
12. "Elektrik devreleri" konularının geçerli olduğu problemler ne kadar zor olursa olsun, elimden geleni yaparım.					
13. "Elektrik devreleri" konular ının ilerideki meslek hayatımda önemli bir yeri olacağını düşünmüyorum.					
14. "Elektrik devreleri" konularından öğrendiklerimin, gündelik hayatta işime yarayacağını düşünüyorum.					
15. "Elektrik devreleri" konuları veya teknolojideki uygulamaları ile ilgili kitaplar okumaktan hoşlanırım.					
16. "Elektrik devreleri" konuları benim için eğlencelidir.					
17. Okulda "Elektrik devreleri" konularını çalışmaktan hoşlanmam.					
18. Daha zor "Elektrik devreleri" ile ilgili problemler ile başa çıkabileceğimden eminim.					
19. Okuldan sonra arkadaşlarla "Elektrik devreleri" konuları hakkında konuşmak zevklidir.					
20. Bana hediye olarak "Elektrik devreleri" ile ilgili bir kitap veya konu ile ilgili aletler, araçlar verilmesinden hoşlanırım.					
21. Yeterince vaktim olursa en zor "Elektrik devreleri" ile ilgili problemleri bile çözebileceğimden eminim.					
22. Arkadaşlarla "Elektrik devreleri" konuları veya teknolojideki uygulamaları ile ilgili meseleleri konuşmaktan hoşlanırım.					
23. "Elektrik devreleri" konuları el becerilerimin gelişmesinde etkilidir.					
24. "Elektrik devreleri" konuları ile ilgili ders saatlerinin daha çok olmasını istemem.					

APPENDIX E

OBSERVATION CHECKLIST

		always	frequently	sometimes	never	no activity
1.	Students obey the procedure					
2.	Students can follow the activities easily					
3.	Students seem to enjoy the lesson					
4.	Students get the information by doing the activities					
5.	Information is given based on textbook					
6.	There is student-student interaction during the lesson					
7.	Teacher acts as a guide					
8.	Teacher answers questions with short explanations					
9.	Activity consist easy to obtain, inexpensive materials					
10.	Teacher has the primary role in delivering the content					

		Individually	In pairs	In groups of three	No activity
11.	Students do the activity				

		0-15 minutes	15-30 minutes	30-40 minutes	No activity
12.	Students are actively engaged in activity within the class hour				

APPENDIX F

ACTIVITY 1

EL EL ÜSTÜNDE (HAND ON HAND)

Konu : Basit elektrik devresi - Kapalı ve açık devre

Amaçlar:

- Elektrik akımı oluşması için kapalı devre olması gerektiği koşulunu belirtmek.
- Kapalı ve açık devre kavramı arasındaki farkı açıklamak.
- Basit elektrik devresini tanımlamak.

Method : Rol-yapma (Öğrenci sayısı= 25-30)

Roller:

- **Üreteç rolü oynayan öğrenciler**: 3 farklı üreteç belirlenir. Üreteç akım üretir ve elektrik potansiyel enerjisi verir. A, B, C olarak isimlendirilir. A üreteci belli aralıklarla yük yollar. Bir üreteç iki kişiden oluşur. Bu iki öğrenci sırt sırta vererek üretecin artı ve eksi kutuplarını oluştururlar.
- **Direnç rolü oynayan öğrenciler:** Hareketi engeller. 4 öğrenci seçilir. 2 öğrenci büyük, 2 öğrenci küçük direnç rolünü oynar. Bunlar fiziksel yapılarına bakılarak seçilir. Yüzleri daire merkezi dışına doğru olacak şekilde sırada yer alırlar. Aldıkları iletiyi geç iletirler.
- **Anahtar rolü oynayan öğrenci:** Akımı kesmeye yarar. "Açık" ve "kapalı" diyerek aktiviteye yön verir. Açık dediğinde iletim sürekliliğini kaybeder. Herkes yaptığı işe son verir. Kapalı dediğinde iletim sürekliliği devam eder.
- **Ampermetre rolü oynayan öğrenci:** Devreye seri bağlandığı açıklanır. Bu kişi iletiyi alır, aynen iletir, ilettiği iletileri sayar.
- **Tel rolünü oynayan öğrenciler:** Üreteç tarafından gönderilen iletilerde aksaklığa sebep vermeden birbirlerine iletirler.

Kullanılan araç-gereçler:

- (+), (-) belirten kartlar üreteçleri oluşturan öğrencilere kutupları belirtmesi için takılır.

Yönergeler:

1. Öğrenciler yüzleri daire merkezine bakacak şekilde daire oluştururlar.
2. Daire oluşturan öğrenciler sağ el avuç içi yukarı bakacak şekilde, sol el avuç içi aşağı bakacak şekilde kollarını açarlar.
3. Öğrenciler kolları açık olarak, sağ ellerine arkadaşlarının sol eli, sol ellerine arkadaşlarının sağ elleri gelecek şekilde ellerini üst üste tutarlar.
4. A üreteci her ikişer sayımda arkadaşının eline vurarak iletimi başlatır.
5. Sağ eline vurulan kişi iletiyi aldıktan sonra, sol eliyle arkadaşının sağ eline vurur.
6. Bu vuruşlar A öğrencisi tarafından ritmik şekilde belli süre yapılır.

Kapalı ve açık devre konusu bu aktiviteyle iki durum için uygulanır.

- ❖ Anahtarın açık ve kapalı olma durumu

Yönergeler:

7. Daireyi oluşturulan öğrencilerden birine anahtar olma görevi verilir.
8. Bu öğrenci belli aralıklarla “kapalı" ve "açık" diye gruba seslenir.
9. "Açık" dediğinde devredeki bütün öğrencilerin hareketlerine son verip, donmuş halde kalmaları söylenir.
10. “Kapalı" dediğinde devredeki bütün öğrencilerin hareketlerine devam etmeleri söylenir.
11. Bu durumun bir kaç defa anahtar tarafından tekrarlanması istenir.

- ❖ Devre elemanlarının içinde ve bağlantılarında kopukluk olması

I. Üretecin devreden çıkarılması

Yönergeler :

12. Üretecin iletiye ara vermesi söylenir.
13. Bu durumda öğrencilerinde iletimi durdurması istenir.
14. Bu durum belli aralıklarla tekrarlanır.

II- Tellerin kopması

15. Daireyi oluşturan öğrenciler tel görevindedir.
16. Bu öğrencilerden birinin daireden çıkması istenir.
17. Bu durumda öğrencilerin hareketi gözlemlenir.

BASİT DEVRE: Bir üretecin kutupları bir iletkenle birleştirilip araya birde lamba (direnç) konulursa basit elektrik devresi elde edilir.

Yönergeler:

18. Öğrenciler bir önceki aktivitedeki gibi daire şeklini oluştururlar.
19. Önceden belirlenmiş direnç rolünü oynayan öğrenciler bu daireyi oluşturan öğrenciler arasına yerleştirilir.
20. Üreteç tarafından iletiler gönderilir.
21. Bu daireye yerleştirilen öğrencilerin iletiyi nasıl devam ettirdikleri gözlemlenir.
22. Bu ileti belli süre tekrarlanır.
23. Dirençlerin yanına ampermetre rolünü oynayan öğrenci yerleştirilir.
24. Bu öğrenci kendine gelen iletileri sayar, kaydeder.

NELER GÖZLEMLEDİK, PAYLAŞMAYA HAZIR MIYIZ☺

1. A öğrencisi aktivitede ne yapıyor?

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2. A öğrencisinin görevi nedir?

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3. Üreteç gerçek devrede neyi sağlar?

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4. Anahtar görevi olan öğrencinin "açık" demesiyle nasıl bir değişiklik gözlemlenir?

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5. Gerçek devrede açık devre kavramını nasıl tanımlarsınız?

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6. Anahtar görevi olan öğrencinin "kapalı" demesiyle nasıl bir değişiklik gözlemlenir?

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7. Gerçek devrede kapalı devre kavramını nasıl tanımlarsınız?

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8. A öğrencisinin daireyle ilişkisinin kesilmesinin etkisi nedir?

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9. Daireyi oluşturan öğrencilerden birinin çıkması sonucu ne gerçekleşir?

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10. Basit devre kısmındaki aktivitede daireye yerleştirilen öğrenciler neyi sağlar?

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11. Direnç gerçek devrede neyi sağlar?

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12. Ampermetre olan öğrenci ne yapıyor?

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13. Bu devreyi aile gibi düşünürsek, bu ailede tanımlanan elemanlar nelerdir?

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14. Aktivitedeki rollerin gerçek olayla benzeyen, benzemeyen yönlerini listeleyin.

BENZEYEN	**BENZEMEYEN**
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ACTIVITY 2

İNİŞ-ÇIKIŞ (LANDING AND LEAVING)

Konu : Potansiyel Fark- Akım Yönü (Aktivite 3 için hazırlık)
Kullanılan araç-gereçler:

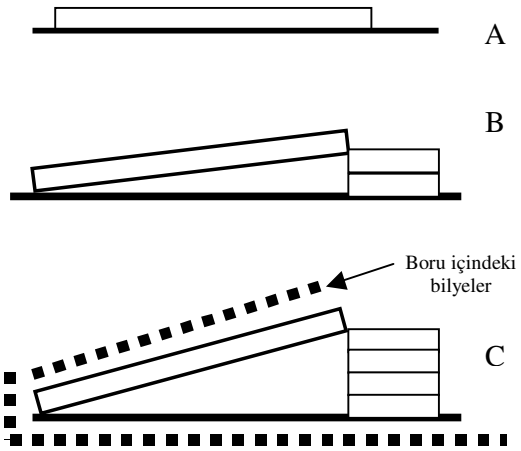
- Belli bir boyutta mukavva
- Boncuklar
- Hortum

Amaçlar:

- Basit elektrik devresinde potansiyel farkı tanımlamak
- Elektrik akımını açıklamak.
- Elektrik akımının yönünü açıklamak

Yönergeler:

1. Belli bir boyutta mukavva alınır.
2. Mukavva düz bir yere konur.(Şekil A)
3. Bir öğrenciden mukavvanın bir ucundan tutması, belli bir yüksekliğe kaldırması istenir. (Şekil B)
4. Belli yüksekliğe kaldıran öğrenciden biraz daha yukarı kaldırması istenir.(Şekil C)
5. Belli yüksekliğe çıkmış mukavva üzerine boru konur.
6. Borudan bu öğrencinin bilyeler atması istenir. Bu bilyeler borudan öğrencinin yanına gelir.
7. Gelen bilyeleri öğrenci borudan tekrar gönderir.



NELER GÖZLEMLEDİK, PAYLAŞMAYA HAZIR MIYIZ?

1. Şekil A daki konumda eğim nedir?

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2. Şekil B de ne gibi değişiklik yapılmıştır?

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3. Şekil B de yapılan değişikle ne değişmiştir?

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4. Şekil C de mukavva biraz daha yukarı kaldırılırsa ne değişir?

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5. Aktivitede kullanılan boru neyi sağlar?

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6. Borunun görevi nedir?

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7. Şekil B ve C deki konumda bilyelerin hızlarında nasıl bir değişiklik gözlemlenir?

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8. Bilyelerin hızı devrede ne olarak tanımlanabilir?

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9. Gerçek devrede potansiyel fark nasıl tanımlanır?

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10. Aktivitedeki rollerin gerçek olayla benzeyen, benzemeyen yönlerini listeleyin.

BENZEYEN	BENZEMEYEN
• .... • .... •	• .... • .... • ....

ACTIVITY 3

MR. OHM DÜNYASI (WORLD OF MR. OHM)

Konu : OHM Yasası
Method : Rol-yapma
Amaçlar:

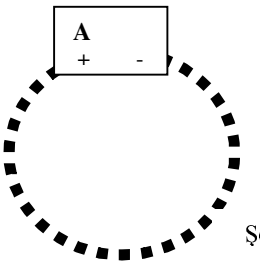
- Akım, potansiyel fark ve direnç arasındaki ilişkiyi kavramak.
- Direnç, akım ve potansiyel fark arasındaki ilişkiyi grafikle göstermek.
- Basit elektrik devrelerinde OHM yasasını problem çözmede uygulamak.

Roller:

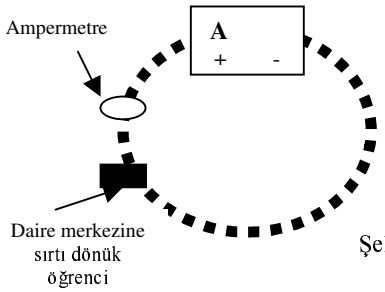
- **Üreteç rolü oynayan öğrenciler:** 4 öğrenci seçilir. Her iki öğrenci sırta sırta verir. Bu iki öğrenciden biri üretecin (+), diğeri (-) kutbunu temsil eder. (+) kutbundaki öğrenci boncuk bulunan kutuyu sıradaki arkadaşına iletir. İletme işi sürekli şekilde devam eder. (-) kutbundaki öğrenci gelen kutuları toplar. A ve B olarak adlandırılır. A içinde iki boncuk bulunan kutuların iletimini sağlar. B içinde dört boncuk bulunan kutuların iletimini sağlar.
- **Direnç rolü oynayan öğrenciler:** Hareketi engeller. 2 öğrenci seçilir. Öğrenciler sırtları daire merkezine dönük olarak yerleşirler. Film kutuları içinden gelen boncuklardan bir tanesini alarak iletiyi devam ettirirler.
- **Ampermetre rolü oynayan öğrenci:** Devreye seri bağlandığı açıklanır. Bu kişi ona gelen kutuları sayar.
- **Tel rolünü oynayan öğrenciler:** Üreteç tarafından gönderilen iletilerde aksaklığa sebep vermeden birbirlerine iletirler.

Kullanılan araç-gereçler: film kutuları, boncuklar
Yönergeler:

1. Öğrenciler yüzleri daire merkezine dönük olacak şekilde daire oluştururlar. Yan yana gelen öğrenciler arasındaki mesafe yarım kol boyu olarak ayarlanır.
2. A (+) görevi gören öğrenci içinde iki boncuk bulunan film kutusunu diğer öğrenciye iletir. Bu iletim belli zaman aralıklarıyla gönderilir.
3. İletim gözlemlenir.
4. Dairenin bir yerine ampermetre rolü oynayan öğrenci yerleştirilir. Ona gelen kutuları sayacağı açıklanır.(Şekil 1)
5. Dairenin bir yerinde bir öğrenci daire merkezine sırtı dönük şekilde yerleşir.
6. Gönderilen kutunun içinden her seferinde bir boncuğu, sırtı merkeze dönük olan öğrenci alır.(Şekil 2)
7. Bu şekilde iletim belli bir süre yapılır.

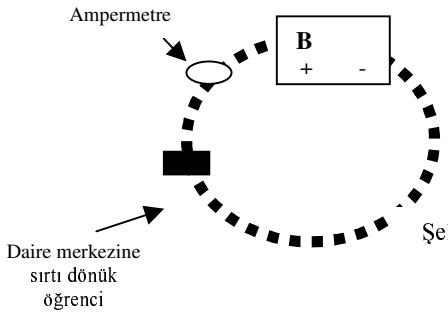


Şekil 1



Şekil 2

8. A görevi gören kişilerin yerine B görevi gören kişiler yerleştirilir.
9. B (+) görevi gören öğrenci içinde dört boncuk bulunan film kutusunu diğer öğrenciye ileterek, iletimi başlatır ve sürekliliğini sağlar.(Şekil 3)



Şekil 3

NELER GÖZLEMLEDİK, PAYLAŞMAYA HAZIR MIYIZ?☺

1. Öğrencilerin daire şeklini oluşturmaları neyi temsil ediyor?

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2. Dairede yer alan öğrencilerin görevi nedir?

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3. İletilen kutular neyi temsil ediyor?

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4. Kutular içindeki boncukların görevi nedir?

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5. Daire merkezine sırtı dönük olan öğrenci aktivitede ne yapıyor?

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6. Gerçek devrede bu öğrencinin görevi nedir?

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7. A ve B neyi temsil ediyor?

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8. A ve B öğrencilerinin ilettikleri kutuların içindeki boncukların sayısının farklı olması neyle açıklanır?

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9. Her iki durumda değişmeyen ve değişen değerler hangisidir?

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10. Bu A, B öğrencilerine ek olarak birde kutuyla altı boncuk ileten bir öğrenci yerleştirilseydi sistemde ne gibi değişiklik gözlemlenir?

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11. Aktivitedeki rollerin gerçek olayla benzeyen, benzemeyen yönlerini listeleyin.

BENZEYEN	**BENZEMEYEN**
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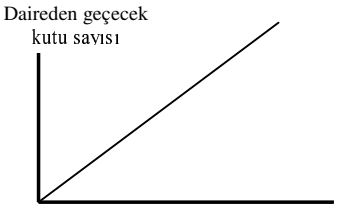
12. Bu üç kavram (direnç, akım, potansiyel fark) arasındaki ilişkiyi gösteren grafik aşağıdakilerden hangisidir?

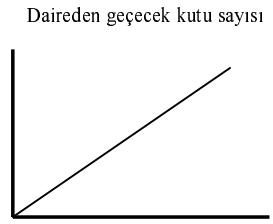
a)



R **sabit** (1 öğrenci

Belli sürede daireden geçen kutu sayısı

b)

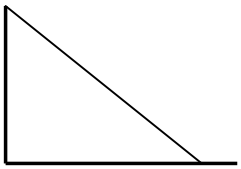


Belli sürede daireden geçen kutu sayısı-

sabit

c)

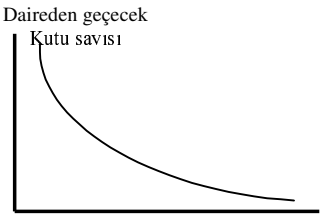
Belli sürede daireden geçen kutu sayısı



Daireden geçecek kutu sayısı-**sabit**

R (2 öğrenci sayısı)

d)



R **sabit** (1 öğrenci sayısı)

Belli sürede daireden geçen kutu sayısı

ACTIVITY 4

ENGELLİ YOL (WAY WITH OBSTACLES)

Konu : Direnç- İletkenlerin direncinin bağlı olduğu faktörler
Method : Rol-yapma (Öğrenci sayısı= 25-30)
Roller:

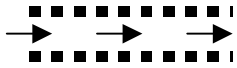
- Her sıradan iki öğrencinin birbirine dönmesi rolü: Direnç görevi görürler,birbirine yaklaşarak direncin kesitini azaltırlar.
- Sıralı öğrenciler: İletken tel görevi görürler.
- Kız- erkek öğrenciler: İletkenin cinsini temsil ederler. Kız öğrenciler alüminyum tel, erkek öğrenciler bakır tel görevi görürler.

Amaçlar:

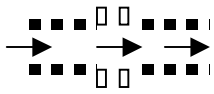
- Direnç kavramını tanımlamak.
- İletkenin boyu, kesiti ve cinsinin iletkenin direncine etkisini açıklamak.
- İletkenin direncini etkileyen faktörleri birbirleri arasında ilişkilendirmek

Yönergeler:

1. Öğrenciler yüzleri birbirine dönük olmayacak, birbirlerinin enselerini görecek şekilde yan yana ikişerli sıra oluştururlar.
2. Önündeki öğrenciyle yarım kol boyu, yanındaki öğrenciyle bir kol boyu mesafe bırakmaları istenir.(Şekil I)
3. İkili sıranın bir yerinde her sıradan iki öğrenci birbirlerine doğru döner ve her biri birer adım yaklaşarak aynı hizaya gelirler.(Şekil II)
4. Bu ikili sıranın içinden diğer öğrencilerin belli bir süre kesintisiz geçişleri sağlanır.
5. Öğrencilerin sıranın içinden geçişleri gözlemlenir.
6. Birbirine dönük öğrencilerin birer adım daha birbirlerine, aynı hizaya gelecek şekilde yaklaşmaları istenir.(Şekil III)
7. Geçişler gözlemlenir.
8. Her sıradan ikişer öğrencinin daha yüzlerini birbirine dönmeleri istenir.(Şekil IV)

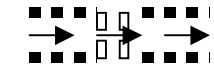


Şekil I

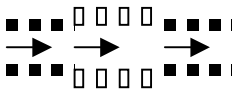


Şekil II

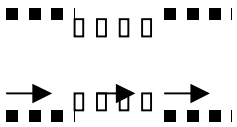
Şekil III



Şekil IV

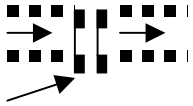


9. Önceki birbirine dönük öğrencilerin birer adım geriye giderek, yeni birbirine dönen öğrencilerle aynı hizaya gelmeleri istenir.
10. Öğrencilerin geçişleri gözlemlenir.
11. Sekiz öğrencinin hep birlikte birbirlerine birer adım yaklaşmaları istenir.(Şekil V)



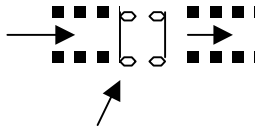
Şekil V

12. Bu yaklaşma sırasındaki sıradan öğrenci geçişleri gözlemlenir.
13. İkili sıra oluşturulduğu sırada, her sıradan birbirine dönecek iki öğrencinin kız seçilmesi sağlanır.
14. Kız öğrencilerin kolları yere paralel olacak şekilde el ele tutuşmaları istenir. Kollarını biraz aşağıya eğerler.



Kız öğrenciler

15. Sıra içinden geçecek öğrenciler el ele tutuşmuş öğrencilerin kolları altından geçmeye çalışırlar. Öğrencilerin geçişleri belli bir süre gözlemlenir.
16. Birbirine dönük kız öğrencilerin yerine erkek öğrencileri yerleştirilir.
17. Erkek öğrencileri kolları yere paralel olacak şekilde el ele tutuşur ve yere eğilirler.
18. Sıradan geçecek öğrenciler bu sefer, erkek öğrencilerin kolları üzerinden atlarlar.
19. Öğrencilerin geçişleri gözlemlenir.



Erkek öğrenciler

NELER GÖZLEMLEDİK, PAYLAŞMAYA HAZIR MIYIZ?☺

1. Oluşturulan ikili sıra neyi temsil ediyor?

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2. İkili sırada birbirine dönük öğrencilerin aktivitede görevi nedir?

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3. Birbirine dönük öğrenciler neyi sağlıyor?

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4. Birbirine dönen öğrencilerin birbirine yaklaşmalarıyla ne sağlanır?

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5. Direnç gerçek devrede neyi sağlar ?

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6. Birbirine dönen öğrencilerin birbirine birer adım yaklaşmlarıyla dirençte nasıl bir değişiklik yapılmıştır ?

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7. Kesitin azalmasıyla ne gibi değişiklik gözlemlenir?

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8. Bir elektrik devresinde direncin kesitinin azalmasıyla ne değişir?

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9. Birbirine dönen öğrenci sayısının artırılmasıyla sistemde nasıl bir değişiklik sağlanır?

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10. Öğrenci sayısının artması aktivitede neyi sağlar ?

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11. Devrede iletkenin direncinin boyunun artması sistemi nasıl etkiler?

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.....

12. Sekiz birbirine dönük öğrencinin birbirine yaklaşmalarıyla aktivitede hangi değerler değişir ?

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13. İletken direncinin boyuyla, kesiti arasında nasıl bir orantı vardır?

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14. Aynı devrede birbirine dönük öğrencilerin hepsinin kız veya erkek seçilmesiyle ne sağlanır ?

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.....

15. Kız öğrenci olduğunda sıradan geçen öğrencilerin geçişiyle erkek öğrenci olduğunda sıradan geçen öğrencilerin geçişi arasında fark var mıdır? Açıklayınız.

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.....
.....

16. Bir elektrik devresinde direncin cinsi elektrik akımı geçişini nasıl etkiler?

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.....
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17. Aktivitedeki rollerin gerçek olayla benzeyen, benzemeyen yönlerini listeleyin.

BENZEYEN	**BENZEMEYEN**
• .... • .... •	• .... • .... • ....

ACTIVITY 5

İŞ DÜNYASI (BUSINESS WORLD)

Konu : Seri ve paralel bağlama
Method : Rol-yapma (Öğrenci sayısı 25-30)
Roller:

- **Üreteç rolü oynayan öğrenciler:** 4 öğrenci seçilir. Her iki öğrenci sırta sırta verir. Bu iki öğrenciden biri üretecin (+), diğeri (-) kutbunu temsil eder. (+) kutbundaki öğrenci boncuk bulunan kutuyu sıradaki arkadaşına iletir. İletme işi sürekli şekilde devam eder. (-) kutbundaki öğrenci gelen kutuları toplar. A ve B olarak adlandırılır. A içinde iki boncuk bulunan kutuların iletimini sağlar. B içinde dört boncuk bulunan kutuların iletimini sağlar.
- **Direnç rolü oynayan öğrenciler:** Hareketi engeller. 4 öğrenci seçilir. Öğrenciler sırtları daire merkezine dönük olarak yerleşirler. Film kutuları içinden gelen boncuklardan bir tanesini alarak iletiyi devam ettirirler.
- **Ampermetre rolü oynayan öğrenci:** Devreye seri bağlandığı açıklanır. Bu kişi ona gelen kutuları sayar.
- **Tel rolünü oynayan öğrenciler:** Üreteç tarafından gönderilen iletilerde aksaklığa sebep vermeden birbirlerine iletirler.

Kullanılan araç-gereçler: film kutuları, boncuklar

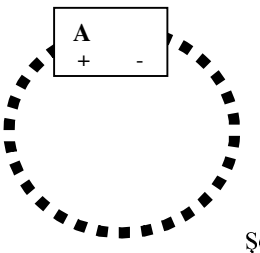
a) SERİ BAĞLAMA:

Amaçlar:

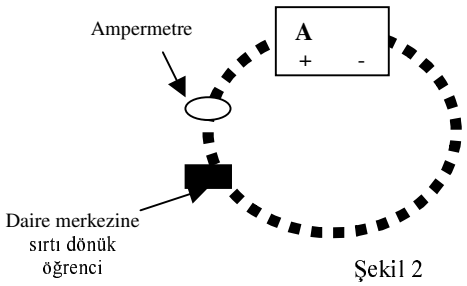
- Seri bağlı devrelerde devre akımının bir yolu takip ettiğini belirtmek.
- Seri bağlı devrelerde her dirençten geçen akımın aynı değerde olduğunu açıklamak.

Yönergeler:

10. Öğrenciler yüzleri daire merkezine dönük olacak şekilde daire oluştururlar. Yan yana gelen öğrenciler arasındaki mesafe yarım kol boyu olarak ayarlanır.
11. A (+) görevi gören öğrenci içinde iki boncuk bulunan film kutusunu diğer öğrenciye iletir. Bu iletim belli zaman aralıklarıyla gönderilir.
12. İletim gözlemlenir.
13. Dairenin bir yerine ampermetre rolü oynayan öğrenci yerleştirilir. Ona gelen kutuları sayacağı açıklanır.(Şekil 1)
14. Dairenin bir yerinde bir öğrenci daire merkezine sırtı dönük şekilde yerleşir.

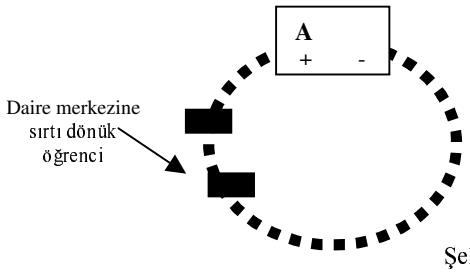


Şekil 1



Şekil 2

15. Gönderilen kutunun içinden her seferinde bir boncuğu, sırtı merkeze dönük olan öğrenci alır.(Şekil 2)
16. Daire merkezine sırtı dönük öğrenci sayısı artırılır. Diğer öğrencinin yanına yerleştirilir.(Şekil 3)
17. Bu durumda ki iletim gözlemlenir.



Şekil 3

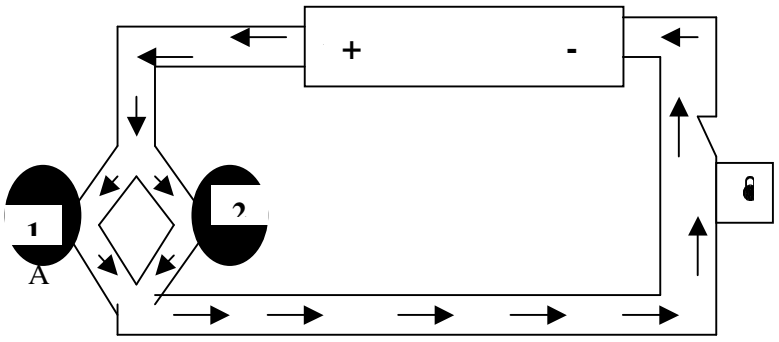
b) PARALEL BAĞLAMA:

Amaçlar :

- Paralel bağlı devrede elektrik akımının farklı yollar izleyerek dirençlere dağıldığını açıklamak.
- Paralel bağlı devrede toplam elektrik akımının her kolda yer alan eşdeğer dirençlere OHM kanununa göre dağıldığını belirtmek.

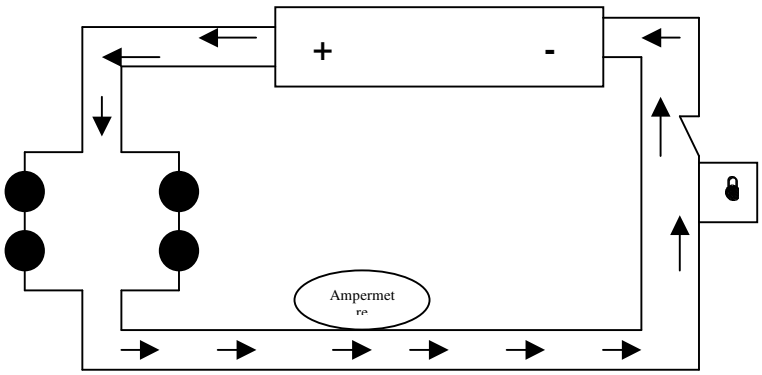
Yönergeler :

1. Öğrenciler yüzleri kare merkezine dönük olacak şekilde tek sıra halinde kare oluştururlar. (Şekil I)
2. A (+) görevi gören öğrenci içinde iki boncuk bulunan film kutusunu diğer öğrenciye iletir.
3. 1 ve 2 numaralı öğrenciler yüzleri birbirine dönük olarak karşılıklı dururlar.
4. 1ve 2 numaralı öğrenciler kendilerine gelen kutuların içinden boncuk alırlar.
5. Bu 1 numaralı öğrenci gelen kutunun içinden bir boncuk alır. Kutuyu 2 numaralı öğrenci alıp sıradaki diğer öğrenciye iletir.
6. Şimdi gelen kutunun içinden boncuğu 2 numaralı öğrenci alır, kutuyu 1 numaralı öğrenciye verir.
7. Bu gelen kutuları sıradaki kişinin önce 1'e sonra 2'ye verilmesi sırayla yapılır. A tarafından gönderilen kutuların gönderilmesi sürekliliğini korur.



Şekil I

8. Karenin bir yerine ampermetre rolü oynayan öğrenci yerleştirilir. Ona ulaşan kutuları sayacağı açıklanır.
9. A üreteci değiştirilir. Yerine B üreteci yerleştirilir. Bu üreteç içinde dört boncuk olan kutuların iletimini sağlar.(Şekil II)
10. Karşılıklı duran öğrencilerin sayısı arttırılır. Bu öğrencilerde 1 ve 2 numaralı öğrenciler gibi gelen kutuların içinden kuralına göre birer boncuk alırlar.



Şekil II

NELER GÖZLEMLEDİK, PAYLAŞMAYA HAZIR MIYIZ? ☺

1. Daire şeklini oluşturan öğrencilerden A öğrencisi ne yapıyor?

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.....
.....

2. Kutuların iletimini başlatarak sisteme ne sağlıyor?

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.....

3. Daire merkezine sırtı dönük olan öğrenci ne yapıyor?

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.....
.....

4. Daire merkezine sırtı dönük öğrenci gerçek devrede neyi temsil eder ?

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.....

5. Bu aktivitede direnç görevi nasıl sağlanıyor?

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.....

6. Boncukların birer birer alınması bize neyi gösterir?

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.....
.....

7. Daire merkezine sırtı dönük öğrenci sayısı artırılırsa ne değişir ?

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.....
.....

8. Sırtı dönük öğrenci sayısı artırılırsa iletilen kutuların sayısında değişiklik gözlemlenir mi?

.....
.....
.....

9. Bu daire sisteminde hangi değerler birbirine eşittir?

.....
.....
.....

10. Kare şeklinde yerleşen öğrenciler sistemde neyi sağlar ?

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.....
.....

11. Karşılıklı olarak sıraya geçen öğrenciler neyi temsil ediyor?

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.....
.....

12. Karşılıklı duran öğrencilerin ilettikleri kutular arasında fark varmıdır ?

.....
.....
.....

13. Paralel kollardaki öğrenci sayısı artırılmasıyla ne değişir?
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.....
.....

14. Paralel kollara dağılan kutu sayılarının eşitliği gerçek devrede neyi gösterir?
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.....

15. Karşılıklı duran iki öğrenciden biri bir boncuk yerine iki boncuk alırsa ne değişir ?
.....
.....
.....

16. Paralel bağlı özdeş dirençlerden oluşan devrede dirençlerden birinin değeri artırılırsa eşdeğer dirençte nasıl bir değişiklik gözlemlenir ?
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.....
.....

17. Aktivitedeki rollerin gerçek olayla benzeyen, benzemeyen yönlerini listeleyin.

BENZEYEN	**BENZEMEYEN**
• .... • .... •	• .... • .... • ....

APPENDIX G

Table G.1 OBJECTIVE-ACTIVITY TABLE

Activity / Objective	Activity 1	Activity 2	Activity 3	Activity 4	Activity 5
1	*				
2	*				
3	*				
4					
5					
6					
7					
8				*	
9					
10		*			
11			*		
12					
13			*		
14			*		
15				*	
16				*	
17					*
18					*
19					
20					
21					*
22					*
23					
24					
25		*			
26		*			
27					
28					
29					
30					
31					
32					
33					

APPENDIX H

Table H.1 CRITERIA-ACTIVITY TABLE

	Activity / Criteria	Act 1	Act 2	Act 3	Act 4	Act 5
1	Activity sheets attracts students interests with its format	*		*	*	*
2	Purpose of the activity is clear	*	*	*	*	*
3	Activity match with objectives	*	*	*	*	*
4	Activity has clear directions and examples	*	*	*	*	*
5	Activity is done with easy to provide, daily life materials		*		*	*
6	It is easy to follow the activity	*	*	*	*	*
7	Activity is done in groups	*	*	*	*	*
8	Activity includes necessary questions to probe students' understanding	*	*	*	*	*
9	Activity contains safety precaution if necessary	*	*	*	*	*
10	Activity can be done out of the class	*	*	*	*	*
11	Activity overcome students' misconceptions	*	*	*	*	*
12	Students are actively engaged in activity	*		*	*	*
13	Activity links physics with daily life phenomena	*	*	*	*	*

APPENDIX I

Table I. 1 MISCONCEPTION- ACTIVITY TABLE

Activity / Criteria	Act 1	Act 2	Act 3	Act 4	Act 5
Weakening current model			*		
Sink model	*				
Clashing current model		*			
Shared current model					*
Power supply as a constant current source	*		*		*
Local and sequential reasoning				*	*
Short circuit	*		*		
Parallel circuit					*

APPENDIX J

DAILY LESSON PLANS

GÜNLÜK DERS PLANLARI

- Günlük Ders Planı-1
- Günlük Ders Planı-2
- Günlük Ders Planı-3
- Günlük Ders Planı-4
- Günlük Ders Planı-5
- Günlük Ders Planı-6

GÜNLÜK DERS PLANI-1

Lesson (Ders)	Fizik
Class (Sınıf)	9
Unit number/name(Ünite no/adı)	Bölüm 2- Madde ve Elektrik
Subject (Konu)	Elektrik Devreleri
Time (Süre)	45 dk
Prerequisite objectives (Önceki hedefler)	• Elektrik akımını tanımlamak • Akım şiddeti ve potansiyel fark kavramlarını tanımlamak • Elektrik kaynaklarını açıklamak
Objectives (Hedefler)	1. Basit elektrik devresini tanımlamak 2. Elektrik akımı oluşması için kapalı devre olması gerektiği koşulunu belirtmek 3. Kapalı ve açık devre kavramı arasındaki farkı açıklamak 4. Bir elektrik devresinde devre elemanlarını adlandırmak. 5. Devre elemanlarının görevlerini açıklamak 6. Devre elemanlarının bir devredeki kullanımını, bağlama şekillerini açıklamak. 7. Devre elemanlarının sembollerini belirtmek.
Symbols And Concepts (Semboller-Kavramlar)	Devre elemanlarının görevleri ve bir elektrik devresinde gösterilirken kullanılan sembolleri öğrencilere dağıtılacak olan Elektrik Devreleri teksirinde yer almaktadır.
Instructional Materials (Öğretim materyalleri)	Tepegözle anlatım sırasında kullanılacak Elektrik Devreleri asetatı Aktivite sırasında kullanılacak renkli kartonlar Devre elemanlarını gösteren laboratuvar malzemeleri
Methods and Techniques	Düz- anlatım, Rol-yapma
Link (Last lesson- Today- Next lesson) Bağlantı (Önceki – Bugünkü- Sonraki ders)	Last lesson: Bir önceki derslerde Elektrik akımının, akım şiddetinin, potansiyel fark kavramlarının açıklandığı belirtildi. Buna paralel olarak maddelerin iletkenliği ve elektrik akımı kaynaklarının tanımı ve çeşitleri hatırlatılır. Today: Bugünkü konumuzun elektrik devreleri olduğu belirtilir. Bu konuyla ilgili hazırlanan figür tepegözde gösterilir. Asıl konumuzun Basit elektrik devresi, kapalı-açık devre ve devre elemanları olduğu belirtilir. Direnç ve ölçülmesi konusuna bir örnekle değinilir. Next lesson: Bir sonraki dersimizde potansiyel farkının ölçülmesi ile Potansiyel farkın ölçülmesi ve Ohm Yasası üzerinde durulacaktır.
Preparation of students (Öğrenci ön hazırlığı) **Preparation of the teacher (Öğretmen önhazırlığı)**	Öğrencilerin ders gelmeden önce elektrik kaynakları, elektrik akımı, maddelerin iletkenliği konuları tekrar etmeleri istenir. Öğretmen ders işlenişi sırasında kullanacağı figürleri, konu özeti içerikli teksirleri hazırlar. Elektrik devre elemanları ile ilgili laboratuvarda kullanacağı malzemeleri hazırlar. Konuyla ilgili aktivite 1 yönergeleri hazırlanır, aktivitenin seri şekilde uygulanması için öğrencilere roller önceden dağıtılır.

Presentation (İşleniş)	
• Öğretmen derse başlamadan önce bir önceki derste işlenen konulara başlık olarak değinir. Elektrik akımı, akım şiddeti, potansiyel fark kavramlarının ne olduğunu öğrencilere sorar, yanıtlarını bekler. Kısaca bu kavramları tanımlar. Elektrik kaynakları nelerdir? Sorusunu yöneltir, açıklama yapar. • Bu derste elektrik devreleri konusuna giriş yapılacağı belirtilir. • Tepegözde gösterilerek elektrik devreleri, basit elektrik devresi açıklanır. Basit elektrik devresine günlük yaşamdan örnekler vermeleri istenir, verilir. • Kapalı ve açık devre kavramları açıklanır. Günlük hayatta evlerde, iş yerlerinde elektrik düğmesini açtığımızda devrenin kapalı durumda olduğu belirtilir. Bu konuyla ilgili aktivite yapacağımız belirtilir. • Bir elektrik devresinde bulunan elemanların neler olabileceği sorulur. Bununla ilgili devre elemanları figürü basamak basamak gösterilir. • Devre elemanları belirtilir. Bunların görevlerine değinilir. Bu devre elemanları laboratuvar ortamında bulunan malzemelerden gösterilir. • Aktiviteye geçmeden önce direnç ve direncin ölçülmesi konusu kısaca açıklanır. • Elektrik devreleri- Devre elemanları ile ilgili hazırlanan figürler, konu içerikli teksirler öğrencilere dağıtılır. • Aktivitenin yönergelerini içeren kağıtlar dağıtılır, aktivitede görevli olan öğrencilerin rolleri dağıtılır, rolleri açıklanır. • Aktivite uygulandıktan sonra öğrencilerin aktiviteyle ilgili soruları cevaplandırmaları istenir, onlara süre tanınır.	
Timing (Zaman dağılımı)	
• Önceki derste işlenen konuyu hatırlatma, bugünkü konuyla ilişki kurma – **2dk** • Elektrik devreleri bölümde işlenecek konuları belirtme-**1dk** • Basit elektrik devresini tanımlama, açık-kapalı durumunu açıklama –**2dk** • Bir elektrik devresinde bulunacak elemanları belirtip, görevlerini açıklama, laboratuvar malzemesi olarak devre elemanlarını gösterme- **5 dk** • Elektrik devreleri, devre elemanları, direnç ve ölçülmesi ile ilgili hazır olan teksirleri dağıtma-**1dk** • Basit elektrik devresi, kapalı-açık devre ile ilgili yapılacak aktivite kağıtlarını dağıtma-**1dk** • Öğrencilerden yönergelerini dikkatlice okumalarını isteme, okumalarını bekleme-**2dk** • Aktivitede yer alacak öğrencilerin rollerini dağıtma –**2dk** • Öğrencilerin aktiviteyi uygulamalarını sağlama için hazırlık-**2dk** • Aktivitenin belirtilen yönergeler doğrultusunda gerçekleştirilmesini sağlama –**5dk** • Aktiviteyle ilgili hazırlanmış kağıdı doldurma-**15dk** • Direnç ve ölçülmesi konusuna değinme –**3dk** • Konuları toparlama-**4dk**	
Evaluation (Değerlendirme)	• Aktivite sonunda dağıtılan kağıtlarla değerlendirme sağlanır.
Figures (Şekiller)	• Elektrik devreleri konusunda işlenecek alt konuları belirten şekil • Devre elemanlarını belirten, görevlerini, sembollerini gösteren şekil

GÜNLÜK DERS PLANI-2

Lesson (Ders)	Fizik
Class (Sınıf)	9
Unit number/name(Ünite no/adı)	Bölüm 2- Madde ve Elektrik
Subject (Konu)	Elektrik Devreleri (Potansiyel farkın ölçülmesi)
Time (Süre)	45 dk
Prerequisite objectives (Önceki hedefler)	• Bir elektrik devresinde devre elemanlarını adlandırmak. • Devre elemanlarının görevlerini açıklamak • Devre elemanlarının bir devredeki kullanımını, bağlama şekillerini açıklamak. • Devre elemanlarının sembollerini belirtmek.
Objectives (hedefler)	• Basit elektrik devresinde potansiyel farkı tanımlamak • Elektrik akımını açıklamak. • Elektrik akımının yönünü açıklamak • Akım, potansiyel fark ve direnç arasındaki ilişkiyi açıklamak.
Symbols And Concepts (Semboller-Kavramlar)	Potansiyel fark, akım şiddeti, voltmetre, ampermetre
Instructional Materials (Öğretim materyalleri)	Laboratuvar malzemeleri, belli bir boyutta mukavva, boncuklar, hortum
Methods and Techniques	Düz- anlatım, (Analoji) Rol-yapma
Link (Last lesson- Today- Next lesson) Bağlantı (Önceki – Bugünkü- Sonraki ders)	Last lesson: Bir önceki dersimizde elektrik devresinde bulunan devre elemanlarının görevleri, sembolleri açıklandı. Today: Bugünkü konumuzun potansiyel farkının ölçülmesi, akımın yönünün açıklanması olduğu belirtilir. Aktivitenin uygulanmasından sonra potansiyel fark ve akım arasındaki ilişkiye değinilir. Next lesson: Bir sonraki dersimizde Ohm Yasası açıklanacaktır. Bu yasayla ilgili aktivite uygulanacaktır.
Preparation of students (Öğrenci ön hazırlığı) **Preparation of the teacher (Öğretmen önhazırlığı)**	Öğrencilerin ders gelmeden önce elektrik devre elemanları konuları tekrar etmeleri istenir. Öğretmen ders işlenişi sırasında kullanacağı figürleri, konu özeti içerikli teksirleri hazırlar. Potansiyel farkının ölçülmesi ile ilgili laboratuvarda kullanacağı malzemeleri hazırlar. Aktivite 2 yönergeleri, teksirleri ve konuyla ilgili figürler ve teksirler hazırlanır.

Presentation (İşleniş)	
• Öğretmen derse başlamadan önce bir önceki derste işlenen konulara başlık olarak değinir. Elektrik akımı, akım şiddeti, potansiyel fark kavramlarının ne olduğunu öğrencilere sorar, yanıtlarını bekler. Kısaca bu kavramları tanımlar. Potansiyel farkının nasıl ölçülebileceğini, potansiyel fark ile akım şiddeti arasında nasıl bir ilişki vardır sorularıyla derse giriş yapar. • Öğrencilerin yanıtlarını bekler, sonra potansiyel fark ve elektrik akımını tanımlar. Akım yönünü belirtir. İniş- çıkış aktivitenin uygulanmasına geçeceğini belirtir. • Aktiviteye geçmeden önce aktiviteyle ilgili teksirler dağıtılır. • Aktivitenin yönergelerini içeren kağıtların dikkatli bir şekilde okunması istenir. • Bu aktivite gösterim ağırlıklı olduğu için, uygulama için üç öğrenci seçilir. • Diğer öğrencilerin uygulamayı izlemeleri sağlanır. Uygulama basamak basamak uygulanırken, öğrencilerin ilgilerini dağıtmamaları için, konuyla ilgili "A konumunda potansiyel fark değeri nedir?" gibi sorular sorulur. • Aktivite 2 uygulandıktan sonra öğrencilerin aktiviteyle ilgili soruları cevaplandırmaları istenir, onlara süre tanınır. • Aktivite kağıtları doldurulduktan sonra sonuçlar açıklanır, tartışılır. Bir elektrik devresinde akım şiddeti ve potansiyel fark arasında nasıl bir ilişki olabileceği sorulur, ilişkiye kısaca değinilir. • OHM Yasası ile ilgili hazırlanan figür tepegözde gösterilir.	
Timing (Zaman dağılımı)	
• Önceki derste işlenen konuyu hatırlatma, bugünkü konuyla ilişki kurma – **2dk** • Potansiyel farkın ölçülmesi konusunda işlenecek olan potansiyel fark ve akım yönü konularını belirtme-**1dk** • Potansiyel fark, akım şiddeti kavramlarını tanımlama–**2dk** • Laboratuvar malzemeleri kullanarak potansiyel fark ve akım değerini ölçme, gösterme- **5 dk** • Potansiyel fark ve akım yönü ile ilgili yapılacak aktivite kağıtlarını dağıtma-**1dk** • Öğrencilerden yönergelerini dikkatlice okumalarını isteme, okumalarını bekleme-**2dk** • Aktivitede yer alacak öğrencileri seçme, görevlerini açıklama–**2dk** • Öğrencilerin aktiviteyi uygulamalarını sağlama için hazırlık-**2dk** • Aktivitenin belirtilen yönergeler doğrultusunda gerçekleştirilmesini sağlama –**5dk** • Aktiviteyle ilgili hazırlanmış kağıdı doldurma-**15dk** • Potansiyel fark ve akım şiddeti arasındaki ilişkiye değinme–**3dk** • Konuları toparlama-**5dk**	
Evaluation (Değerlendirme)	• Aktivite sonunda dağıtılan kağıtlarla değerlendirme sağlanır.
Figures (Şekiller)	• OHM Yasası konusunda işlenecek kısımları belirten şekil

GÜNLÜK DERS PLANI-3

Lesson (Ders)	Fizik
Class (Sınıf)	9
Unit number/name(Ünite no/adı)	Bölüm 2- Madde ve Elektrik
Subject (Konu)	Elektrik Devreleri (OHM Yasası)
Time (Süre)	45 dk
Prerequisite objectives (Önceki hedefler)	• Basit elektrik devresinde potansiyel farkı tanımlamak • Elektrik akımını açıklamak. • Elektrik akımının yönünü açıklamak
Objectives (Hedefler)	1. Akım, potansiyel fark ve direnç arasındaki ilişkiyi kavramak. 2. Direnç, akım ve potansiyel fark arasındaki ilişkiyi grafikle göstermek. 3. Basit elektrik devrelerinde OHM yasasını problem çözmede uygulamak.
Symbols And Concepts (Semboller-Kavramlar)	OHM Yasası içinde geçen terimleri ve aralarındaki bağıntıyı anlatan teksir hazırlanmıştır. Kavramlar potansiyel fark, akım şiddeti ve dirençtir.
Instructional Materials (Öğretim materyalleri)	Tepegözle anlatım sırasında kullanılacak OHM Yasası asetatı Aktivite sırasında kullanılacak malzemeler (film kutuları, boncuklar) Bağıntıyı sayısal olarak gösteren laboratuvar malzemeleri
Methods and Techniques	Düz- anlatım, Rol-yapma
Link (Last lesson- Today- Next lesson) Bağlantı (Önceki – Bugünkü- Sonraki ders)	Last lesson: Bir önceki derste potansiyel fark ve akim şideeti ile akım yönü üzerinde duruldu. Today: Bugünkü konumuzun OHM Yasası olduğu belirtilir. Bu konuyla ilgili hazırlanan figür tepegözde gösterilir. Akım, potansiyel farkı ve direnç arasındaki bağıntıya değinileceği belirtilir. Direnç kavramı açıklanır. Next lesson: Bir sonraki dersimizde iletkenlerin direncinin bağlı olduğu faktörler ve öz direnç kavramı üzerinde durulacaktır.
Preparation of students (Öğrenci ön hazırlığı) **Preparation of the teacher (Öğretmen önhazırlığı)**	Öğrencilerin ders gelmeden önce potansiyel fark, akım şiddeti kavramları konularını tekrar etmeleri istenir. Öğrencilerin yaşamda karşılaştıkları zorlukların neler olduğunu düşünmeleri istenir. Öğretmen ders işlenişi sırasında kullanacağı figürü, konu özeti içerikli teksiri hazırlar. OHM Yasasını açıklamada kullanacağı laboratuvar malzemelerini hazırlar. Konuyla ilgili aktivite 3 yönergelerini hazırlar, aktivitenin seri şekilde uygulanması için öğrencilere roller önceden dağıtılır.

Presentation (İşleniş)	
• Öğretmen derse başlamadan önce bir önceki derste işlenen konulara başlık olarak değinir. Elektrik akımı, akım şiddeti, potansiyel fark kavramlarının ne olduğunu öğrencilere sorar, yanıtlarını bekler. Kısaca bu kavramları tanımlar. • Yaşamda karşılaştıkları sorunlar üzerinde durulur. Bu sorunlara karşı direndikleri belirtilir. Bir elektrik devresinde de direnme var mıdır?, sorusuyla OHM Yasasına geçilir. • Potansiyel fark ve akım arasındaki oranın OHM Yasasıyla ilişkisi kurulur ve bu ilişki grafikle gösterilir. • OHM Yasası figürü gösterilir. • Laboratuvar malzemelerini kullanarak(voltmetre, ampermetre, ampul ve pil) akım, potansiyel fark arasındaki ilişkiyi gösterir. • Bu konuyla ilgili Aktivite 3'ün yapılacağı belirtilir.. • Aktiviteye geçmeden önce direnç kavramı tanımlanır. • OHM Yasası ile ilgili hazırlanan şekil, konu içerikli teksir öğrencilere dağıtılır. • Aktivitenin yönergelerini içeren kağıtlar dağıtılır, aktivitede görevli olan öğrencilerin rolleri dağıtılır, rolleri açıklanır. • Aktivite 3 uygulandıktan sonra öğrencilerin aktiviteyle ilgili soruları cevaplandırmaları istenir, onlara süre tanınır.	
Timing (Zaman dağılımı)	
• Önceki derste işlenen konuyu hatırlatma, bugünkü konuyla ilişki kurma – **2dk** • Potansiyel fark, akım şiddeti kavramlarını tanımlama–**2dk** • Basit elektrik devresini kurma, potansiyel farkı değiştirerek akım şiddetindeki değişimi gözlemleme–**2dk** • Gözlem sonucu çıkan değerleri yazı tahtası üzerinde açıklama- **5 dk** • Potansiyel fark, akım ve direnç arasındaki bağıntıyı OHM Yasası olarak açıklama-**1dk** • OHM Yasası ile ilgili yapılacak aktivite kağıtlarını dağıtma-**1dk** • Öğrencilerden yönergelerini dikkatlice okumalarını isteme, okumalarını bekleme-**2dk** • Aktivitede yer alacak öğrencilerin rollerini dağıtma –**2dk** • Öğrencilerin aktiviteyi uygulamalarını sağlama için hazırlık-**2dk** • Aktivitenin belirtilen yönergeler doğrultusunda gerçekleştirilmesini sağlama –**5dk** • Aktiviteyle ilgili hazırlanmış kağıdı doldurma-**15dk** • Direnç ve ölçülmesi konusuna değinme –**3dk** • Konuları toparlama-**3dk**	
Evaluation (Değerlendirme)	• Aktivite sonunda dağıtılan kağıtlarla değerlendirme sağlanır.
Figures (Şekiller)	• OHM Yasası konusunda işlenecek kavramları, kavramlar arasındaki ilişkiyi belirten şekil

GÜNLÜK DERS PLANI-4

Lesson (Ders)	Fizik
Class (Sınıf)	9
Unit number/name(Ünite no/adı)	Bölüm 2- Madde ve Elektrik
Subject (Konu)	Elektrik Devreleri- İletkenlerin direncinin bağlı olduğu faktörler ve özdirenç
Time (Süre)	45 dk
Prerequisite objectives (Önceki hedefler)	• Akım, potansiyel fark ve direnç arasındaki ilişkiyi kavramak. • Direnç kavramını tanımlamak.
Objectives (Hedefler)	1. İletkenin boyu, kesiti, sıcaklığı ve cinsinin iletkenin direncine etkisini açıklamak. 2. İletkenin direncini etkileyen faktörleri birbirleri arasında ilişkilendirmek.
Symbols And Concepts (Semboller-Kavramlar)	Direnç, özdirenç kavramları, iletkenlerin dirençlerini etkileyen faktörleri sıralama
Instructional Materials (Öğretim materyalleri)	Tepegözle anlatım sırasında kullanılacak Direnç asetatı
Methods and Techniques	Düz- anlatım, Rol-yapma
Link (Last lesson- Today- Next lesson) Bağlantı (Önceki – Bugünkü- Sonraki ders)	Last lesson: Bir önceki derste potansiyel fark, akım şiddeti ve direnç arasındaki ilişkiye değinildi. OHM Yasası açıklandı. Today: Bugünkü konumuzun iletkenlerin direncinin bağlı olduğu faktörler ve özdirenç olduğu belirtilir. Bu konuyla ilgili hazırlanan Direnç figürü tepegözde gösterilir. OHM Yasası ile ilgili problem çözülür. Next lesson: Bir sonraki dersimizde elektrik devrelerinde akım konusu üzerinde durulacaktır.
Preparation of students (Öğrenci ön hazırlığı) **Preparation of the teacher (Öğretmen önhazırlığı)**	Öğrencilerin ders gelmeden önce potansiyel fark, akım şiddeti ve direnç arasındaki bağıntıyı tekrar etmeleri istenir. Öğretmen ders işlenişi sırasında kullanacağı şekilleri, konu özeti içerikli teksirleri hazırlar. Konuyla ilgili aktivite 4 yönergeleri hazırlanır, aktivitenin seri şekilde uygulanması için öğrencilere roller önceden dağıtılır.

Presentation (İşleniş)	
• Öğretmen derse başlamadan önce bir önceki derste işlenen konulara başlık olarak değinir. Elektrik akımı, akım şiddeti, potansiyel fark kavramlarının ne olduğunu öğrencilere sorar, yanıtlarını bekler. Kısaca bu kavramları tanımlar. • Bu derste iletkenlerin direncinin bağlı olduğu faktörler ve özdirenç konusunun işleneceği belirtilir. • Potansiyel fark ve akım şiddeti arasında OHM Yasasına göre nasıl bir orantı vardır?, Bir elektrik devresinde potansiyel fark arttırılırsa ne değişir?, gibi sorular yöneltir, cevabını bekler. • Direnç nedir?, sorusuyla konuya giriş yapar. Bakır telle alüminyum tel arasında nasıl bir farklılık vardır? • Direnç ile ilgili asetat tepegözde gösterilir. Direnç ve özdirenç tanımı yapılır. Bu konuyla ilgili aktivite yapacağımız belirtilir. • Aktiviteye geçmeden önce OHM Yasası ile ilgili iki problem çözülür. • İletkenlerin direncinin bağlı olduğu faktörler ve özdirenç ile ilgili hazırlanan şekil, konu içerikli teksirler öğrencilere dağıtılır. • Aktivitenin yönergelerini içeren kağıtlar dağıtılır, aktivitede görevli olan öğrencilerin rolleri dağıtılır, rolleri açıklanır. • Aktivite 4 uygulandıktan sonra öğrencilerin aktiviteyle ilgili soruları cevaplandırmaları istenir, onlara süre tanınır.	
Timing (Zaman dağılımı)	
• Önceki derste işlenen konuyu hatırlatma, bugünkü konuyla ilişki kurma – **2dk** • Direnç bölümünde işlenecek konuları belirtme-**1dk** • Direnç ve özdirenç kavramlarını tanımlama–**5dk** • Direnç ile ilgili hazır olan teksirleri dağıtma-**1dk** • İletkenlerin direncinin bağlı olduğu faktörler ile ilgili yapılacak aktivite kağıtlarını dağıtma-**1dk** • Öğrencilerden yönergelerini dikkatlice okumalarını isteme, okumalarını bekleme-**2dk** • Aktivitede yer alacak öğrencilerin rollerini dağıtma –**2dk** • Öğrencilerin aktiviteyi uygulamalarını sağlama için hazırlık-**2dk** • Aktivitenin belirtilen yönergeler doğrultusunda gerçekleştirilmesini sağlama –**7dk** • Aktiviteyle ilgili hazırlanmış kağıdı doldurma-**15dk** • Direnç ve ölçülmesi konusuna değinme –**3dk** • Konuları toparlama-**4dk**	
Evaluation (Değerlendirme)	• Aktivite sonunda dağıtılan kağıtlarla değerlendirme sağlanır.
Figures (Şekiller)	• İletkenlerin direncinin bağlı olduğu faktörler ve özdirenç ile ilgili işlenecek konuları belirten şekil

GÜNLÜK DERS PLANI-5

Lesson (Ders)	Fizik
Class (Sınıf)	9
Unit number/name(Ünite no/adı)	Bölüm 2-Madde ve Elektrik
Subject (Konu)	Elektrik Devrelerinde Akım-Dirençlerin Seri Bağlanması
Time (Süre)	45 dk
Prerequisite objectives (Önceki hedefler)	• Akım, potansiyel fark ve direnç arasındaki ilişkiyi kavramak. • Direnç kavramını tanımlamak.
Objectives (Hedefler)	8. Seri bağlı devrelerde devre akımının bir yolu takip ettiğini belirtmek. 9. Seri bağlı devrelerde her dirençten geçen akımın aynı değerde olduğunu açıklamak. 10. Seri bağlı devrelerde potansiyel farkın doğru orantılı olarak dirençlere dağıldığını belirtmek. 11. Seri bağlı devrelerde dirençlerin uçları arasındaki potansiyel farklarının toplamının, devrenin potansiyeline eşit olduğunu belirtmek. 12. Seri ve paralel bağlı devrelerde eşdeğer direnci hesaplamak 13. Seri bağlı devrede direnç sayısı (lambaların sayısı) arttıkça eşdeğer direncinin arttığı sonucunu çıkarmak. 14. Seri ve paralel bağlı devrelerle ilgili problemler çözmek.
Symbols And Concepts (Semboller-Kavramlar)	Akım, potansiyel fark, direnç, eşdeğer direnç
Instructional Materials (Öğretim materyalleri)	Aktivite sırasında kullanılacak film kutuları ve boncuklar Laboratuvar malzemeleri (ampermetre, voltmetre, duy, güç kaynağı, ampuller, bağlantı kabloları)
Methods and Techniques	Düz- anlatım, Rol-yapma
Link (Last lesson- Today- Next lesson) Bağlantı (Önceki – Bugünkü- Sonraki ders)	Last lesson: Bir önceki derste iletkenlerin direncinin bağlı olduğu faktörler ve özdirencin ne olduğu açıklandı. Today: Bugünkü konumuzun elektrik devrelerinde akım olduğu ve iki kısımda işleyeceğimiz belirtilir. Next lesson: Bir sonraki dersimizde paralel devrede akım, dirençlerin paralel bağlanması ve kısa devre konuları işlenecektir.
Preparation of students (Öğrenci ön hazırlığı) **Preparation of the teacher (Öğretmen önhazırlığı)**	Öğrencilerin dersegelmeden önce seri ve paralel devrede akım ve potansiyel farkın nasıl dağıldığı konusunda araştırma yapmaları istenir. Öğretmen ders işlenişi sırasında kullanacağı konu özeti içerikli teksirleri hazırlar. Seri ve paralel devrede akımın dağılması ile ilgili laboratuvarda kullanacağı malzemeleri hazırlar. Konuyla ilgili aktivite 5 yönergeleri hazırlanır, aktivitenin seri şekilde uygulanması için öğrencilere roller önceden dağıtılır.

Presentation (İşleniş)	
• Öğretmen derse başlamadan önce bir önceki derste işlenen konulara başlık olarak değinir. • Bu derste elektrik devrelerinde akım konusuna giriş yapılacağı, bu konunun iki kısımda işleneceği belirtilir. • Laboratuvar malzemelerinden yararlanılarak basit bir devre kurulur. Bu devreye iki ampul uç uca eklenir. Devredeki ampermetre değeri okunur. Sonra ampullerden birine voltmetre bağlanır, voltmetrenin gösterdiği değer kaydedilir. Daha sonra diğer ampule bağlanır. Diğer okunur. Bu iki değer karşılaştırılır. Bu iki değerin toplamının neyi verdiği sorulur. • Devrede oluşan elektrik akımının dirençler (ampuller) üzerinden nasıl dağıldığı gözlemlenir, ampermetrenin gösterdiği değerde bir değişiklik var mıdır?, sorusuyla öğrencilerin genelleme yapması istenir. • Aktiviteye geçmeden önce seri bağlı devrelerde akım ve potansiyel farkın nasıl dağıldığı açıklanır. • Elektrik devrelerinde akım ile ilgili konu özeti içerikli teksirler öğrencilere dağıtılır. • Aktivitenin yönergelerini içeren kağıtlar dağıtılır, aktivitede görevli olan öğrencilerin rolleri dağıtılır, rolleri açıklanır. • Aktivite 5 çalışmasının seri devrelerle ilgili kısmı uygulandıktan sonra öğrencilerin aktiviteyle ilgili soruları cevaplandırmaları istenir, onlara süre tanınır.	
Timing (Zaman dağılımı)	
• Önceki derste işlenen konuyu hatırlatma, bugünkü konuyla ilişki kurma – **2dk** • Elektrik devrelerinde akım bölümünde işlenecek konuları belirtme-**1dk** • Bir seri bağlı elektrik devresi kurarak akım ve potansiyel fark dağılımının gösterilmesi- **5 dk** • Elektrik devrelerinde akım ile ilgili hazır olan teksirleri dağıtma-**1dk** • Seri bağlı devrelerle ilgili yapılacak aktivite kağıtlarını dağıtma-**1dk** • Öğrencilerden yönergelerini dikkatlice okumalarını isteme, okumalarını bekleme-**2dk** • Aktivitede yer alacak öğrencilerin rollerini dağıtma –**2dk** • Öğrencilerin aktiviteyi uygulamalarını sağlama için hazırlık-**2dk** • Aktivitenin belirtilen yönergeler doğrultusunda gerçekleştirilmesini sağlama –**7dk** • Aktiviteyle ilgili hazırlanmış kağıdı doldurma-**15dk** • Seri bağlı devrelerle ilgili genelleme yapılması, örnek soru çözülmesi -**3dk** • Konuları toparlama-**4dk**	
Evaluation (Değerlendirme)	• Aktivite sonunda dağıtılan kağıtlarla değerlendirme sağlanır. • Konuyla ilgili örnek soru çözülür.
Figures (Şekiller)	----------

GÜNLÜK DERS PLANI-6

Lesson (Ders)	Fizik
Class (Sınıf)	9
Unit number/name(Ünite no/adı)	Bölüm 2- Madde ve Elektrik
Subject (Konu)	Elektrik Devrelerinde Akım-Dirençlerin Paralel Bağlanması
Time (Süre)	45 dk
Prerequisite objectives (Önceki hedefler)	• Akım, potansiyel fark ve direnç arasındaki ilişkiyi kavramak. • Direnç kavramını tanımlamak. • Seri bağlı devrelerde devre akımının bir yolu takip ettiğini belirtmek. • Seri bağlı devrelerde her dirençten geçen akımın aynı değerde olduğunu açıklamak. • Seri bağlı devrelerde potansiyel farkın doğru orantılı olarak dirençlere dağıldığını belirtmek.
Objectives (Hedefler)	15. Paralel bağlı devrede elektrik akımının farklı yollar izleyerek dirençlere dağıldığını açıklamak. 16. Paralel bağlı devrede toplam elektrik akımının her kolda yer alan eşdeğer dirençlere OHM kanununa göre dağıldığını belirtmek. 17. Paralel bağlı devrede her paralel kolda oluşan potansiyel farkın aynı değerde olduğunu açıklamak. 18. Seri ve paralel bağlı devrelerde eşdeğer direnci hesaplamak. 19. Paralel bağlı devrede direnç sayısı (lambaların sayısı) arttıkça eşdeğer direncin azaldığını belirtmek. 20. Seri ve paralel devrelerde ampullerin parlaklığı ile devrenin elektrik akımı, potansiyel fark ve eşdeğer direnci arasında ilgi kurmak. 21. Kısa devreyi açıklamak. 22. Kısa devreyle ilgili problemler çözmek. 23. Karışık devrelerle ilgili problemler çözmek
Symbols And Concepts (Semboller-Kavramlar)	Akım, potansiyel fark, direnç, eşdeğer direnç
Instructional Materials (Öğretim materyalleri)	Aktivite sırasında kullanılacak film kutuları ve boncuklar Laboratuvar malzemeleri (ampermetre, voltmetre, duy, güç kaynağı, ampuller, bağlantı kabloları)
Methods and Techniques	Düz- anlatım, Rol-yapma
Link (Last lesson- Today- Next lesson) Bağlantı (Önceki – Bugünkü- Sonraki ders)	Last lesson: Bir önceki derste seri devrede akım, dirençlerin seri bağlanması işlendi. Today: Bugünkü konumuzun elektrik devrelerinde akım olduğu, paralel devrede akım, dirençlerin paralel bağlanması ve kısa devre konuları işlenir. Next lesson: Bir sonraki dersimizde elektrik devrelerinin emniyeti konusu işlenecektir.

<table>
<tr><td>Preparation of students (Öğrenci ön hazırlığı)
Preparation of the teacher (Öğretmen önhazırlığı)</td><td>Öğrencilerin derse gelmeden önce seri ve paralel devrede akım ve potansiyel farkın nasıl dağıldığı konusunda araştırma yapmaları istenir.
Öğretmen ders işlenişi sırasında kullanacağı konu özeti içerikli teksirleri hazırlar. Seri ve paralel devrede akımın dağılması ile ilgili laboratuvarda kullanacağı malzemeleri hazırlar. Konuyla ilgili aktivite 5 yönergeleri hazırlanır, aktivitenin seri şekilde uygulanması için öğrencilere roller önceden dağıtılır.</td></tr>
<tr><td colspan="2">Presentation (İşleniş)</td></tr>
<tr><td colspan="2">• Öğretmen derse başlamadan önce bir önceki derste işlenen konulara başlık olarak değinir.
• Bu derste elektrik devrelerinde akım konusuna giriş yapılacağı, bu konunun iki kısımda işleneceği belirtilir.
• Laboratuvar malzemelerinden yararlanılarak basit bir devre kurulur. Bu devreye iki ampul birbirine paralel bağlanır. Devredeki her ampuldeki ampermetre değerleri okunur. Ampullerden herhangi birine bağlanan voltmetrenin gösterdiği değer okunur.
• Devrede oluşan elektrik akımının dirençler (ampuller) üzerinden nasıl dağıldığı gözlemlenir, ampermetrenin gösterdiği değerde bir değişiklik var mıdır?, sorusuyla öğrencilerin genelleme yapması istenir.
• Aktiviteye geçmeden önce seri bağlı devrelerde akım ve potansiyel farkın nasıl dağıldığı açıklanır.
• Paralel bağlı dirençlerde akım şiddeti dirençlerin değerlerine bakılarak ters orantılı olarak dağılır. Küçük değerli dirence büyük akım dağılır. Her iki ampulde de voltmetre değeri eşit değeri gösterir sonucuna varılır.
• Kısa devre olayı kısaca açıklanır, laboratuvar malzemeleriyle kısa devre kurulur, sonuç tartışılır.
• Elektrik devrelerinde akım ile ilgili konu özeti içerikli teksirler öğrencilere dağıtılır.
• Aktivitenin yönergelerini içeren kağıtlar dağıtılır, aktivitede görevli olan öğrencilerin rolleri dağıtılır, rolleri açıklanır.
• Aktivite 5 çalışmasının paralel devrelerle ilgili kısmı uygulandıktan sonra öğrencilerin aktiviteyle ilgili soruları cevaplandırmaları istenir, onlara süre tanınır.</td></tr>
<tr><td colspan="2">Timing (Zaman dağılımı)</td></tr>
<tr><td colspan="2">• Önceki derste işlenen konuyu hatırlatma, bugünkü konuyla ilişki kurma – 2dk
• Bir paralel bağlı elektrik devresi kurarak akım ve potansiyel fark dağılımının gösterilmesi- 5dk
• Kısa devre olayının gösterilmesi-2dk
• Elektrik devrelerinde akım ile ilgili hazır olan teksirleri dağıtma-1dk
• Paralel bağlı devrelerle ilgili yapılacak aktivite kağıtlarını dağıtma-1dk
• Öğrencilerden yönergelerini dikkatlice okumalarını isteme, okumalarını bekleme-1dk
• Aktivitede yer alacak öğrencilerin rollerini dağıtma –1dk
• Öğrencilerin aktiviteyi uygulamalarını sağlama için hazırlık-2dk
• Aktivitenin belirtilen yönergeler doğrultusunda gerçekleştirilmesini sağlama –5dk
• Aktiviteyle ilgili hazırlanmış kağıdı doldurma-12dk
• Paralel, seri bağlı devrelerle ilgili örnek sorular çözülmesi -11dk
• Konuları toparlama-2dk</td></tr>
<tr><td>Evaluation (Değerlendirme)</td><td>• Aktivite sonunda dağıtılan kağıtlarla değerlendirme sağlanır.
• Kısa devre, seri ve paralel bağlı devrelerle ilgili örnek sorular çözülür.</td></tr>
<tr><td>Figures (Şekiller)</td><td>----------</td></tr>
</table>

APPENDIX K

HANDOUTS

ELEKTRİK DEVRELERİ

Bir üretecin kutupları, bir iletkenle birleştirilip araya bir de lamba konulursa, basit bir elektrik devresi elde edilir. Devrede yük hareketi varsa devre kapalıdır. Devre bir yerinden kesilirse yük hareketi durur. Bu durumda devre açıktır.

Üretecin iletken telde oluşturduğu elektriksel alanın serbest elektronlara uyguladığı kuvvet elektronları iletken tel üzerinde (-) kutuptan (+) kutba getirir. Devrede bir akım oluşmuştur ve bu akımın yönünün iletken tel üzerinde (-) yüklerin hareketine zıt yönde olduğu yani (+) kutuptan (-) kutuba doğru olduğu kabul edilmiştir.

BİR ELEKTRİK DEVRESİNDE DEVRE ELEMANLARI

Elektrik devrelerine çeşitli amaçlarla bağlanan üreteç, direnç, ampermetre, voltmetre, anahtar, ampul (lamba) gibi araçlara elektrik devresi elemanları denir. Elektrik devrelerinde bu elemanların resimlerini çizmek yerine bu elemanların sembolleri kullanılır.

- **Üreteç:** Elektrik devresinde kullanılan pil, akümülatör, batarya, güç kaynağı gibi elektrik kaynaklarına denir.

- **Ampermetre:** Bir elektrik devresinden geçen akım şiddetini ölçmeye yarayan iki uçlu bir araçtır. Ampermetreler devreye seri bağlanır.

- **Voltmetre:** Bir devre elemanının uçları arasında oluşan potansiyel farkını ölçmeye yarayan iki uçlu araçtır. Voltmetreler potansiyel farkı ölçülecek elemanla paralel bağlanır.

- **Direnç:** Bir elektrik devresinde iletkenlerin cinslerine göre elektrik akımına gösterdikleri zorluğa direnç denir. Örneğin; bakır, alüminyum bir elektrik devresinde akımın geçişine çok az direnç gösterirken; krom-nikel alaşımı akımın geçişine karşı çok fazla direnç göstererek devreye bağlandıklarında ısınırlar. Bunlardan direnici en büyük olan krom-nikel alaşımı en çok ısındığında elektrikli aletlerde direnç teli olarak kullanılır.

- **Anahtar:** Devreden geçen akımı istediğimiz anda kesip istediğimiz anda tekrar akım verilmesini sağlayan devre elemanıdır. Anahtar ile devreden akım geçmesi sağlanırsa bu durumda anahtar kapalıdır deriz.

- **Ampul:** Elektrik devrelerinde oluşan elektrik enerjisi başka enerjilere çevrilebilir. Örneğin ampul elektrik enerjisini ışık enerjisine çevirir. Ampulü devreye bağlamakta kolaylık olması açısından iki uçlu duylar kullanılabilir.

Direnç, potansiyel fark ve akım şiddetinin gösterilişi ve birimleri:

Büyüklük	Direnç (R)	Potansiyel Fark (V)	Akım Şiddeti (i)
Birimi	Ohm (Ω)	Volt (V)	Amper (A)

DİRENÇ VE ÖLÇÜLMESİ

Elektrik akımı metallerde serbest elektronların hareketi sonucu oluşur. Elektronların bu hareketi bazı iletkenlerde kolay, bazı iletkenlerde zordur. Maddelerin serbest elektronların hareketlerine gösterdikleri bu güçlük veya kolaylık maddelerin elektriksel dirençlerini belirler. Elektroniğin temel parçaları olan dirençler çok küçük olduklarından üzerlerine yazılmaz. Değerler üzerlerinde ki renkli şeritlerle gösterilir. Her renk bir rakama karşılık gelir. Bu rakamlar aşağıdaki tabloda görülmektedir.

Renkler	1. Halka	2. Halka	3. Halka	4. Halka
Siyah	0	0	10^0	
Kahverengi	1	1	10^1	
Kırmızı	2	2	10^2	
Turuncu	3	3	10^3	
Sarı	4	4	10^4	
Yeşil	5	5	10^5	
Mavi	6	6	10^6	
Mor	7	7	10^7	
Gri	8	8	10^8	
Beyaz	9	9	10^9	
Altın				- %5 ,+%5
Gümüş				-%10 ,+%10

İLETKENLERİN BAĞLI OLDUĞU FAKTÖRLER VE ÖZ DİRENÇ

Farklı maddelerden yapılmış iletkenlerin akıma gösterdiği dirençler farklıdır. İletkenler aynı maddeden yapılmış olsa bile boyları, kesitleri ve sıcaklıkları değiştikçe dirençler de değişir.

Elektrik akımına karşı gösterilen zorluğa direnç denir. Direnç R ile gösterilir. Birimi Ohm (Ω)

Bir iletkenin direnci;

- İletkenin cinsine (özdirencine) bağlı olup doğru orantılıdır.
- İletkenin uzunluğu ile doğru orantılıdır.
- İletkenin kesit alanı ile ters orantılıdır.
- Sıcaklıkla maddenin cinsine göre, doğru ya da ters orantılı olarak değişir.

$$R = \rho \cdot \frac{l}{S}$$

l iletkenin boyu
ρ iletkenin öz direnci
S iletkenin kesiti

Büyüklük	Birimi
Direnç (R)	Ohm (Ω)
Boy (l)	Metre (m)
Kesit alanı (S)	Metrekare (m^2)
Özdirenç (ρ)	Ohm.metre (Ω.m)

AKIM, POTANSİYEL FARKI VE DİRENÇ ARASINDAKİ BAĞINTI (OHM YASASI)

Bu yasa akım potansiyel farkı, akım şiddeti ve direnç arasındaki bağıntıyı belirtir.
Bir iletkenin sıcaklığı sabit kalmak şartıyla iletkenin uçları arasındaki potansiyel farkı ile iletkenden geçen akım şiddeti arasında sabit bir oran vardır. Bu orana, iletkenin direnci denir. Direnç elektrik enerjisini ısı enerjisine dönüştürür.

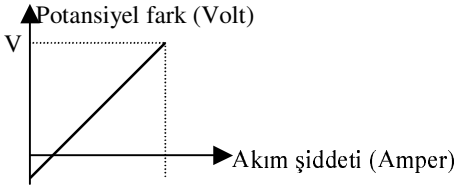
$$\frac{V_1}{i_1} = \frac{V_2}{i_2} = \frac{V_3}{i_3} = \text{Sabit} \qquad \mathbf{R = \frac{V}{i}}$$

Direnç, potansiyel fark ve akım şiddetinin gösterilişi ve birimleri:

Büyüklük	Direnç (R)	Potansiyel Fark (V)	Akım Şiddeti (i)
Birimi	Ohm (Ω)	Volt (V)	Amper (A)

Direnç sabit ise potansiyel farkı ile akım şiddeti doğru orantılı olarak Şekil 1'deki gibi değişir.

Şekil 1



ELEKTRİK AKIMI:

Yüklere etkiyen kuvvetin etkisiyle, yüklerin harekete geçmesi sonucu oluşan yük akışıdır.

AKIM ŞİDDETİ:

Bir iletkenin kesitinden birim zamanda geçen yük miktarına **akım şiddeti** denir.

POTANSİYEL FARK:

Üzerinden geçen bir iletkenin iki uç noktasının potansiyeli aynı değildir. Çünkü elektronlar bir iletkenin ucundan diğer ucuna giderken enerji kaybeder. Dolayısıyla telin uç kısımlarında birim yük başına düşen enerjiler yani potansiyeller farklı olur. Bu iki uç arasındaki potansiyellerin farkına **potansiyel farkı** denir.

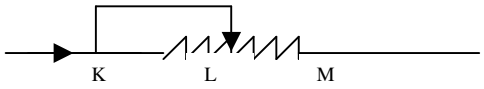
+1 birimlik yükün, elektriksel kuvvetin etkisinde, elektriksel alan içinde bir noktadan diğer bir noktaya gitmesi halinde kuvvetin yaptığı işe, bu iki nokta arasındaki **potansiyel farkı** denir.

REOSTA- KISA DEVRE:

Reosta bir elektrik devresinden geçen akım şiddetini değiştirmeye yarayan iki uçlu ayarlanabilir dirençtir.

Şekildeki reostanın sürgüsü L noktasında iken, K noktasına gelen akımın L noktasına ulaşması için iki yol vardır.

- Dirençli yol
- Dirençsiz yol



Akım dirençsiz yoldan geçer. Reostanın K-L noktaları arasındaki direncin bir önemi kalmamaktadır. Bu aynı zamanda K-L arasındaki direncin **kısa devre** olması demektir. Sürgü ileri doğru hareket ettirilirse direnç azalır, geriye doğru hareket ettirilirse direnç artar.

DİRENÇLERİN BAĞLANMASI

Elektrik devrelerinde dirençler seri ve paralel olmak üzere iki ayrı şekilde bağlanırlar. Birden çok direncin yaptığı etkiyi tek başına yapabilen dirence "eşdeğer direnç" denir.

- **SERİ BAĞLAMA**

Dirençlerin uç uca eklenmeleri ile oluşan bağlama şekline denir.

Seri bağlı dirençlerde;

1. Devreden geçen akım her dirençten aynen geçer.

$$i = i_1 = i_2 = \ldots\ldots\ldots\ldots\ldots\ldots\ldots = i_n$$

2. Dirençlerin uçları arasındaki potansiyel farklarının toplamı dirençleri besleyen üretecin uçları arasındaki potansiyel farkına eşittir.

$$V = V_1 + V_2 + V_3 + \ldots\ldots\ldots\ldots\ldots\ldots\ldots V_n$$

3. Eşdeğer direnç; dirençlerin toplamına eşittir.

$$R_{eş} = R_1 + R_2 + R_3 + \ldots\ldots\ldots R_n$$

4. Akımlar eşit olduğundan; büyük direncin uçları arasındaki potansiyel farkı büyük olur.

$$R_1 > R_2 \Rightarrow V_1 > V_2$$

- **PARALEL BAĞLAMA**

Dirençlerin birer uçlarının kendi aralarında birleştirilmeleri ile oluşan bağlama şekline denir.

Paralel bağlı dirençlerde;

1. Devreden geçen akım ortak uçta direnç sayısı kadar kola ayrılır. Dirençlerden geçtikten sonra devresini tamamlar.

$$i = i_1 + i_2 + \ldots\ldots\ldots\ldots\ldots\ldots\ldots + i_n$$

2. Dirençlerin uçları arasındaki potansiyel farkları birbirlerine eşit olup o da üretecin uçları arasındaki potansiyel farkına eşittir.

$$V = V_1 = V_2 = V_3 = \ldots\ldots\ldots\ldots\ldots\ldots\ldots = V_n$$

3. Eşdeğer direncin tersi; dirençlerinin toplamına eşittir.

$$\frac{1}{R_{eş}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots\ldots\ldots\ldots + \frac{1}{R_n}$$

4. Paralel bağlı dirençlerde potansiyel farkları eşit olduğunda büyük dirençten küçük, küçük dirençten de büyük akım geçer.

a) $R_1 > R_2 \Rightarrow i_1 < i_2$

b) $R_1 = R_2 \Rightarrow i_1 = i_2$

c) $R_1 < R_2 \Rightarrow i_1 > i_2$

APPENDIX L

FIGURES

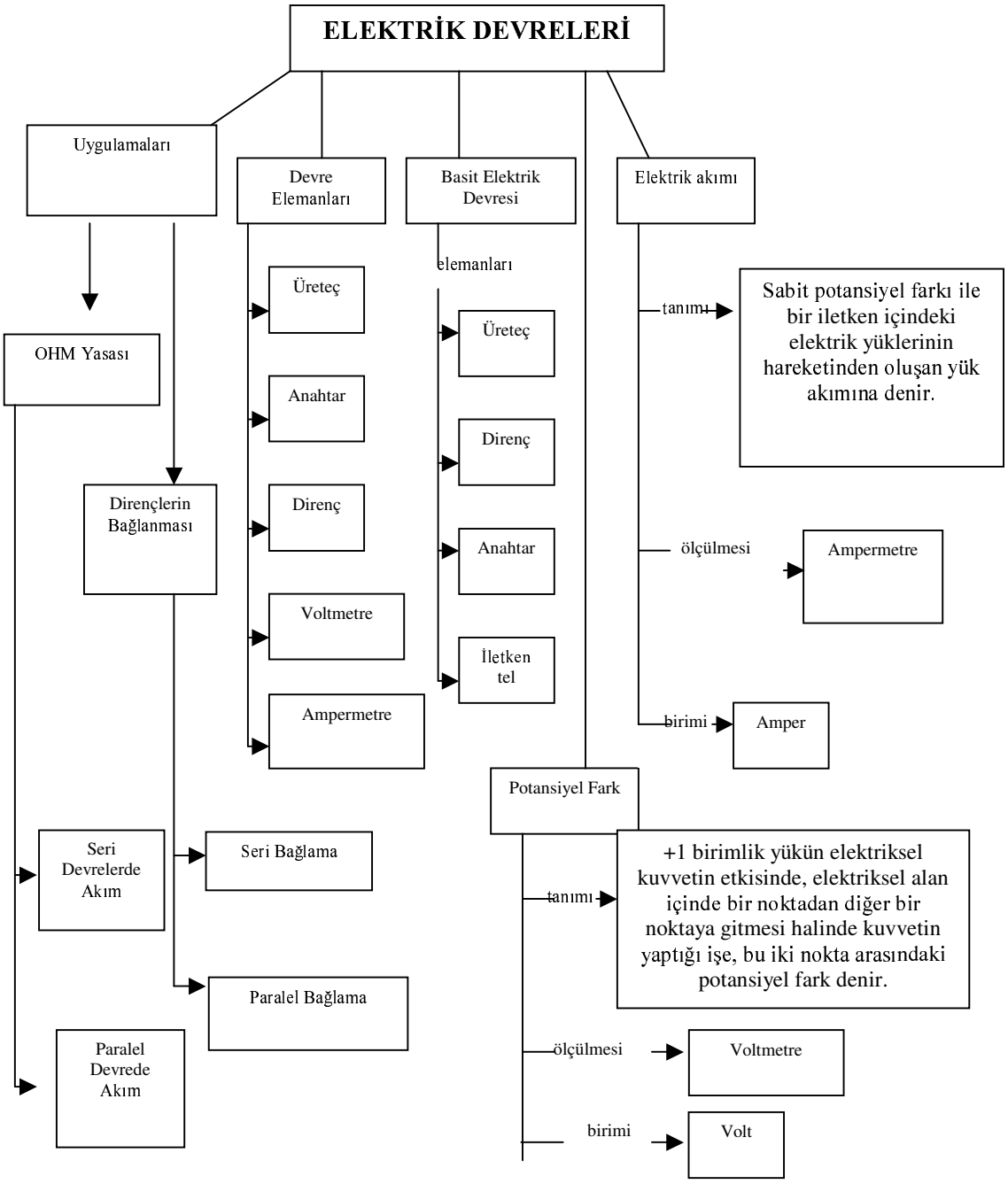


Figure L.1 Elektrik Devreleri

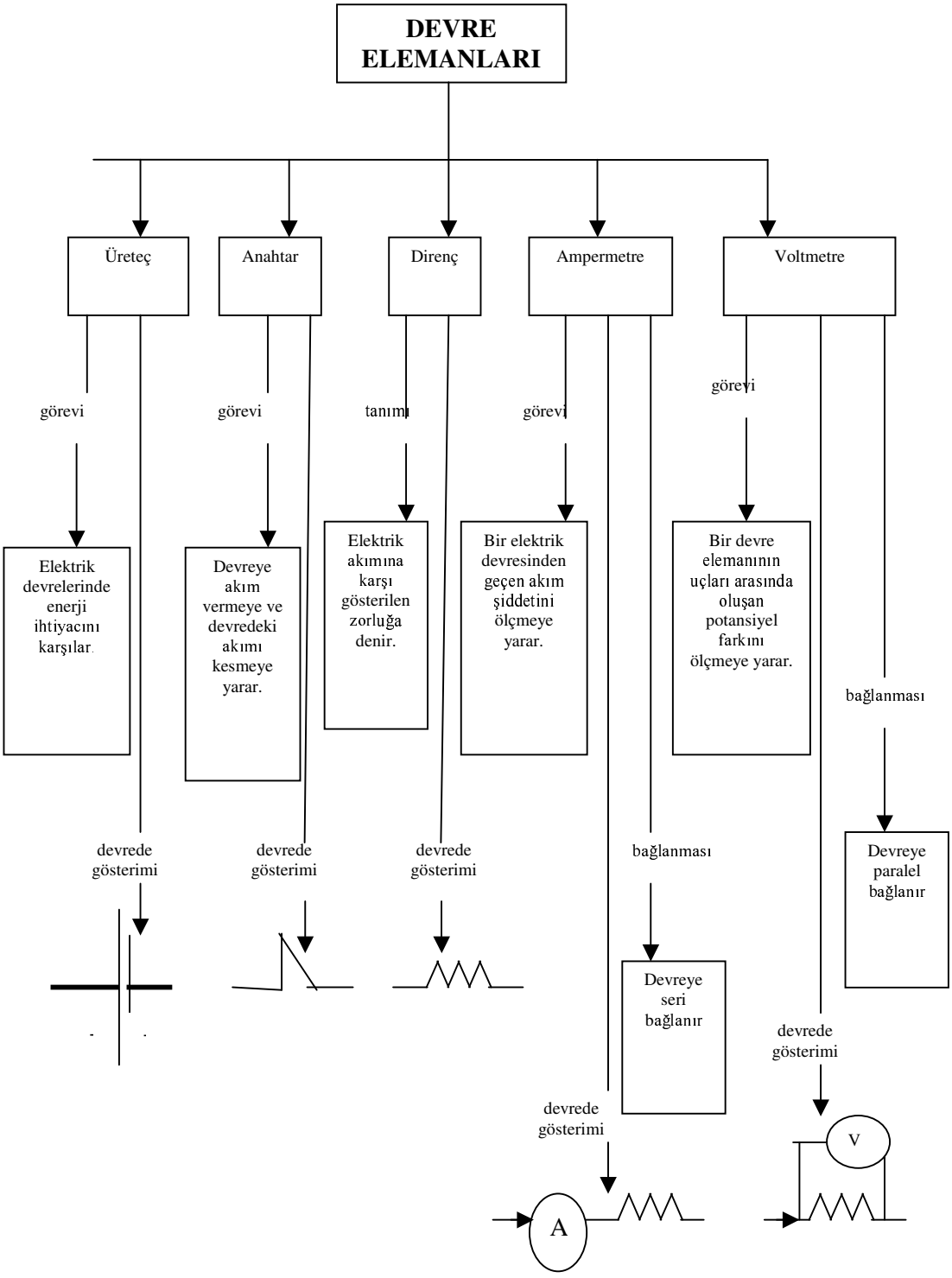


Figure L.2 Devre Elemanları

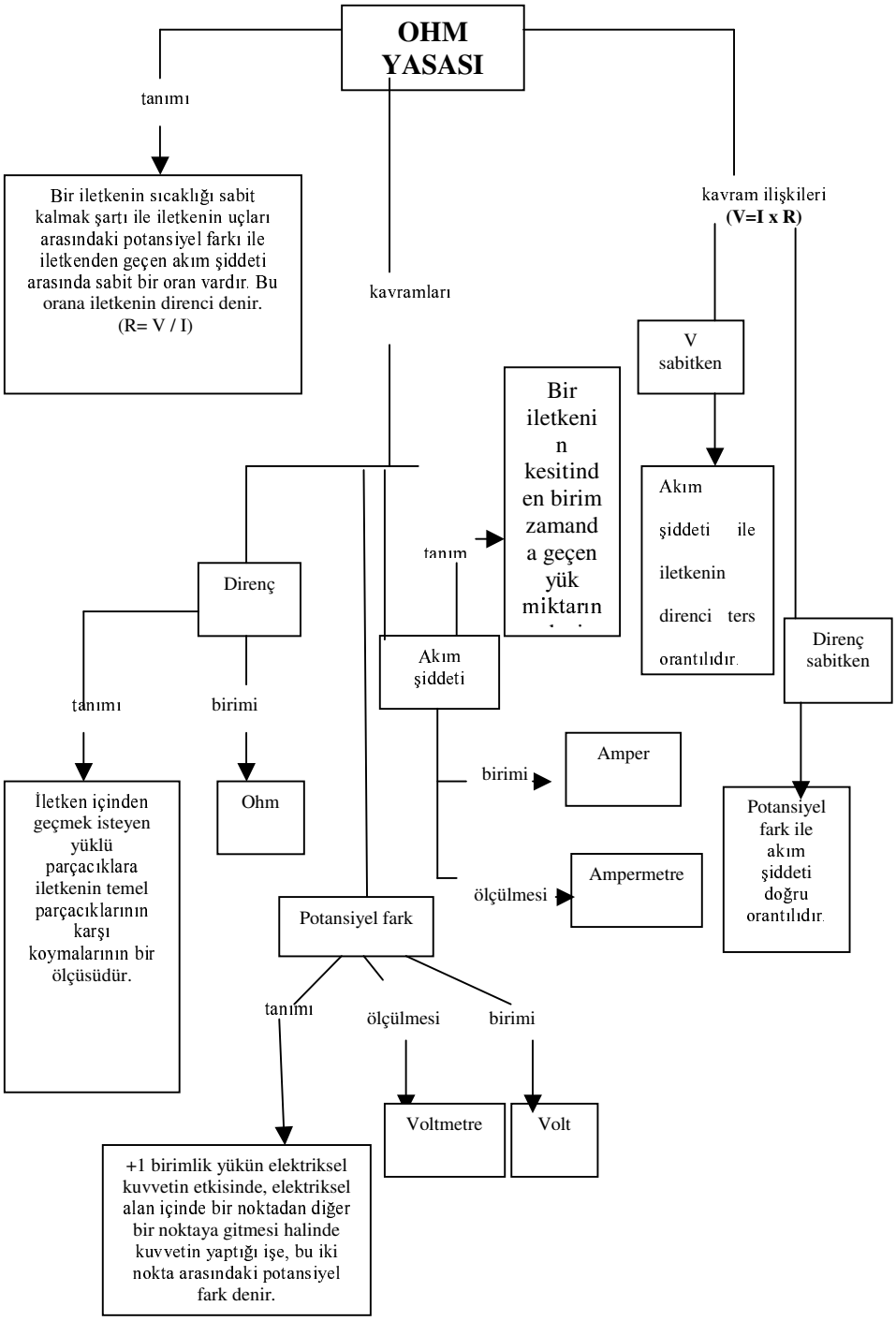


Figure L.3 OHM Yasası

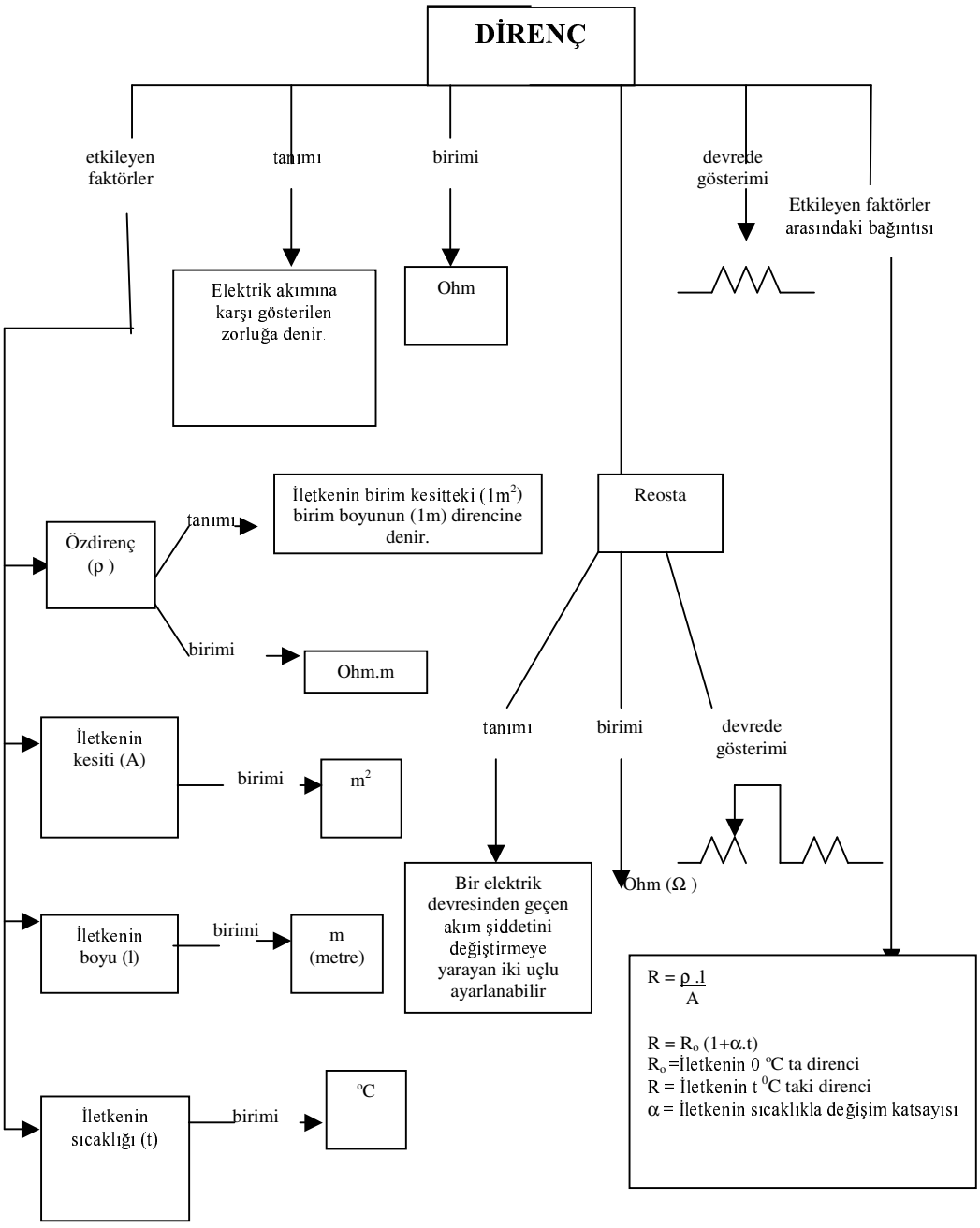


Figure L.4 Direnç

APPENDIX M

CORRESPONDENCE

T.C
Orta Doğu Teknik Üniversitesi
Ortaöğretim Fen ve Matematik Alanları Bölümü Başkanlığına,
ANKARA

Ortaöğretim Fen ve Matematik Alanları Eğitimi Bölümü yüksek lisans programı öğrencisiyim. "Rol- yapma öğretim tekniğine dayalı Elektrik Devreleriyle ilgili aktivitelerin 9. sınıf Öğrencilerinin Fizik Başarı ve Tutumlarına Etkileri" konulu yüksek lisans tezi hazırlamaktayım.

Bu araştırmada çalışma deseni, deneysel araştırma metodu olup deney ve kontrol grupları yer alacaktır. Bu gruplara Elektrik Devreleri Başarı Testi ve Elektrik Devreleri Tutum Ölçeği ön test ve son test olarak iki kez uygulanacaktır. Başarı testinin içeriği Ek-1 de verilen örnek sorulara paralel ve bakanlığın belirlediği amaçları ölçen nitelikte olacaktır. Tutum Ölçeği Ek-2 de verilmiştir. Kontrol grubunda düz anlatım öğretim tekniği uygulanırken deney grubunda rol-yapmayla zenginleştirilmiş düz anlatım öğretim tekniği kullanılacaktır. Deneysel grupta kullanılacak rol yapma tekniğine göre hazırlanmış Elektrik devreleri aktivitelerinden bir örnek Ek- 3 de verilmiştir.

Araştırmanın evreni Denizli ilinin devlet ortaöğretim okullarından bütün süper lise 9. sınıf öğrencileri olarak belirlenmiştir. Bu evrenden araştırmacıya uygunluğuna göre Cumhuriyet Lisesi ve Acıpayam ilçesi Acıpayam Lisesi öğrencilerinin toplamından 6 sınıf örneklem olarak seçilmiştir.

Deneysel çalışma 2003-2004 eğitim- öğretim yılı 2. döneminde yürütülecektir. Araştırma mevcut düzeni bozmayacak niteliktedir. Bu araştırmaya katılan okul, öğretmen ve öğrenci isimleri kesinlikle saklı tutulacaktır.

Öğretim tekniklerinin ders içindeki çeşitliliği önemlidir. Fizik konularını somutlaştırmak için, günlük hayatta kullanılabilirliğini sağlamak gerekir. Rol-yapma tekniğinin öğrencileri konunun içine katabilmesi ve somutlaştırmayı kolaylaştırması beklenmektedir. Ayrıca bu teknikle öğrencilerin Elektrik Devreleri konularının işlenişinden zevk almaları, eğlenerek öğrenmeleri ve buna bağlı olarak fizik dersi başarılarında artış ve derse karşı tutumlarında olumlu yönde gelişme beklenmektedir. Lise 1 Fizik dersi Elektrik devreleri öğrencilerin zorlandıkları konulardandır. Bu nedenle Elektrik devreleri konularının öğretilmesinde rol-yapma tekniği seçilmiştir.

Aktivitelerin ve ölçüm araçlarının (başarı testi ve tutum ölçeği) yukarıda belirlediğim liselerde uygulanabilmesi için gereğinin yapılmasını saygılarımla arz ederim.

Yadikar KÜÇÜKER (TUNÇER)

EK- 1: Fizik Başarı Testi
EK- 2 : Tutum Ölçeği
EK- 3 : Rol-yapma tekniğine göre hazırlanmış Elektrik Devreleri Aktivitelerinden bir örnek

T.C.
DENİZLİ VALİLİĞİ
İl Milli Eğitim Müdürlüğü

SAYI : B.08.4.MEM.4.20.30.09.01.010/ 13782
KONU : Uygulama Dersleri

18 MAYIS 2004

VALİLİK MAKAMINA

İLGİ : Orta Doğu Teknik Üniversitesi Öğrenci İşleri Daire Başkanlığının 26/04/2004 tarih ve 72.00/2781-006629 sayılı yazıları

Üniversiteniz Ortaöğretim Fen ve Matematik Alanları Eğitimi EABD Yüksek Lisans Öğrencilerinden Yadigar TUNÇER Müdürlüğümüze bağlı *Merkez Cumhuriyet Lisesi ve Süper Lisesinde İlçemiz Acıpayam Lisesi ve Süper Lisesinde* **'Rol-yapma öğretim tekniğine dayalı elektrik devreleriyle ilgili aktivitelerin 9. sınıf öğrencilerinin fiziki başarı ve tutumlarına etkileri"**başlıklı yüksek lisans tez çalışması yapmak istedikleri ilgi yazılarında belirtilmiştir.

Adı geçen öğrencinin yukarıda belirtilen konular ile ilgili adı geçen okullarda uygulama çalışması yapması Müdürlüğümüzce uygun görülmektedir.

Makamlarınızca da uygun görüldüğü takdirde OLUR'larınıza arz ederim.

Ekrem EKİCİ
Milli Eğitim Müdürü

OLUR
17/05/2004
İsmail DEMİRHAN
Vali a.
Vali Yardımcısı

EKLER :
EK-1 İlgi Yaz.ve Ekleri (7 adet)

DAĞITIM :
Gereği :
1-Acıpayam Kaymakamlığına.
2-Mrk. Cumhuriyet Lis.Müd.

NCT : Verilen cevaplarda yazımızın tarihi ve sayısı belirtilmelidir.
Satak Mah. Oğuzhan Cad. No: 76 20100 DENİZLİ / Eğitim Öğretim Şb.
egitim20@meb.gov.tr
0 - 258- 235 55 54 615

APPENDIX N

Table N.1 RAW DATA

Student	Gender	Age	Group	PSTACH	PSTATT	PREACH	PREATT
1	1	15	1	16	97	16	103
2	2	16	1	17	69	15	73
3	2	15	1	15	77	15	95
4	1	15	1	15	70	13	73
5	2	16	1	19	82	13	96
6	2	15	1	16	45	11	77
7	1	16	1	14	87	12	87
8	1	15	1	15	78	11	76
9	2	15	1	14	80	12	88
10	1	15	1	13	84	12	67
11	1	15	1	12	93	16	80
12	1	15	1	13	94	12	101
13	1	17	1	16	95	11	99
14	2	15	1	17	107	15	97
15	2	15	1	19	68	10	67
16	2	15	1	17	96	12	81
17	1	15	1	13	67	11	68
18	1	15	1	17	93	15	101
19	1	15	1	14	81	9	85
20	1	15	1	16	74	11	76
21	2	15	1	10	68	6	78
22	1	15	1	16	90	13	93
23	2	15	1	17	63	12	84
24	2	15	1	14	79	13	88
25	1	15	1	16	92	9	89
26	1	15	1	19	87	10	89
27	2	17	1	15	87	11	95
28	1	15	1	11	82	10	78
29	1	15	1	18	71	13	91
30	1	16	1	17	96	8	76
31	2	15	1	13	99	11	94
32	2	15	1	13	94	5	78
33	1	17	1	11	102	7	95
34	2	15	1	13	81	6	87
35	1	15	1	11	75	12	88
36	2	16	1	10	79	14	76
37	1	15	1	14	86	10	89
38	1	14	1	14	79	10	86
39	2	16	1	16	87	12	77

40	2	15	1	14	70	10	66
41	1	16	1	14	82	11	76
42	2	16	1	12	61	10	90
43	1	15	1	12	64	9	65
44	2	15	1	10	83	10	90
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54	2	15	1	9	57	8	86
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56	1	15	2	6	78	8	91
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71	1	15	2	13	72	10	59
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76	1	15	2	13	72	3	72
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102	1	15	2	16	94	12	90
103	2	15	2	14	87	3	84
104	2	16	2	11	77	9	74