

**REPUBLIC OF TURKEY
YILDIZ TECHNICAL UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**THE EFFECTS OF USING ALGODOO IN SCIENCE TEACHING AT
MIDDLE SCHOOL**

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A thesis submitted by Ayşegül CAYVAZ in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE** is approved by the committee on 12.06.2018 in Department of Math and Sciences, Science Education Program.

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LIST OF ABBREVIATIONS

A1	Experiment Group Class1
A2	Experiment Group Class2
A3	Experiment Group Class3
ANCOVA	Analysis of Covariance
C1	Control Group Class1
C2	Control Group Class2
C3	Control Group Class3
IWB	Interactive White Board
MEB	Ministry of Education
PBS	Perceptions of Being Scientist
SAS	Science Attitude Scale
SC	Science Classes
SPST	Scientific Process Skill Test
ST	Science Teachers
TAT	Technology Attitude Scale
USS	Usefulness of Science Study
WPST	Work and Power Success Test

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ABSTRACT

THE EFFECTS OF USING ALGODOO IN SCIENCE TEACHING AT MIDDLE SCHOOL

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MSc. Thesis

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The study examined the effects of instructional approaches as support for scientific learning using a simulation program, Algodoo. The well-known difficulties on learning science concept is supported by Algodoo program. Algodoo is a physic simulation program and it is integrated 7th grade work and energy unit science classes. The study is conducted at a state school in İstanbul 2017-2018 semesters ,3 instructors and their two classes totally six classes and 202 students participate the study. The study designed as an experimental research. Each instructors' experiment and control group is randomly selected. During the three weeks, each instructors lecture control group with traditional method and experimental group is studied science lessons supported with Algodoo. Pre-test and post –test are applied to all participant as quantative data tools and reflections and worksheets are applied to experiment groups as qualitative data tools. The acquired results show that students have positive attitudes towards Algodoo program they seen lesson which is applied Algodoo more enjoyable and meaningful for them. These kinds of feedback also effect the students' perspective towards science lesson and students 'success. Algodoo can be applied to students from different education levels.

Keywords: Algodoo, work and energy unit, simulations,

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ORTAOKUL FEN ÖĞRETİMİNDE ALGODOO KULLANIMININ ETKİSİ

Ayşegül CAYVAZ

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Bu çalışmada simülasyon destekli öğrenme yaklaşım programlarından olan Algodoo nun etkilerinin araştırılması amaçlanmıştır. Fen konularında genel zorluk çekilen konular Algodoo programı ile desteklenmektedir. Algodoo fizik simülasyon programı olup yedinci sınıf fen ve teknoloji dersinde iş ve enerji ünitesine entegre edilmiştir. Çalışma bir devlet okulunda gerçekleştirilmiş olup, çalışmada 3 öğretmen ve her öğretmene ait iki sınıf olmak üzere 6 sınıfta öğrenim gören toplam 202 7.sınıf öğrencisi yer almaktadır. Çalışma deneysel bir çalışma olarak desenlemiştir. Her bir öğretmene deney ve kontrol grupları rastgele olarak atanmıştır. Her bir öğretmen üç hafta boyunca kontrol grubunda ders kitabı ağırlıklı, deney grubunda ise Algodoo destekli fen ve teknoloji dersi işlemiştir. Nicel veri kaynakları ön test ve son test olarak uygulanmıştır ayrıca nitel veri kaynağı olarak deney grubunda çalışma kâğıtları ve dönütler kullanılmıştır. Çalışma sonuçlarına göre öğrencilerin Algodoo programına karşı olumlu tutuma sahip oldukları ayrıca programı eğlenceli ve öğretici buldukları tespit edilmiştir. Ayrıca öğrenci başarısı açısından deney ve kontrol grubu arasında deney grubu lehine anlamlı bir fark olduğu görülmüştür. Algodoo programı farklı eğitim seviyelerinde uygulanabilir.

Anahtar Kelimeler: Algodoo, iş, güç enerji ünitesi, simülasyon

INTRODUCTION

1.1 Literature Review

The main goal of the science education is to bring up people who have scientific literacy. Scientific literacy provides people for solving problems, critical thinking, having self-confidence, good communication skills, and being conscious of sustainable life [1]. Scientific literacy can be regarded as the ability to analyze questions and making inference basing on evidence to see and help making decision about the world. The aims of the scientific literacy and the objectives of the science curriculum should correspond to each other.

Science investigates, examines, and explains the relationship between living organisms and concepts or events in a discipline [2]. Science education is an inevitable part for education system. The recent improvements in the curriculum and the education system show that concept's understanding has an important role in learning and comprehending science. Concepts can be considered the basic elements for the structure of knowledge [3]. In science education, concepts help students making science meaningful. Students' conceptions are the basic components of their own knowledge. conceptual understanding permits one to transfer an explanation of a phenomenon to different variants of a situation that have been previously analyzed, is clearly a goal to be recruited under the label learning the science at any level.

Energy is an important and interdisciplinary concept in science education. Students face with this concept in daily life in various forms like heat, electricity, light, sound, potential energy. Despite of this familiarity, students have problems with energy concept. Akbulut, Şahin and Çepni explains this situation like that students have problems with abstract concepts because they tend to think macroscopic dimension

rather than microscopic dimension so they do not construct a schema related with energy [4].

Energy underpins many topics in science education such as work, power, force, photosynthesis, chemical reactions. It is core subject for science education but it is an abstract concept and both teachers and students have difficulty on setting connection with other topic to energy, transition to real life [5]. Constructivist approaches is supported by many researches to manage this problem.

Constructivist approaches is defined as to construct knowledge by using own experiences and thoughts. Setting connections between existed knowledge and new information can be called constructivism [6]. Constructivist approaches offers both teachers and students using different sources as teaching materials. Students and teachers are more active in learning process. Also, constructivist approach contributes to disappear misconceptions. The literature shows that students have many misconceptions related with energy topic. To get rid of misconceptions students must be dissatisfied with their existed conceptions; and the new concepts must be intelligible and plausible. At this point serving different information sources to learners is a reasonable way. Technology is a good way to supply different teaching material and sources [7].

In recent years, the development in every discipline has affected education that it causes changing in education system and curriculum. Many attempt and project is conducted by researchers and ministry to meet the need of society and time. FATİH project is one of these attempts. FATİH project is one of the comprehensive project wants to integrate technology to education [8]. Within the scope of this project interactive white boards(IWB) set in the classes and begin the use. Nearly 80% of the school has IWB in Turkey. It is high percentage when it compares the countries. Around 70% of all classroom in Denmark and Netherlands, and more than 50% of classroom in Australia and USA [9].

Technology supply chance to students setting connection of their observations to social meanings that they create and elaborate by sharing their observation and experiences. Technology support learning by serving different options to different type of learners. For the extreme points, dangerous situations, abstract concepts and lack of equipment technology is used to meet the deficit [10].

Technology serve multiple representation to different type of learners so using technology and integrate technology into lessons is rational way to both meet the needs of different kind of learners and increase the success of students [11]. Presentations, simulations, experiments, video based learning are some of examples using technology at lessons and they improve students' success. The research is conducted by Lars Bollen and Wouter R.van Joolingen support this idea. In the research, the researcher use SimSketch program which is an integrated drawing and modeling tool, allows students to creates schemas and apply behaviors to elements. The results show that students will learn much earlier and easier science concepts by using this program [12].

Teaching, learning and education have connections to each other both of them are process. Technological developments, social needs, society, policy affect the transition between these terms. Teachers and students are the mutual points of teaching, learning and education so the integration of new developments take time for all of them.

Efforts to change teaching and learning practices in education have been a major topic for many years in Turkey. Philosophy, methods, technics, curriculum and books are changed to catch up the needs of society and era because education is global issue and it is flexible and can be shaped with respect to the needs. Technology using in classrooms is one of the developments which come with era [13].

The classrooms become increasingly prominent by using technology like equipment and software supplied to create, store transmit, interpret and manipulate information in different formats because students' needs are different and modern society is in need of like technologies [14]. Technology as a mean that support instruction to help students see concrete concepts through visualizing abstract concepts that are impossible to observe real setting. The visualization is a distinguishing advantage of technology to serve visual type of learners. The technological environments and activities became very effective by directly manipulate concepts by users [15].

Active learning involves opportunities for students to meaningfully talks, write, try, discuss and reflect on content, ideas and issues. In other words, learners do anything and thinking about what they are doing. The main character, the decision mechanism is learner in active learning. At this point, teaching techniques should encourage students to actively engage with materials to promote critical thinking and facilitate storage and

retrieval. Students give attention higher-order tasks like analysis, synthesis and evaluation to be actively involved to process [16].

The productivity of technology use in the classroom mostly depends on teachers. Teachers' knowledge about software and attitudes towards technology has important effect on the both students' perspectives to the technology and the success of technology usage in classroom. Many teachers want to use technological support in their classrooms but they find themselves easily turn back to their secure and traditional teaching style because of lacking knowledge. Sharmas' research show that teachers mostly prefer PowerPoints as a software because it is most familiar one of the software [17].

Simulations are another multiple representation tool which are used in the science lessons. Simulations are software contains real world elements which can be controlled by user supply virtual learning environments [18]. Also simulations' lots of benefits can be seen in the learning environments. By using technology based environments – especially simulations- students calculate data, sort data, test hypothesis, change variable, observe results and visualize the process of information [19].

Technology based application-video based-increases the students' activeness in the science classes when they appropriately integrate to lesson. The examined literature shows this result at many researches. Students are more active in science classes when video based applications-simulations-are used in the science classes. By using this kind of interactive methods, students get better results taking into account knowledge in active learning [20]. Cindy E.Hmelo –Silver and friends' research results support that computer based tools can provide extra opportunities for students to engage in inquiry practices and composing of science concepts[21].

Simulation supported applications scaffold the process of students' conceptual and procedural knowledge acquisition in addition to these gains simulations supported learnings supply students to data interpretations and self-regulation [22].

There are some applications and programs can be used easily during class time. Algodoo is one of them. Algodoo is a unique 2D simulation program contains interactive scenes with enjoyable manner. Users can form simulation scenes using simple drawing tools by using Algodoo. It triggers students and children's own creativity, ability and motivation to construct knowledge while having fun [23].

Similarly, when the literature is examined, Algodoo has many positive perspectives by users. The research is conducted by Harun Çelik and his friends examine the pre-service teachers' perspective about Algodoo. Their opinions are that Algodoo has enough features to teach physic concepts [11]. The research which is applied by Silva and his friends support the Harun Çelik and his friends results and they also add Algodoo can be applicable all grade level. By using Algodoo's features teachers can create own experiment or learning environments so it is a good point to create discussion atmosphere to discuss and check students' ideas related with topic [24].

Students' opinions related with Algodoo is positive. The applied researches shows that students seen Algodoo as an enjoyable way to create own experiments. They can check the independent variables easily and they can observe the results [25]. Students state that their ideas as we can easily check what we want to manipulate. By using Algodoo we can try to it is impossible to try in the real world [18].

Various tools and attempts are supported teaching and learning process but they face to resistance from many users to technology usage [24]. There are some problems which are user come to face during simulation program by using. Foreign language, preparation time, lack of properties and tools, unavailability for mathematical calculations, lack of computer literacy and operating program is some problems which face to during Algodoo usage and these problems can be solved with short training because Algodoo has easy interface and can be use easily by teachers and students [19].

The examined literature shows that there are applied research about Algodoo and they mostly related with high school students, physic classes and pre service teacher. There is not a research Algodoo with secondary school. The related topic and research question is decided with respect to this gap in the literature and students' need. The topic is selected from 7th grade science curriculum work and power unit.

1.2 Objective of the Thesis

The aim of the study is that determine the effect of using Algodoo at 7th grade students' science lesson work and power unit on students' attitudes towards science, students' success, students' scientific process skills and attitudes towards technology.

1.3 Hypothesis

- Is there meaning difference at students' achievement test score between pre-test and post-test concerning Algodoo supported education?
- Is there meaning difference at students' attitudes towards science between pre-test and post-test concerning Algodoo supported education?
- Is there meaning difference at students' scientific process skills between pre-test and post-test concerning Algodoo supported education?
- Is there meaning difference at students' attitudes towards technology between pre-test and post-test concerning Algodoo supported education?

1.4 Research Question

Simulations are one of the way of multiple representation ways. Learning concepts is difficult and supporting learning by using simulation can be beneficial for learners. Visualizing and creating a schema for a concept can be difficult at some topics and simulations can serve different type of learners. Algodoo is a 2D simulation program and every educator can use this program which is free in own lessons. The program give opportunity to educators create an area which all physic rules can be applied.

As an educator I decide to search the effect of using Algodoo at 7th grade students' success at work, energy and power unit because many times the imagination of these concept is difficult for students and Algodoo is a good source to solve this problem

FRAMEWORK OF THE STUDY

2.1 Introductory

Nowadays called as technology era and it comes together many opportunities together. The needs of the society changes and to meet needs of the society the basic aim of the education is bringing up individuals who are qualified. To generate productive people who are enthusiastic to search and ask it is good idea to use advantages of technology [26]. Growing as a productive people is the main vision of the Turkey's curriculum [1]. The attempt and projects are supported by Ministry of Education to bring forth scientific literate people who can utilize science knowledge and skills to create problem solving and making reasoned decision in real life situation [27].

The term of scientific literacy is more common in science education. One of the broad purpose of the science education is to promote scientific literacy which is affecting both people's own lives and society. The importance of scientific literacy is indisputable truth for science education but people do not reach consensus the exact definition of it. The definitions or framework of scientific literacy divided into four basic categories; science knowledge and application, operational skills, nature of science and perception components. Researcher perspective and background determines the details of these categories so the definition of scientific literacy is not exact [27].

Adeleke and Joshua defines science education as making decision based on information and understanding and this is vital development of modern society. The gained futures by scientific literacy serves as an equipment for future workforce with essential scientific skills and science-based knowledge [28]. Surpless defines scientific literate

person as someone is familiar with natural world, understand the basic concept and principle of science and be able to use science-based knowledge for personal and social aims[29]. They advocated that the definition or frame work is not important for scientific literacy ,the important part is understanding of scientific process.

The definition of scientific literacy changes or interpreted with respect to researcher perspective and the aim of the research like as an operational definition. Sooabard and Rannikame (2015) defines scientific literacy as utilizing science knowledge and skills particularly related with creative problem solving and making reasoned decisions in real life situation.

The emphasis is setting connection between knowledge and real life. The more general purpose of the promoting scientific literacy is that more than only use science based knowledge in both schools and real life. The general purpose is that gained a more holistic lenses. Being able to set connection between the disciplines or realizing the connections between the philosophy, history and sociology of science. The ultimate aim of the scientific literacy affecting individuals' worldview [30].

Science education has basic elements and concepts are one of them. Concepts can be defined as ideas, objects or events that helps people see the world around. Conceptual understanding permits one to transfer an explanation of a phenomenon to different variants of a situation that have been previously analyzed, is clearly a goal to be recruited under the label learning the science at any level [31]. At some points it's aims is parallel to scientific literacy.

Energy is an important and interdisciplinary concept in science education. It is related to daily life and exists in various forms like; heat, electricity, kinetic energy, light, sound. Despite of familiarity, students have problems with energy concepts. Teachers and students states many reasons why they face with problem with this topic, the emphasis on it is and abstract and complex concept. The teaching procedure of energy concept should be supported by different materials and teaching approaches. Technology is chance to manage this problem [32].

The needs of the society and the developments in the society brings with the new requirements during the educational process. The productive combination of needs and technological advantages is suitable way to prepare educational materials that meet the needs of each students. Technology is not an alternative of teachers but it is an

advantage comes with time. The effective use of technology in educational process increases the quality of educational materials and educations. Animations, simulations, graphics, audio visual materials are the product of technology which serve to make real educational objectives to students' individual differences and learning styles [33].

Technology is an application of scientific knowledge for practical purposes. Technology has really broad domain from wheels to nanotechnology and education is one of them. The new developments bring with new habits together so integrating technology into education is necessary to catch up with the times.

To use technology productively being technology literate becomes a necessity because technology is not related with a specific area, it penetrates all area of life. Education does not only contain academic knowledge or achievement the vital purpose of the education prepares individuals to real life [13]. The current era is called technology era and being technology literate carries onward people. Technology literate people has critical perspective about technology can distinguish advantages and disadvantages of technology so they are comfortable and objective using technology [34].

The productivity of the educational technology mostly depends on the educators' proficiency at the program, material or what they prefer to use at lessons as a tool. Using technology becomes a necessity but educators' perspectives and attitudes towards technology usage at lesson has undeniable effect on the both integration technology in the curriculum and students' adaptation to new tools [17]. Teachers' attitudes and beliefs are the key points of technology integration into education. Constructivist approach is a target for Turkish Science Education and teachers needs to view technology as a basic material of education which integrates constructivist approaches to active learning for students to effectively benefit from this approach to learning [13].

Educators and authorities worried about the decreasing in young people' interest in science and technology education in Western countries. To change this situation, they advocate that teachers should take responsibility to create innovative approaches for taking attentions of students in science learning in school [35]. The news developments at technology can be used to get attention of students. Computers and the applications come with the technology and they entered the educational process. The developments on technology and education brings with many software for educational purposes. The integration of this kind of software in to the lessons can carry from teacher centered

model to more student centered interactive ones. Interactive methods that focus on learner and learning should be used [36].

Simulations are educational programs that are easy to use and free of expense, so they became the most frequently preferred educational tools which are the product of technology. Simulations both give chance to students to create own virtual world and experience what they want to try. The opportunity to create a discussion with data can be easily design by using simulations [24].

2.2 Theoretical Background

Learning is an ongoing and social process. There are many theories about learning and many factors that composes these theories. Ausebel meaningful learning theory is one of them. Meaningful learning theory argue that learning is a construction process between what already known concept and new concepts. He stated if a connection is formed by learners meaningfully the learning became permanent. According to Ausebel meaningful learning theory the construction can be supported by organizers and multiple representations [37].

Multiple representation term is widely used in educational research. Multiple representations support cognitive process in learning and problem solving also leads the learners to a deeper understanding of the concepts being expected [38]. Learners tend to benefit when information is serve in more than one representation. The functions of multiple representations in learning situation is complement the learning process, constrain interpretation of concept by familiarity and trigger the construction of deeper understanding of abstractions and relations [39].

CHAPTER 3

METHOD

This chapter consists of participants, instrumentation, research design and procedure part.

3.1 Research Design

The study is conducted in a state school in Istanbul. Experimental research design is used in this research. Experimental research design is selected as appropriate research type because it is the best type for testing hypotheses about cause and effects [40]. The independent the changes of students are examined with respect to work and power success test, science attitude scale, scientific process skill test and technology attitude test after application of Algodoo in science classes

Table 3.1 Research Design

GROUPS	PRETEST	APPLICATION	POSTTEST
Control Groups	WPST SAS TAT SPST	Traditional Science Education	WPST SAS TAT SPST
Experiment Groups	WPST SAS TAT SPST	Science Education which is Supported by Algodoo Using	WPST SAS TAT SPST

The reflection papers which are contains the students' answers related to Algodoo usage is applied to experiment groups after the introductory Algodoo lesson and at the end of the application.

3.2 Instrumentation

3.2.1 Algodoo

The first version of the Algodoo is delivered in 2008 is called Phun. The first version of the Algodoo is used for demonstration and storytelling. Through the education process Phun found a room into classes. With further developments Phun completed as a more educational product and called Algodoo [41]. Algodoo is a unique 2D-simulation software from Algorix Simulation AB. Algodoo is created for to making interactive scenes with playful, cartoony features. By using Algodoo, instructors discover physic, create games or make experiments. Algodoo prompt students and children's creativity, ability and motivation to construct knowledge while having fun. It is both educational and enjoyable. Algodoo is also a reasonable mean for children to learn and practice physics at home by ownelves.

Instructors and learners can design simulations using simple drawing tools like boxes, circles, polygons, gears, brushes, planes, ropes and chains these items are located in legend of the screen with Algodoo. Users can manipulate items by rotating, scaling, moving, cutting or cloning objects.

Instructors and learners can also add more physics in their simulation scenes like fluids, springs, hinges, motors, thrusters, light rays, tracers, optics and lenses. Students are able to manipulate what they want to explore and change with different parameters like gravity, friction, restitution, refraction, attraction, etc. Nearly all physical laws can be applied by using Algodoo [23].

It is easy to use at all grader science, physics, chemistry classes. Algodoo is free application and it can be set up for all Windows and Mac. Also, it can be run on interactive white boards(IWB) and nearly 80% of the schools have IWB in Turkey [9].

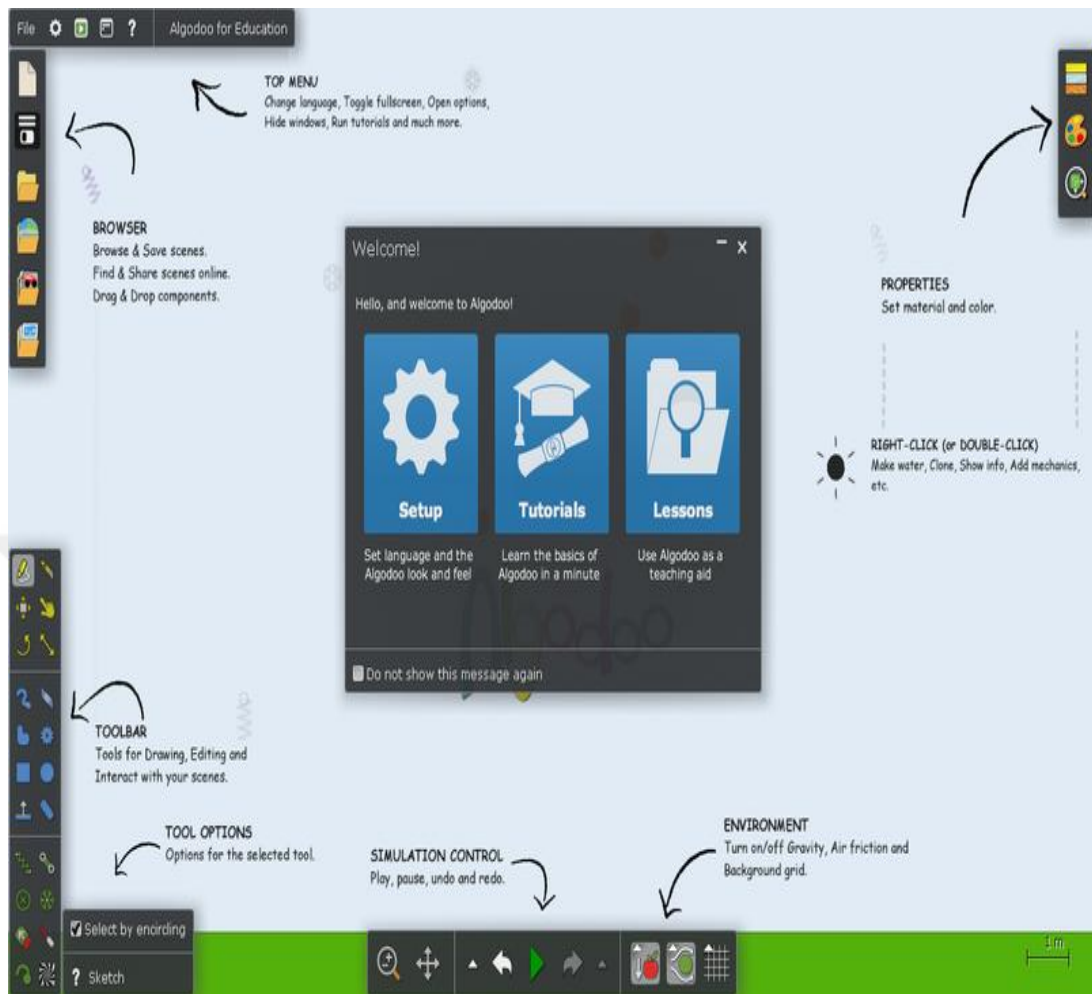


Figure 3.1 The Interface of Algodoo Application

Algodoo simulation program has a clear interface. Toolbar is the main part of the program and the simulations elements are composed by using this legend. There are basic characters and the simulations quality depends on the users' creativity and expert. Users can easily learn to use program in a few sessions. Also, instruction videos and session are available in the program.

3.2.2 Work and Power Success Test(WPST)

The work and power success test is developed by Osman Erşahan for his doctoral thesis. The test is formed to measure participant students' academic success at work and power unit with respect to Ministry of Education science curriculum objectives. The researcher gives emphasis on containing two or three question of each objectives during the question determination process. The content validity of the test is controlled by an expert group at science education area composes of five people.

Table 3.2 Item Analysis of the WPST

Item Difficulty Index	Item Distinctiveness Index	Related Items
0.60-0.90	$r > 0.20$	1, 3, 8, 9, 11, 12, 13, 14, 16, 17, 18, 19, 20, 22, 27
$p < 0.60$	$r > 0.20$	21, 23, 24, 28, 29, 30, 31, 32
$p < 0.60$	$r < 0.20$	2, 4, 5, 6, 7, 10, 15, 25, 26
Reliability Coefficient(32 items)	0,80	
Reliability Coefficient of Post Test(23 items)	0,76	

During the test development process pilot study is conducted in Ankara Çankaya Gülen Pakoğlu Primary School 2014-2015 semester with 141 8th grade students. At the beginning the test is consist of 32 questions and derived data is entered SPSS program and evaluated. The reliability coefficient is calculated 0,80. The items' difficulties and distinctiveness is calculated by using Excel program. The nine question is removed from test after item analysis with respect to expert opinions. The last form of the work and power success test consist of 23 questions and the reliability coefficient is calculated 0,76 [42].

The reliability coefficient is calculated 0,71 after the implementation for work and power success test of this study.

3.2.3 Science Attitude Scale(SAS)

The science attitude scale contains 18 items and these items assess four sub-groups. The grading is done as a Likert scale. The scale range from absolutely agree to absolutely disagree into five groups. “Absolutely Agree” (5), “Agree” (4), “Hesitant” (3), “Disagree” (2), “Absolutely Disagree” (1) statements are used. The negative items are graded reverse (Q5, Q14, Q15, Q17). The Cronbach alpha coefficient of the instrument for current study was calculated as .76. The scale aims to measure student attitudes and preferences in the following four sub-scales: Science Teachers (ST), Science Classes (SC), Usefulness of Science Study (USS) and Perceptions of Being a Scientist (PBS) [43].

Table 3.3 Question Number of the Sub-Scales SAS

Sub-Scales	Question Number
Science Teachers	5,10
Science Classes	1,2,7,8,9,14
Usefulness of Science Study	3,4,6,11
Perceptions of Being a Scientist	12,13,15,16,17,18

The reliability coefficient is calculated 0,70 after the implementation for science attitude scale of this study.

3.2.4 Technology Attitude Test (TAT)

The technology attitude test is developed by Balcı and Kenar (2012). It consists of 15 questions and the grading is done as a Likert scale. “Absolutely Agree” (5), “Agree” (4), “Hesitant” (3), “Disagree” (2), “Absolutely Disagree” (1) statements are used. The negative items are graded reverse. The reliability coefficient of the technology attitude test is calculated 0,86. The eight items of the technology attitude scale is positive (1,2,3,4,5,7,12,15) and seven items are negative. (6,8,9,10,11,13,14) [44].

The reliability coefficient is calculated 0,84 after the implementation for technology attitude test of this study.

3.2.5 Scientific Process Skill Test(SPST)

The science process test is developed by Eager and Yager (1998) and translated into Turkish by Koray (2007) is used to determine students' science process skills. Koray (2007) studied students have similar features to reliability of test. By using ITEMAN test researcher removed five question and the last version of the test contains 31 questions [45].The reliability coefficient of the scientific process skill test is calculated as 0,81 by Koray (2007)

Table 3.4 Sub-Categories of the Scientific Process Skill Test

Sub-Categories of the Scientific Process Skill Test	Question Number
Observation	2
Space /Time Relation	3
Classification	3
Using Numbers	3
Measurement	3
Binding	3
Forecasting	3
Controlling Variables	3
Interpretation of Data	2
Forming Hypotheses	3
Responding	1
Experimentation	2

The reliability coefficient is calculated 0,72after the implementation for scientific process skill test of this study.

3.2.6 Reflection Paper

The reflection paper is formed by researcher. It is applied after introductory Algodoo lesson and at the end of the application process to gather qualitative data from students. It contains six open ended questions. The answer of the students is evaluated by using categorization and frequency table.

3.3 Participants

Table 3.5 The Number of Participant

Class	# of Boys	# of Girls
Algodoo1(A1)	18	15
Control1(C1)	17	17
Control2(C2)	22	12
Algodoo2(A2)	18	17
Control3(C3)	17	16
Algodoo3(A3)	20	13
TOTAL	112	90

Three teachers and their two classes participate the study. Teachers experiences range from four to six years. 202 of 7th grade students participate the study. Their age range from 13 to 14.91(45,05%) of the participant students are girls and 111(54,95%) of the participant is boys. The number of the class size varied between 33-35. The distribution of the girls and boys in the six classes are similar. Before the study, students had received no formal instruction on Algodoo. All students participated in the study voluntarily.

3.4 Procedure

The study is applied by three different teachers and their two classes one of them is control group one of them is experiment group for each teacher. Totally six classes participate the study. Before applications teachers participate three instruction sessions. During the instruction session teachers are informed about Algodoo program's features and usage. Teachers set connection between simulations which formed by using Algodoo and objectives of curriculum. After these instruction sessions teachers apply one introductory Algodoo simulation at dynamometer topic.

Dynamometer topic is at the beginning of the work and power unit in the 7th grade science lesson curriculum. The aim of the introductory application is that both teachers make a practice with students and observing students' reactions to the Algodoo application. Before program application pre-tests are implemented to all participants.

The application process last three weeks. During application process Algodoo simulations are used as supporting tool to content of the lessons. Simulations are supported by worksheet to increase the students' engagements. After application process post-test are implemented to all participants.

3.4.1 Participant Teacher Training

Tree training lesson is done with participant teachers. The first lesson contains the introduction of Algodoo program; the introduction of the legend of program. Each button and what these button can do in Algodoo program is explained. The first lesson is more like lecturing.

The second training lesson serves preparation of application lessons. Teachers and educators create Algodoo simulations with together to work and power unit objectives. Participant teachers discuss what can add and how they use program efficiently.

The third lesson is the most interactive lesson of the introductory sessions. Participant teachers apply a microteaching by using Algodoo. They try to observe at which point they are good and at which point they should make practice.

3.4.2 Introductory Algodoo Lesson

The Algodoo based instruction lessons is designed for 7th grade science courses work and power unit force, work and energy relations (7.2.3) and energy conservation (7.2.4)

part's. An introductory Algodoo lesson is planned before application to prevent losing attention of students during application, making familiar students to Algodoo program and creating practice chance to use Algodoo program both participant teachers and students.

7.2.1 objectives are selected to design the first Algodoo lesson. The objective of the lesson is introducing dynamometer to students. This topic is available to apply Algodoo because observing variables is easy and both teachers and students can use easily Algodoo program during the application.

A reflection sheet is applied to experiment group of study. This sheet composed from questions related with what students' think about Algodoo, they want to use next lessons and which point they have difficulties on Algodoo usage.

The research application lessons are planned after the introductory Algodoo lesson. The research application lessons take three weeks.

3.4.3 First Week Application Algodoo Lessons

The first week class takes four hours. The objectives of the lessons are related to classification energy: potential energy and kinetic energy. Lesson plans, worksheets and simulations are designed according to objectives. The simulations contain graphs and visual material which are the variables potential and kinetic energy depends on.

The Algodoo lessons are designed more interactive than control group lessons. At the beginning of the lesson students are lead to lessons topic by using questions and teachers create a discussion atmosphere. At the content part of the lesson, teachers give information about the topic. The conclusion part of the lessons, Algodoo is used. The worksheets are filled by the students' estimations and observations. By using Algodoo students get chance to observe and try want they want try.

3.4.4 Second Week Application Algodoo Lessons

The second week class takes four hours. The objectives of the lessons are related to conservation of energy. Lesson plans, worksheets and simulations are designed according to objectives. Conservation of energy is abstract concept and students have problems on concretization of concepts. Simulations and simulated graphs are beneficial

means to visualize the concepts. The simulations contain graphs and visual material which can see daily life like swing and pendulum.

3.4.5 Third Week Application Algodoo Lessons

The third week class takes four hours. The objectives of the lessons are related to friction force. Lesson plans, worksheets and simulations are designed according to objectives. The simulations contain graphs and visual material which are the variables friction force depends on. Students have chance to try which material what they want to use and they can compare their daily life experiences.

3.4.6 Control Groups Lessons

The science lessons of the control groups are done more teacher centered. Text-book are used as source. Teachers are more active than students. Generally, explanations and questioning method is used during the lessons.

Table 3.6 The Procedure of the Research

Classes	First Week Science Lesson	Second Week Science Lesson	Third Week Science Lesson
7/A(A1) 7/F(A2) 7/Ī(A3)	Algodoo supported lesson ,kinetic and potential energy simulations and worksheets	Algodoo supported lesson ,conservation of energy simulations and worksheets	Algodoo supported lesson ,friction force simulations and worksheets
7/B(C1) 7/E(C2) 7/L(C3)	Text book based education, teacher-centered explanations	Text book based education, teacher-centered explanations	Text book based education, teacher-centered explanations

RESULTS AND DISCUSSION

The purpose of the research is examining the impact of using Algodoo on students' achievements, science process skills, attitude towards science and attitudes towards technology in science lessons at work and power units during four weeks.

The dependent variable for scientific process skill test was accepted as post test scores means of WPST; the covariate was accepted as pre-test scores means' of WPST and treatment-Algodoo based instruction –as fixed factors while applying ANCOVA in SPSS.

The dependent variable for work and power test was accepted as post test scores means of SPST; the covariate was accepted as pre-test scores means' of SPST and treatment-Algodoo based instruction –as fixed factors while applying ANCOVA in SPSS.

The dependent variable for science attitude scale was accepted as post test scores means of SPST; the covariate was accepted as pre-test scores means' of SPST and treatment-Algodoo based instruction –as fixed factors while applying ANCOVA in SPSS.

The dependent variable for technology attitude scale was accepted as post test scores means of SPST; the covariate was accepted as pre-test scores means' of SPST and treatment-Algodoo based instruction –as fixed factors while applying ANCOVA in SPSS.

4.1 Results of Applied Test

Table 4.1 Means and standard deviations of the WPST pre-test and post-test scores

Class	N	Pre-test		Post-test	
		Mean	Standard Deviation	Mean	Standard Deviation
Algodoo1(A1)	33	8,60	2,71	11,96	3,71
Algodoo2(A2)	35	6,85	1,98	12,31	2,67
Algodoo3(A3)	33	7,39	2,95	13,45	4,35
Control1(C1)	34	8,44	2,48	9,88	2,91
Control2(C2)	34	6,85	2,85	8,97	3,28
Control3(C3)	33	8,54	3,09	10,42	3,81

Table 4.1 shows that the WPST's mean and standard deviation of the control and application groups' pre and posttests. The lowest mean score of pretest is observed A2 group and the highest mean score is observed A1 group. The lowest mean score of posttest is observed C1 and the highest score is observed A3 group. The increment of the Algodoo groups' mean score of WPST is higher than the control groups' mean score of WPST. The incensement is in the scores of the t Algodoo groups after the intervention. (Algodoo1_{pre} =8,60 Algodoo1_{post} =11,60; Algodoo2_{pre} =6,85 Algodoo2_{post} =12,31; Algodoo3_{pre} =7,39 Algodoo3_{post} =13,45)

Table 4.2 The effects of Algodoo-based instruction on the WPST

Dependent Variable: Posttest						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Significance differences
Corrected Model	1181,359 ^a	6	196,893	22,715	,000	A1-C1 A1-C2 A2-C2 A3-C3
Intercept	688,716	1	688,716	79,455	,000	
Pretest	703,005	1	703,005	81,104	,000	
Class	562,170	5	112,434	12,971	,000	
Error	1690,250	195	8,668			
Total	28045,000	202				
Corrected Total	2871,609	201				
a. R Squared = ,411 (Adjusted R Squared = ,390)						

An ANCOVA test conducted to determine the significance difference between the treatment and control group in terms of their work and power achievement test after the intervention of Algodoo based instruction. The results indicated that the intervention had significant impact on work and power achievement of students.

Analysis of ANCOVA indicated that there is significance differences among classes. To find out significance differences post-dock comparison was made the results indicated that there is significant differences between A1-C1 groups and the differences is 0,007; A1-C2 groups significance differences value is 0,017; A2-C2 groups significance differences value is 0,000; A3-C3 groups significance differences value is 0,000.

Table 4.3 Means and standard deviations of the WPST pre-test and post-test scores with respect to gender

Gender	N	Pretest		Posttest	
		Mean	Standard Deviation	Mean	Standard Deviation
Girls	90	8,10	2,83	11,52	3,59
Boys	112	7,50	2,67	10,87	3,91

The increment is observed on means and standard deviations of the WPSOT pre-test and post-test scores with respect to gender. Girls pretest mean score of WPST is 8,10 and posttest mean score is 11,52. Boys pretest mean score of WPST is 7,50 and posttest mean score is 10,87. Girls are more successful than boys at WPST.

Table 4.4 The effects of Gender on the WPST

Dependent Variable: Posttest						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	622,967 ^a	2	311,483	27,566	,000	,217
Intercept	888,363	1	888,363	78,618	,000	,283
Pretest	602,064	1	602,064	53,281	,000	,211
Gender	3,777	1	3,777	,334	,564	,002
Error	2248,642	199	11,300			
Total	28045,000	202				
Corrected Total	2871,609	201				

a. R Squared = ,217(Adjusted R Squared = ,209)

The gender does not have an important effect on the WPST score because the significance difference value is 0,564 and it is higher than the 0,005.

Table 4.5 Means and standard deviations of the SPST pre-test and post-test scores

Class	N	Pre-test		Post-test	
		Mean	Standart Deviation	Mean	Standart Deviation
Algodoo1(A1)	33	15,30	4,71	15,72	4,61
Algodoo2(A2)	35	16,85	4,62	17,68	3,12
Algodoo3(A3)	33	14,27	4,79	17,54	4,69
Control1(C1)	34	17,50	4,32	16,08	4,23
Control2(C2)	34	14,08	3,51	12,38	5,38
Control3(C3)	33	14,33	4,12	13,27	5,89

Table 4.5 shows that the SPST's mean and standard deviation of the control and application groups' pre and posttests. The lowest mean score of pretest is observed C2 group and the highest mean score is observed C1 group. The lowest mean score of posttest is observed C2 and the highest score is observed A2 group. The increment of the Algodoo groups' mean score of SPST is higher than the control groups' mean score of SPST. The incensement is in the scores of the t Algodoo groups after the intervention. (Algodoo1_{pre} =15,30 Algodoo1_{post} =15,72; Algodoo2_{pre} =16,85 Algodoo2_{post}=17,68; Algodoo3_{pre} =14,27 Algodoo3_{post}=17,54)

Table 4.6 The effects of Algodoo-based instruction on the SPST

Dependent Variable: Posttest						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Significant Differences
Corrected Model	2394,971 ^a	6	399,162	27,839	,000	A2-C2
Intercept	424,336	1	424,336	29,595	,000	A2-C3
Pretest	1585,170	1	1585,170	110,557	,000	A2-C1
Class	578,167	5	115,633	8,065	,000	A1-C2
Error	2795,925	195	14,338			A3-C3
Total	53165,000	202				
Corrected Total	5190,896	201				

a. R Squared = ,461 (Adjusted R Squared = ,445)

An ANCOVA test conducted to determine the significance difference between the treatment and control group in terms of their scientific process skill test after the intervention of Algodoo based instruction. The results indicated that the intervention had significant impact on scientific process skill tests' score of students.

Analysis of ANCOVA indicated that there are significance differences among classes. To find out significance differences post-dock comparison was made the results indicated that there is significant difference between A2-C2 groups and the differences is 0,000; A2-C2 groups significance differences value is 0,000; A2-C1 groups

significance differences value is 0,028; A1-C2 groups significance differences value is 0,016; A3-C3 groups significance differences value is 0,000.

Table 4.7 Means and standard deviations of the SPST pre-test and post-test scores with respect to gender

Gender	N	Pretest		Posttest	
		Mean	Standard Deviation	Mean	Standard Deviation
Girls	90	15,76	4,21	16,41	4,42
Boys	112	15,57	4,65	15,66	4,58

The increment is observed on means and standard deviations of the SPST pre-test and post-test scores with respect to gender. Girls pretest mean score of SPST is 15,76 and posttest mean score is 16,41. Boys pretest mean score of SPST is 15,57 and posttest mean score is 15,66. Girls are more successful than boys at SPST.

Table 4.8 The effects of Gender on the SPST

Dependent Variable: Posttest					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1886,244 ^a	2	943,122	56,793	,000
Intercept	453,827	1	453,827	27,329	,000
Pretest	1757,927	1	1757,927	105,859	,000
Gender	69,440	1	69,440	4,182	,042
Error	3304,652	199	16,606		
Total	53165,000	202			
Corrected Total	5190,896	201			

a. R Squared = ,363 (Adjusted R Squared = ,357)

The significance differences value is 0,042 after application of Algodoo based instruction in class between gender.

Table 4.9 Means and standard deviations of the TAT pre-test and post-test scores

Class	N	Pre-test		Post-test	
		Mean	Standart Deviation	Mean	Standart Deviation
Algodoo1(A1)	33	3,95	0,57	4,24	0,54
Algodoo2(A2)	35	4,18	0,56	4,30	0,44
Algodoo3(A3)	33	4,01	0,55	4,25	0,49
Control1(C1)	34	4,17	0,52	4,41	0,43
Control2(C2)	34	3,91	0,62	4,03	0,69
Control3(C3)	33	4,26	0,58	4,29	0,51

Table 4.9 shows that the TAT's mean and standard deviation of the control and application groups' pre and posttests. The lowest mean score of pretest is observed C2 group and the highest mean score is observed C3 group. The lowest mean score of posttest is observed C2 and the highest score is observed C1 group. The incensement is in the scores of the Algodoo groups after the intervention. (Algodoo1_{pre} =3,95 Algodoo1_{post} =4,24; Algodoo2_{pre} =4,18 Algodoo2_{post} =4,30; Algodoo3_{pre} =4,01 Algodoo3_{post} =4,25)

Table 4.10 ANCOVA test results for the effects of Algodoo-based instruction on the TAT

Dependent Variable: Posttest						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	17,927 ^a	6	2,988	14,619	,006	,310
Intercept	19,375	1	19,375	94,798	,000	,327
Pretest	15,213	1	15,213	74,438	,000	,276
Class	1,345	5	,269	1,316	,259	,033
Error	39,854	195	,204			
Total	3720,302	202				
Corrected Total	57,781	201				

a. R Squared = ,310 (Adjusted R Squared = ,289)

There is an incensement at the mean scores between pretest and posttest of the TAT however, there is no significance difference pretest and posttest score of TAT. The significance value is 0,259 and it is higher than 0,005.

Table 4.11 Means and standard deviations of the TAT pre-test and post-test scores with respect to gender

Gender	N	Pretest		Posttest	
		Mean	Standard Deviation	Mean	Standard Deviation
Girls	90	4,08	0,56	4,23	0,56
Boys	112	4,09	0,59	4,27	0,51

The increment is observed on means and standard deviations of the TAT pre-test and post-test scores with respect to gender. Girls pretest mean score of TAT is 4,08 and posttest mean score is 4,23. Boys pretest mean score of TAT is 4,09 and posttest mean score is 4,27. Boys are more successful than boys at TAT.

Table 4.12 The effects of Gender on the TAT

Dependent Variable: Posttest						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	16,643 ^a	2	8,322	40,256	,000	,288
Intercept	19,712	1	19,712	95,355	,000	,324
Pretest	16,566	1	16,566	80,139	,000	,287
Gender	,062	1	,062	,289	,586	,001
Error	41,137	199	,207			
Total	3720,302	202				
Corrected Total	57,781	201				

a. R Squared = ,288 (Adjusted R Squared = ,281)

The gender does not have an important effect on the TAT score because the significance difference value is 0,586 and it is higher than the 0,005.

Table 4.13 Means and standard deviations of the SAS pre-test and post-test scores

Class	N	Pre-test		Post-test	
		Mean	Standart Deviation	Mean	Standart Deviation
Algodoo1(A1)	33	3,79	0,26	3,81	0,39
Algodoo2(A2)	35	3,51	0,34	3,62	0,62
Algodoo3(A3)	33	3,86	0,36	3,89	0,26
Control1(C1)	34	3,59	0,42	3,55	0,37
Control2(C2)	34	3,62	0,33	3,50	0,39
Control3(C3)	33	3,98	0,31	3,99	0,25

Table 4.13 shows that the SAS's mean and standard deviation of the control and application groups' pre and posttests. The lowest mean score of pretest is observed C1 group and the highest mean score is observed C3 group. The lowest mean score of posttest is observed C2 and the highest score is observed C2 group. The incensement is in the scores of the Algodoo groups after the intervention. (Algodoo1_{pre} =3,79 Algodoo1_{post} =3,81; Algodoo2_{pre} =3,51 Algodoo2_{post} =3,62; Algodoo3_{pre} =3,86 Algodoo3_{post} =3,89)

Table 4.14 ANCOVA test Results for The Effects of Algodoo-based instruction on the SAS

Dependent Variable: Posttest						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	11,640 ^a	6	1,940	13,336	,000	A1-C2 A3-C2 A2-C2
Intercept	7,097	1	7,097	48,784	,000	
Pretest	4,058	1	4,058	27,897	,000	
Class	3,511	5	,702	4,827	,000	
Error	27,203	195	,145			
Total	2706,062	202				
Corrected Total	38,843	201				
a. R Squared = ,300 (Adjusted R Squared = ,277)						

An ANCOVA test conducted to determine the significance difference between the treatment and control group in terms of their science attitude test after the intervention of Algodoo based instruction. The results indicated that the intervention had significant impact on scientific process skill tests' score of students.

Analysis of ANCOVA indicated that there is significance difference among classes. To find out significance differences post-dock comparison was made the results indicated that there are significant differences between A1-C2 groups and the differences is

0,004; A2-C2 groups significance differences value is 0,005; A3-C2 groups significance differences value is 0,000.

Table 4.15 Means and standard deviations of the SAS pre-test and post-test scores with respect to gender

Gender	N	Pretest		Posttest	
		Mean	Standard Deviation	Mean	Standard Deviation
Girls	90	3,70	0,39	3,72	0,41
Boys	112	3,74	0,36	3,75	0,47

There is no increment on means and standard deviations of the SAS pre-test and post-test scores with respect to gender. Girls pretest mean score of SAS is 3,70 and posttest mean score is 3,72. Boys pretest mean score of SAS is 3,74 and posttest mean score is 3,75.

Table 4.16 The effects of Gender on the SAS

Dependent Variable: Posttest						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	8,130 ^a	2	4,065	25,278	,000	,209
Intercept	5,638	1	5,638	35,064	,000	,155
Pretest	8,117	1	8,117	50,480	,000	,209
Gender	,001	1	,001	,005	,941	,000
Error	30,713	199	,161			
Total	2706,062	202				
Corrected Total	38,843	201				

a. R Squared = ,209 (Adjusted R Squared = ,201)

The gender does not have an important effect on the SAS score because the significance difference value is 0,941 and it is higher than the 0,005.

The reflection papers are applied to experiment groups ‘students after introductory Algodoo lesson and after at the end of the research application lessons. The students’ answers are categorized and frequency tables are formed.

Table 4.17 The Frequency Table of Algodoo Reflection Papers

		Before Algodoo Application		After Algodoo Application	
Class	Idea	N	f	N	f
Algodoo1(A1)	I want to use Algodoo next lessons	22	68,75%	32	96,96%
	It can be maybe	1	3,12%	0	0
	I don't want to use Algodoo next lessons	10	31,25%	1	3,04%
Algodoo2(A2)	I want to use Algodoo next lessons	27	77,14%	33	94,28%
	It can be maybe	4	11,42%	2	5,72%
	I don't want to use Algodoo next lessons	4	11,42%	0	0
Algodoo3(A3)	I want to use Algodoo next lessons	28	84,84%	33	100%
	It can be maybe	1	3,03%	0	0
	I don't want to use Algodoo next lessons	4	12,12%	0	0

The reflection papers are separated to students after introductory Algodoo lesson and after at the end of the research application lessons. The duration is nearly six weeks. The first reflection paper results show that nearly %70 of the students wants to use Algodoo next lessons. The rest of the students are hesitated or not want to use Algodoo next lessons.

The applied reflection papers at the end of the research application shows that nearly %95 of the students want to use Algodoo for next lessons.

Table 4.18 Students' ideas which Features They Like Algodoo

Ideas	N	f
The Algodoo make concept embodied	28	27,72
The variables can be manipulated	22	21,78
The objects can move	10	9,90
The graphs are formed simultaneously	6	5,94
The results can be estimated	15	14,85
The results can be observed immediately	10	9,90
It looks like computer games	13	12,87
It is colorful	3	2,97

Some examples of students' ideas about which features they like during Algodoo usage:

Student 8 from Algodoo1 class: "It is colorful and it gets my attention, I distinguish objects more easily."

Student 27 from Algodoo1 class: "I can change variables what value I want to try and I can observe the results immediately."

Student 16 from Algodoo2 class: "Objects are moving it looks like computer game, cartoon so it remains my mind more easily and colorfully."

Student 9 from Algodoo3 class: "Forming graphs simultaneously is the most excited features of the application."

Table 4.19 Students' ideas which features they have problems on Algodoo usage

Ideas	N	f
The terms are English	55	54,45
The teacher does not know English so he did not found object quickly	35	34,65
It is too colorful it distracts me	5	4,95
I face problems graphs formation	6	5,94

Some examples of students' ideas which features they have problems on Algodoo usage:

Student 2 from Algodoo1 class: "The terms are English so I did not understand at the beginning but other lessons I familiar with the items."

Students 14 from Algodoo 2 class: "The teacher does not know English so he faced with some difficulties."

Student 25 from Algodoo 3 class: "Some terms are English so sometimes I could not find where we compose graphs easily."

Student 30 from Algodoo 3 class: "It is more colorful and my attention is lose sometimes easily."

4.2 Discussion

The research attempt to examine the effects of using Algodoo in science lessons at middle school. Science education has an important place both education life and daily lives. Science education mostly depend on the understanding and setting relationships between the concepts. In other words, growing scientific literate people the primary aim of science education [1]. Scientific literate people is a need for both society and era.

Needs and developments brings with positive and negative features with together so manipulations on each areas are inevitable truths. Education is an ongoing and alive process so integrating new developments into educations especially classes is necessity. Technology integration into classes is one of the attempt to meet the needs of society. The attempt is mostly supported by state and FATİH project is an evidence of this. FATİH project is one of the comprehensive project wants to integrate technology to education [8]. Within the scope of this project interactive white boards(IWB) set in the classes and begin the use. Nearly 80% of the school has IWB in Turkey.

Technology usage in classes is a contradictive topic but to meet the needs of society and era the integration of technology into education should be done effectively. Simulations are the applications which are comes with the technology. Algodoo is a simulation application easy to use in the classroom.

The study examines the using Algodoo in science classes into four categories: students' achievement at 7th grade work and power unit, scientific process skills, attitudes toward science and attitudes towards technology.

The examined literature shows that using simulations and Algodoo has positive effects on students' science achievement. Energy is an abstract concept and students have problems with this topic. Misconceptions and energy conversion are the mostly problematic part of the topic. To get rid of misconceptions students must be dissatisfied with their existed conceptions; and the new concepts must be intelligible and plausible. At this point serving different information sources to learners is a reasonable way. Technology is a good way to supply different teaching material and sources[7].The study is conducted by Akbulut, Şahin and Çepni(2013) shows that the main reason of misconceptions which are related to energy topic is that students are passive so they do not embodied the topic. To solve this, students should be active during the knowledge acquisition process [4]. Simulations create chances to students being active in the

process and embodied the topic. Thus, the researcher claimed and construct the hypotheses that the using Algodoo increase the students' WPST scores with respect to rationale.

After testing hypotheses, the findings of the study disclosure that the experiment group increased the post score of the WPST and, scores are better than the control group. The results found significance difference between A1-C1, A1-C2, A2-C2, A3-C3 between groups' achievement. It means that each partner group, each instructors experiment groups show higher increasement than control group. Three different instructor get meaningful differences. Also, there is meaningful differences between two different instructors. It shows that the research can be repeatable and it shows positive improvement on students' achievement.

The findings of the study are consisted with some studies in the literature. Technology based activities foster student learning process, participation and collaboration because the well designed and integrated simulation enables learners to try and observe what they wonder. Students actively engage in analysis, synthesis and evaluation when they actively involve the learning process [16]. Discussions are the important means to prompt active learning in the classes. During the research process worksheets are used to supply evidence based argumentation and gathering data.

The used worksheets are designed as data collection table and students can select the variables value and they had to chance to observe their hypotheses. If they face a confused point they can repeat the simulations and observe the results. Also, students discuss the each other hypotheses.

Setting connections between concepts mostly affect the science achievement because concept learning has an important place at science education. For abstract concepts multiple representation gains attention more like energy. Students are more able to transfer knowledge when they acquired it more than one sources. The Kumar and Sherwood research is conducted about classes of organism and ecosystem with 83 9th grade students. The teaching process is supported with multimedia simulations ant the researchers observed that simulations improve the students understanding of science [46]. A similar research is applied to 124 8th grade students on the topic ecosystem water. Eckhardt (2013) find that combination of instruction and particular methods like simulations get results positive learning outcomes [47].

The instruction is supported by Algodoo application during the research process and students get chance to active engage in participation and manipulation of the variables. Manipulation and visualization simultaneously has positive effect on not only physic topics but also chemistry topics. 170 second semester general chemistry students attend the study and they used simulations at particulate level and macroscopic level. Tang and Abraham's (2016) study shows that different level of representations of simulations affect the students learning positively [48].

Table 4.1 show that the results of applied study. The experimental group of students who receive instruction and Algodoo application in the science classes get higher scores on the Work and Power Success Test (WPST) than control group who receive mostly text book based instruction. Algodoo has positive impact on students' work and power unit achievement test.

Science education contains some part and scientific process skills is one of them. Improving students' scientific process skills has a big room in science education. Sooabard and Rannikame (2015) defines scientific literacy as utilizing science knowledge and scientific process skills particularly related with creative problem solving and making reasoned decisions in real life situation [27]. The basic aim of the science curriculum is taken into consideration scientific process skills get more attention.

Scientific process skills contain experimentation, observation, space/time relation, classification, using numbers, measurement, binding, forecasting, controlling variables, interpretation of data, responding and forming hypotheses [45]. To develop these features argumentations, discussions, making experiments should be done. Different sources and multiple representations make serve students to get students who are different types of learners.

The researcher gets parallel results with the former research with respect to scientific process skills test. The findings of the study revealed that the experiment group increased the post score of the SPST and, scores are better than the control group. The results found significance difference between A2-C2, A2-C3, A2-C1, A1-C2, A3-C3 between groups' achievement. It means that partner groups, different instructors' experiment groups show higher increasement than control group.

Experiments can be different purposes in the science classes. Embodied concept, visualization, data collection, forming hypotheses some of the using aim of experiment in science educations. At some points, making experiments cannot be possible in such situation technology can be helpful means to educators. Simulations are interactive programs includes artificial environment. It supplies students chance to experiment harmlessly and simulate process in a virtual environment [22].

Simulations compatible with principles of scientific discovery learning. Discovery learning process contains some inquiry learning features like predicting, conducting and reasoning. All of these features are located in a good designed simulation program [47]. Learners can set a connection between complex concepts like energy conversation and variables by using simulations.

Creating opportunities to students for think critically about complex contents supply that students needs chance to ask questions, generate ideas, collect data and evaluate evidence. Simulations are scaffolders for learners to develop deep science content understanding [49]. The applied research results similar to these ideas. The scientific process skill test score of experiment group is higher than the control group. It shows that using Algodoo has positive impact on students' scientific process skills.

The positive impact of Algodoo using in science lessons not only observed at students' test score but also attitudes towards science. The results which get from applied research show that experiment group students' positive increase of attitudes towards science is higher than the control group. The examined literature also supports the results. The research is conducted by Özer, Bilici and Karahan (2015) with 6th grade students at "Force and Motion Unit"- "Light and Sound Unit" results students develops positive impact both science and Algodoo usage in science classes. The students say that we can more easily understand the topic by using Algodoo in their interview [18]. Another research which is conducted with 10th grade student by Çelik, Sarı and Harwanto results that Algodoo program has positive impact on students' science attitude and students' understanding [19]. A similar result with this study is found by Aydın and Balım in 2004-2005 semesters. The experimental group of the study is consisted of 68 7th grade students show more positive attitude towards science than control group [6].

The positive impact on attitudes towards science is observed some study implicitly. Berber & Sari (2010) advocate that the positive improvement of the interest in science affect the attitudes towards science. They observed more positive increasement in experiment group than control group in terms of interest in science [50]. Also, being active during the learning process increase the learners' motivation and motivation affect the whole attitudes of students, attitudes towards science too [51].

Algodoo has positive effect on students' attitudes towards technology. The experiment group show higher increasement than control group on technology attitude scores. Algodoo has an easy interface to use. Technology literacy is 21st century skill and the improvement of attitudes towards technology is demanded.

Cydis (2015) states that technology integration is a basic feature of students' competence in the technology era. The easy and enjoyable applications make easier to integration of technology into education and increase the students' interest towards technology [13]. A research which is conducted in Finnish and Estonian schools indicate that Technical craft has an impact on motivation for learning technology [52].

Although the existence of attempts and needs of society, technology is not used by educators enough. The most important reason of this situation teachers have not enough information about technologies which can be used in classes. They do not feel comfortable when they use a new technology or application because teachers are not master on subject so teachers do not prefer use new technologies in the classes. The examined literature and research findings support this idea. Gregorcic(2017) explains the teachers feeling when they used a new technology in their science classes like that "I feel anxious at the beginning because I am not expert on using Algodoo and I can lose control of the class"[9]. To prevent this extraneous variables' effect the participant teachers apply an introductory lesson before application.

Students' feedback of Algodoo using in the science classes is positive. They declare that it is enjoyable, playful, observable. The statements show that students are more eager to participate to lessons and they are more active. Teachers are the most important part of education process. However, this does not mean to only they are the active in teaching and learning process. Students should be more active to increase the knowledge acquisition. By using technology teachers can create more student active learning

environment. Teachers attitudes play an important role the integration of technology into education [53].

4.3 Conclusion

The previous researches shows that using simulations does not have negative effect. Also, the examined results explain the positive relationship between the using Algodoo and knowledge acquisition. The study not only results positive impact on achievement but also different areas like scientific process skills, attitudes towards science and technology. There is significance difference between pre-test and post-test score of the control and experiment group. The higher positive improvement is observed at work and power success test, scientific process skill test, science attitude scale and technology attitude scale score of experiment group.

4.4 Implementation for Future Research

- The examined literature shows that the applications are done mostly with preservice teachers or high school students. The new research can be conducted at each grade.
- Students' feedback of the research is positive so Algodoo application can be used different units at science classes.
- Technology integration into classes is important topic and Algodoo is easy, free and compatible to IWB so it can be used each teacher.
- The study can be repeated with respect to different independent variables such as motivation.

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LESSON PLANS

A.1 Lesson Plan 1 (Introductory Algodoo Lesson)

Lesson: Science Education

Topic: The Relationship between Mass and Gravity

Grade :7

Time:40+40 minutes

Objective:

7.2.1.1 Kütleyle etki eden yerçekimi kuvvetini ağırlık olarak adlandırarak, ağırlığı bir kuvvet

olarak tanımlar ve büyüklüğünü dinamometre ile ölçer.

7.2.1.1: Students called gravity as a force which is affect the mass, define gravity as a force and measure the gravity with dynameters.

Concepts:Mass and Gravity

INTRODUCTION: (15 minutes)

- Teachers ask questions to students related with topic to set connection between daily life. By doing so, teacher can both get information about students' readiness and supply formative assessment of students 'misconceptions if they are existed.
 - What is the mass?
 - Where do we use mass term in daily life?

- Are there any other terms which are used with mass term? (Questioning continues until students mention gravity term)
- What is the gravity?
- Are the mass and gravity same terms?

CONTENT:

1.Part (25 minutes)

- Teachers give a brief information to students about topic. By using question and answer, mass and gravity are different terms is indicated.

2.Part (20 minutes)

- The mass concept is taught by using Algodoo at the second part of the lesson.
- How does the mass effect the object? What is the direction of gravity? Questions are asked to students and their prediction is listened and the results are showed by using Algodoo program.

CONCLUSION and EVALUATION: (20 minutes)

- Students fulfill the worksheets during the lecture and application part. The worksheets are used as both teaching material and evaluation material.

WORKSHEET

The Used Dynameters and Forces	The Used Material Gravity	The Extension of The Spring(you can draw or write dimension)

A.2 Lesson Plan 2 (Example of Applied Lessons)

Lesson: Science Education

Topic: Force, work and energy relations

Grade :7

Time:40+40 minutes

Objective:

7.2.3.2. Enerjiyi iş kavramı ile ilişkilendirir, kinetik ve potansiyel enerji olarak sınıflandırır.

7.3.2.2: Students set a relationship between work and energy, classify the kinetic and potential energy.

Concepts: Physical work, kinetic energy, potential energy, gravitational potential energy, flexibility potential energy

INTRODUCTION: (15 minutes)

- Questions are asked to students about topic. By doing so, teacher Öğrencilere konudaki ana kavramlar hakkında sorular sorulur. By doing so, teacher can both get information about students' readiness and supply formative assessment of students' misconceptions if they are existed.
 - What is the energy?
 - Where do we hear the energy term? (Teacher lead students answer to work and energy because many students answer questions related with food' energy)
 - Do we categories energy? If we can do it, what can be the criterions?

CONTENT:

1.Part (25 minutes)

- Teachers give a brief information to students about topic. By using question and answer, the criterions of the energy classification are decided.

2.Part (20 minutes)

- The energy concept is shown by using Algodoo simulations at the second part of the lesson.
- The graphs are simultaneously shown students by using Algodoo application and they fulfill their worksheet.

CONCLUSION and EVALUATION: (20 minutes)

- According to students guess and hypothesis simulation is manipulated and they fulfill worksheets.



WORKSHEET

Matter Velocity(m/s)	Mass of Matter(kg)	Kinetic Energy(joule)

Matter Velocity(m/s)	Mass of Matter(kg)	Kinetic Energy(joule)

- Drive graphs by using gathering data

- What is the relationship between velocity –kinetic energy, mass-kinetic energy?

Worksheet

1.Beginning Ideas

What does the kinetic energy depend on?

2.Test

What did you do to find what kinetic energy depend on?

3.Claims

What did I get by using by results and observations? (What is my ideas at the end of the lesson?)

4.Proof

The proof which are derived from observations and findings support my ideas.

5.Reflections

The comparison of my ideas between beginning and end of the class.

A.3 Reflection Paper

1) Which terms do you hear in the first time at the lesson?

2) What is your opinion about using Algodoo in the lesson?

3) If you will be the teacher of your science lesson, is there anything to add lesson?

4) Do you want to use Algodoo for next science classes?

5) Which features do you like mostly when you use Algodoo?

6) At which points you face with problems using Algodoo?

APPENDIX-B

MEB PERMISSION PAPER



T.C.
İSTANBUL VALİLİĞİ
İl Millî Eğitim Müdürlüğü

Sayı : 59090411-20-E.4314389

28/02/2018

Konu: Anket ve Araştırma İzin Talebi

VALİLİK MAKAMINA

- İlgi: a) Yıldız Teknik Üniversitesinin 25.01.2018 tarih ve 1801250307 sayılı yazısı.
b) MEB. Yen. ve Eğ. Tk. Gn. Md. 22.08.2017 tarih ve 12607291/ 2017/25 No'lu Gen.
c) Millî Eğitim Araştırma ve Anket Komisyonunun 26.02.2018 tarihli tutanağı.

Yıldız Teknik Üniversitesi Fen Bilimleri Enstitüsü yüksek lisans öğrencisi Ayşegül CAYVAZ'ın "**Algodoo Kullanımının Ortaokul Fen Öğretiminde Etkileri**" konulu tezi kapsamında, ilimiz Esenler ilçesinde bulunan Fidan Demircioğlu ortaokulunda öğrenim gören öğrenci ve fen bilimleri öğretmenlerine; fen tutum ölçeği, teknoloji tutum ölçeği, iş ve enerji başarı testi ve bilimsel süreç beceri testini uygulama istemi hakkındaki ilgi (a) yazı ve ekleri Müdürlüğümüzce incelenmiştir.

Araştırmacının söz konusu talebi; bilimsel amaç dışında kullanılmaması, **uygulama sırasında bir örneği müdürlüğümüzde muhafaza edilen mühürlü ve imzalı veri toplama araçlarının kurumlarımıza araştırmacı tarafından ulaştırılarak uygulanması, katılımcıların gönüllülük esasına göre seçilmesi, araştırma sonuç raporunun müdürlüğümüzden izin alınmadan kamuoyuyla paylaşılmaması koşuluyla, okul idarelerinin denetim, gözetim ve sorumluluğunda, eğitim-öğretimi aksatmayacak şekilde ilgi (b) Bakanlık emri esasları dâhilinde uygulanması, sonuçtan Müdürlüğümüze rapor halinde (CD formatında) bilgi verilmesi kaydıyla Müdürlüğümüzce uygun görülmektedir.**

Makamlarınızca da uygun görülmesi halinde olurlarınıza arz ederim.

Ömer Faruk YELKENCİ
Millî Eğitim Müdürü

OLUR
28/02/2018

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Vali a.
Vali Yardımcısı

- Ek:1- Genelge
2- Komisyon Tutanağı

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APPLIED TESTS

C.1 Work and Power Success Test

Kuvvet ve Hareket Ünitesi Başarı Testi
Hazırlayan: Osman ERŞAHAN

(Lütfen: Soruların cevaplarını cevap anahtarının üzerine işaretleyiniz).

1) Bir öğrenci içi boş bir kutuyu 10 metre ilerlettiğine göre bu öğrenci ile ilgili olarak aşağıdaki ifadelerden hangisi yanlıştır?

- A) Öğrenci kutuyu ilerletirken kuvvet harcamıştır.
B) Öğrenci kutuyu ilerletmiş ama iş yapmamıştır.
C) Öğrenci kutuyu ilerletirken enerji harcamıştır.
D) Öğrenci kutuyu 20 metre ileri itseydi daha fazla enerji harcamış olacaktı.

2) Aşağıda belirtilen hangi durumlarda bulunan kişiler fen anlamında iş yapmıştır?

- I. Volkan kutuyu iterek hareket ettiriyor.
II. Bengü bankta oturup biraz dinleniyor.
III. Kemal kaydırdıktan kayıyor.
IV. Deniz merdivenlerden iniyor.

- A) I ve II B) I, II ve III C) II, III ve IV D) I, III ve IV

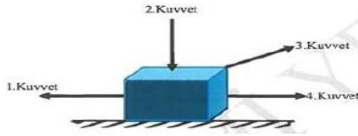
3) Aşağıdaki seçeneklerden hangisinde iş ile enerji arasındaki ilişki doğru tanımlanmıştır?

- A) Enerji iş yapabilme yeteneğidir.
B) İşin birimi enerji olarak tanımlanır.
C) Enerji harcanan her yerde iş yapılmış olur.
D) Enerji ve iş birbirinden bağımsız kavramlardır.

4) Fen anlamında iş yapılabilmesi için bir cisme kuvvet uygulanmalı ve cismin kuvvet yönünde yol alması gerekmektedir. Buna göre işin birimi aşağıdakilerden hangisidir?

- A) Joule B) metre/Newton C) Newton D) Newton/Joule

5)



Yukarıdaki cisme 4 adet kuvvet tek tek uygulanıyor. Bu kuvvetlerden hangisi fiziksel anlamda iş yapamaz?

- A) 1. Kuvvet B) 2. Kuvvet C) 3. Kuvvet D) 4. Kuvvet

6) Aşağıda verilen durumların hangisi bir kinetik enerji belirtir?

- I. Masada duran kalem II. Hareket eden araba
III. Yuvarlanarak hareket eden misket

- A) II ve III B) Yalnız II C) Yalnız I D) I, II ve III

7) Aşağıdaki şekillerde yatay düzlem üzerinde hareket eden K, L, M, N cisimlerinin kütleleri ve süratleri verilmiştir. Hangi cismin kinetik enerjisi en küçüktür?



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

Sınıf:

8)



Yandaki şekilde m kütleli cisim h yüksekliğinde tutulurken potansiyel enerjisi E kadardır. Aşağıdaki seçeneklerde verilen sistemlerin hangisinde cismin potansiyel enerjisi 4E dir?

9) Çekim potansiyel enerjisi aşağıda verilenlerden hangisine bağlı değildir?

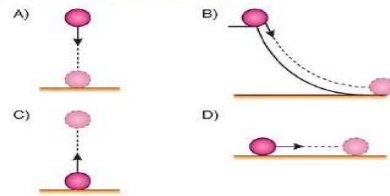
- A) Cismin kütlesi B) Cismin yerden yüksekliği
C) Cismin hızı D) Yerin çekim ivmesi

10) Şekil 1 ve Şekil 2'deki özdeş yaylar aynı miktarda sıkıştırılarak önüne K cismi konulmuştur. Şekil 1'de sıkıştırılan yay serbest bırakıldığında K topu h yüksekliğine, Şekil 2'de ise 2h yüksekliğine çıkmıştır. Bu iki durum ile ilgili olarak aşağıda söylenenlerden hangisi yanlıştır?



- A) Sıkıştırılan yay esneklik özelliği nedeni ile esneklik potansiyel enerjisine sahip olur.
B) Yayın esneklik potansiyel enerjisi yayın sıkıştırılma miktarı arttıkça azalır.
C) Sıkıştırılan yayda esneklik potansiyel enerjisi, kinetik enerji ve potansiyel enerji şeklinde enerji dönüşümü vardır.
D) Şekil 2'deki yay daha çok sıkıştırıldığı için K topu daha yükseğe çıkmıştır.

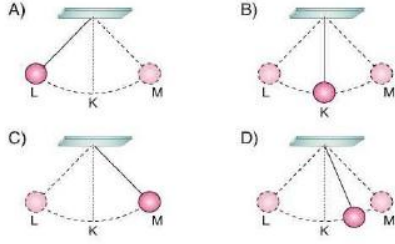
11) Hareket yönü ok işaretleriyle belirtilen aşağıdaki sistemlerin hangisinde cismin potansiyel enerjisi artarken kinetik enerjisi azalır? (Ortamdaki sürtünme ihmal ediliyor.)



12) Kişi ya da nesnelerin sahip oldukları enerjiler ile ilgili aşağıdaki yorumlardan hangisi doğrudur?

- A) Kaydırdıktan kayan çocuk kinetik enerjiye sahiptir.
B) Duvarda asılı duran tablonun hiçbir enerjisi yoktur.
C) Sirtında çanta taşıyan kız öğrencinin sırt çantası herhangi bir enerjiye sahip değildir.
D) Arabayı iten adamın hareket ettirdiği araç hiçbir enerjiye sahip değildir.

13) Bir cisim sürtünmesi önemsenmeyen bir ortamda aşağıdaki gibi L-M noktaları arasında salınım hareketi yapıyor. Buna göre cismin en büyük kinetik enerjiye sahip olduğu konum aşağıdakilerden hangisinde doğru verilmiştir?

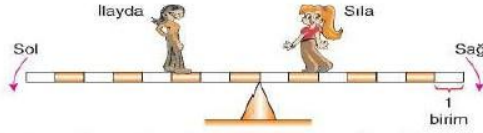


14) Kuvvetin yönünü ve büyüklüğünü değiştirmek için kullanılan aletlere ne denir?

- A) İş B) Enerji C) Basit makine D) Güç

15) Aşağıdakilerden hangisi basit makineler için doğru değildir?

- A) Kuvvet ve yoldan aynı anda kazanç sağlar.
B) İş yapma kolaylığı sağlar
C) Bir kuvvetin yönünü değiştirmek için kullanılan makinelerdir.
D) Bir kuvvetin büyüklüğünü değiştirmek için kullanılan makinelerdir.



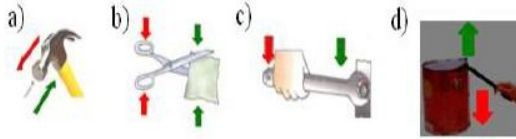
16) İlayda ve Sıla yukarıdaki gibi tahterevalliyeye bindiklerinde denge sağlanıyor. Buna göre;

- I. İlayda'nın ağırlığı Sıla'nın ağırlığından azdır.
II. İlayda ile Sıla yer değiştirirse tahterevallinin dengesi sola doğru bozulur.
III. İlayda bir birim desteğe yaklaşırsa desteğin dengesi sağa doğru bozulur.

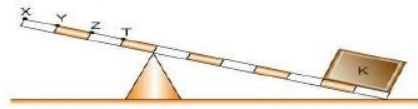
ifadelerden hangileri doğrudur? (Tahterevalli çubuğunun ağırlığı ihmal ediliyor.)

- A) Yalnız I B) I ve II C) II ve III D) I, II ve III

17) Aşağıdaki şekillerde günlük hayatta sıklıkla kullandığımız aletler görülmektedir. Resimlerin üzerindeki oklar ise bu işleri yaparken uyguladığımız kuvvetin ve elde ettiğimiz kuvvetin yönlerini göstermektedir. Sızca yapılan bu gösterimlerden hangisi yanlıştır?



18) Aşağıdaki kaldıraçta bulunan K cismini yukarıya doğru en büyük kuvvetle kaldırmak için seçeneklerde verilen noktalardan hangisine kuvvet uygulamamız gerekir?



- A) X B) Y C) Z D) T

19) I. Aynı dönme eksenini üzerinde bulunan yarıçapları farklı silindirlere oluşan basit makinedir.

II. Eğik düzleme benzeyen genellikle kesme işleminde kullanılan basit makinedir.

III. İnşaatlarda ağır yükleri üst katlara taşıırken kullanılabilen bir basit makinedir.

Yukarıda tanımlanan basit makineler aşağıdakilerden hangisinde doğru olarak verilmiştir.

I	II	III
A) Çıkrık	Vida	Makara
B) Vida	Kama	Eğik düzlem
C) Çıkrık	Makara	Eğik düzlem
D) Çıkrık	Kama	Makara

20) Bir buharlı lokomotifte kömürün yanmasından tekerleklerin dönmeye kadar ki enerji dönüşümü, aşağıdakilerden hangisinde doğru olarak verilmiştir?

- A) Kimyasal-Isı-Hareket B) Isı-Kimyasal-Hareket
C) Isı-Elektrik-Hareket D) Elektrik-Isı-Kimyasal-Hareket

21) Fatih Sultan Mehmet Han'ın İstanbul'u fetherederken gemileri bir gecede Haliç'e karadan indirmesi Mısır'da piramitleri inşa eden işçilerin piramitler yükseldikçe, blokları yukarıya doğru çıkarması



Yukarıdaki resimlerde verilen olaylar ile ilgili aşağıdakilerden hangisi söylenebilir?

- I. Teknoloji tarih içinde farklı şekilde basit makineleri hep kullanmıştır.
II. Basit makineler ihtiyaçlara göre değişim göstermiştir.
III. Resimlerde görülen basit makineler toplum içinde üretilmiş ve çeşitli ihtiyaçlara çözüm üretmiştir.

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

22) Aşağıda sürtünme kuvveti ile ilgili verilen ifadelerden hangisi yanlıştır?

- A) Cisimlerin kinetik enerjileri azaltılabilir.
B) Birimi yoktur.
C) Sürtünen yüzeylerin türüne bağlıdır.
D) Yönü daima cismin hareket yönüyle zıttır.

23) Düz yolda fren yapan bir arabaya uygulanan sürtünme kuvveti ile ilgili aşağıda yapılan yorumlardan hangileri doğrudur?

- I. Araba fren yaparken arabanın kinetik enerjisinin bir kısmı ısı enerjisine dönüşmüştür.
II. Araba fren yaparak durduğunda sahip olduğu enerjinin tamamı bitmiştir.
III. Sürtünme kuvveti olmasaydı araba duramazdı.

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

İş-Güç-Enerji Testi Cevap Anahtarı

1. B
2. D
3. A
4. A
5. B
6. A
7. B
8. B
9. C
10. B
11. C
12. A
13. B
14. C
15. A
16. D
17. C
18. D
19. D
20. A
21. D
22. B
23. C

C.2 Scientific Process Skill Test

Gözlem Yapma

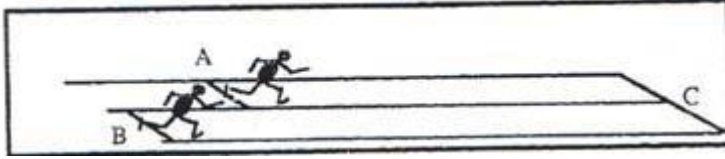
1. Aşağıdakilerden hangisi gözlemdir?

- a) Metalin bir kısmı kırmızı bu yüzden sıcaktır.
- b) Sokak ıslak demek ki yağmur yağmış.
- c) Masa ağaçtan yapılmış gibi görünüyor.
- d) Çocukların kaldıkları binanın rengi turuncudur.

2. Aşağıdakilerden hangisi görme duyusuyla gözlemlenir?

- a) Havadaki sıcaklık değişimini gözlemlenir
- b) Bitkilerin boyundaki değişimi gözlemlenir
- c) Yeni kimyasal maddelerin kokusundaki değişimi gözlemlenir
- d) Motordan çıkan sesin değişimini gözlemlenir

Uzay –Zaman İlişkisi



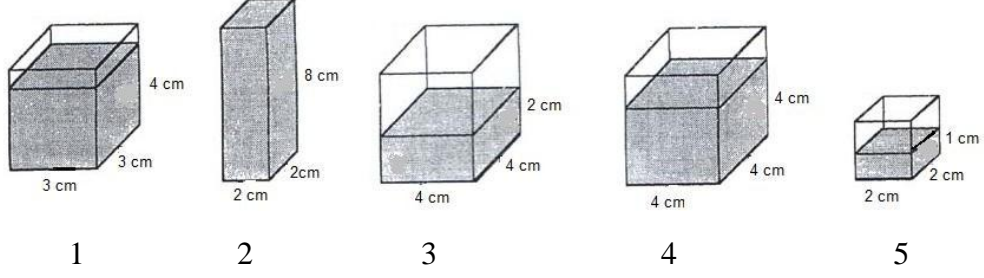
3. Eğer A ve B koşucuları aynı anda başlarsa bitiş çizgisine (C) aynı anda varıyorlar. Bu durumda hangi koşucu daha hızlı koşar?

- a) A B'den daha hızlı koşar.
- b) B A'dan daha hızlı koşar.
- c) A ve B aynı anda koşar.
- d) B A'dan daha yavaş koşar.

4. Aşağıdaki gölge şekillerinden hangisi tam silindir kullanılarak oluşturulmaz?

- a) Daire
- b) Kare
- c) Dikdörtgen
- d) Üçgen

5.



Yukarıdaki şekle göre hangi iki kutudaki suyun hacmi yaklaşık olarak birbirine eşittir?

a)1 ve 2 b)2 ve 3 c)3 ve 5 d)2 ve 5

6.Aşağıdaki tabloda Atatürk İlköğretim Okulundaki bazı öğrenciler hakkında bilgiler yer almaktadır.

1 İsim	2 Cinsiyet	3 Doğum Günü	4 Milliyet	5 Okula Giriş Yılı
Tuğba	Kız	Haziran 1990	Türk	1995
Ramazan	Erkek	Mart 1990	Amerikan	1995
Ali	Erkek	Aralık 1989	Türk	1995
Özlem	Kız	Mayıs 1990	Türk	1995
Gürkay	Erkek	Ekim 1989	Fransız	1995
Murat	Erkek	Ağustos 1989	İngiliz	1995

Aşağıdaki kategorilerden hangisi tablodaki öğrencileri en az iki farklı gruba ayrılabilmesini sağlamaz?

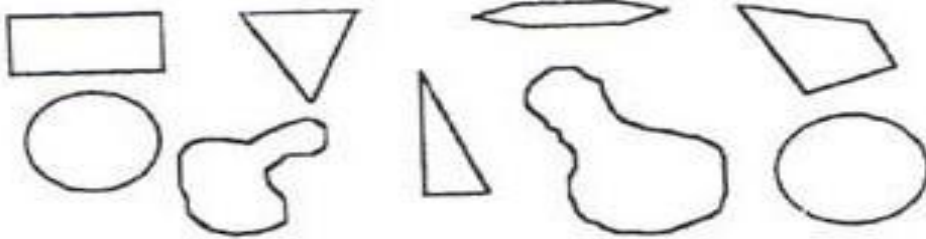
a)Cinsiyet(Kız-Erkek)

b)Doğum Tarihi

c)Milliyet

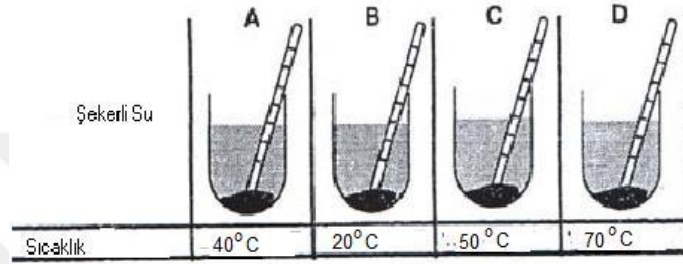
d)Okula giriş yılı

7.Aşağıdaki şekilleri iki grupta sınıflandırmak için en iyi özellik hangisidir?



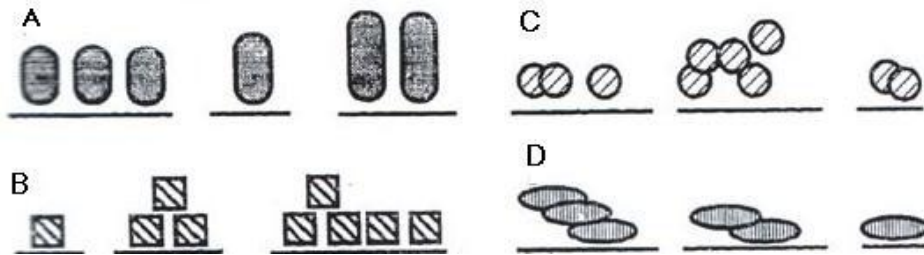
- a)Kare olanlar veya kare olmayanlar
- b)Dört tane düz kenarı olan veya hiç düz kenarı olmayanlar
- c)Eğri köşesi olanlar veya düz köşesi olanlar
- d)Köşe sayısı tek sayı olanlar veya köşe sayısı tek sayı olanlar

8. “Bir kapta bulunan suyun sıcaklığı ne kadar fazlaysa, içinde bulunan şekerin çözünme hızı da o kadar fazla olacaktır.” Bu bilgiye göre her birinde eşit miktarda şeker bulunan aşağıdaki kavanozları, şekerin en yavaştan en hızlı çözünmesine doğru sıralayınız.



- a)A,B,C,D
- b)B,A,C,D
- c)C,B,D,A
- d)D,C,B,A

9.Aşağıdaki şekil gruplarından hangisinde şekiller soldan sağa doğru en küçük sayıdan en büyük sayıya doğru sıralanmaktadır?



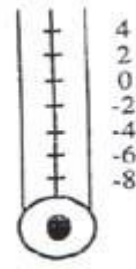
10.Aşağıdaki sayı sıralama etkinliğinde soru işaretli yere hangi sayı gelecektir?

2 3 5 8 12 17 ?

- a)19
- b)23
- c)24
- d)28

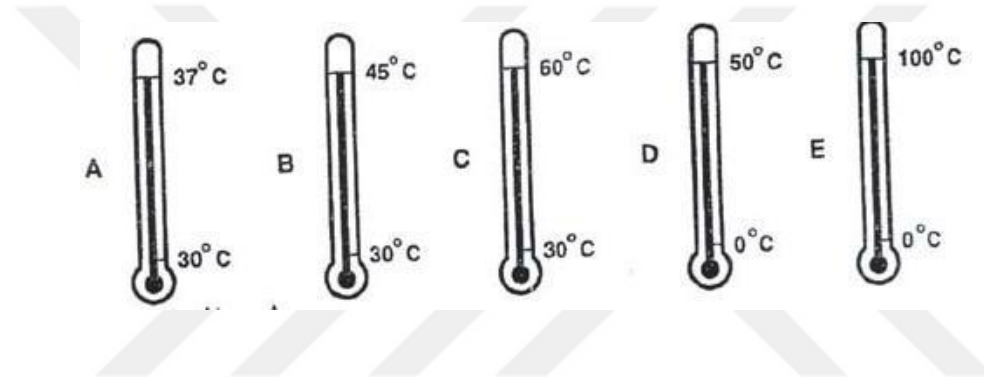
11. Dün hava sıcaklığı -6°C idi, bugün ise 2°C dir. Dün ile karşılaştırıldığında bugün hava sıcaklığı kaç derece daha fazladır?

- a) 10°C b) 8°C
c) 4°C d) 2°C



Ölçüm Yapma

12. Normalde insan vücudunun sıcaklığı 37°C 'dir. Hasta insanların vücutlarının sıcaklığı 36°C ile 42°C arasında değişir. Aşağıdaki termometrelerden hangisi insan vücudunun sıcaklığını ölçmek için en uygundur?



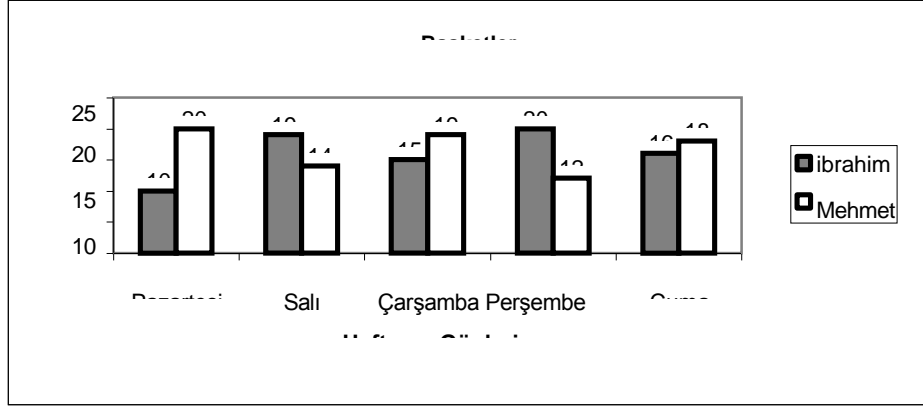
- a) A b) B c) D d) E

13. Bir deneyde dört çocuk, kendilerine verilen bitkileri yetiştirmektedir. Her çocuk dört farklı zamanda bitki boylarının uzama miktarını ölçmüş ve kaydetmişlerdir. Çocukların bitkilerine verdikleri su miktarı dört farklı gözlemden de eşit olduğuna göre; aşağıdaki tabloda hangi öğrencinin ölçümleri daha dikkatli ve güvenilirdir?

	1. Gözlem	2. Gözlem	3. Gözlem	4. Gözlem
Avni'nin bitkisi	3 cm	6 cm	10 cm	8 cm
Gürkay'ın bitkisi	4 cm	5 cm	5 cm	4 cm
Tamer'in bitkisi	2 cm	10 cm	4 cm	8 cm
Fatih'in bitkisi	8 cm	3 cm	2 cm	1 cm

- a) Avni b) Gürkay c) Tamer d) Fatih

14.Aşağıdaki tabloda İbrahim ve Mehmet 'in basket sonuçları gösterilmektedir. Her ikisi de Pazartesi, Salı, Çarşamba, Perşembe ve Cuma günleri 20 defa serbest atış yaptıklarına göre; İbrahim, Mehmet'ten haftanın kaç günü, daha fazla basket atmıştır?



- a)1 b)2 c)3 d)4 e)5

İlişkilendirme

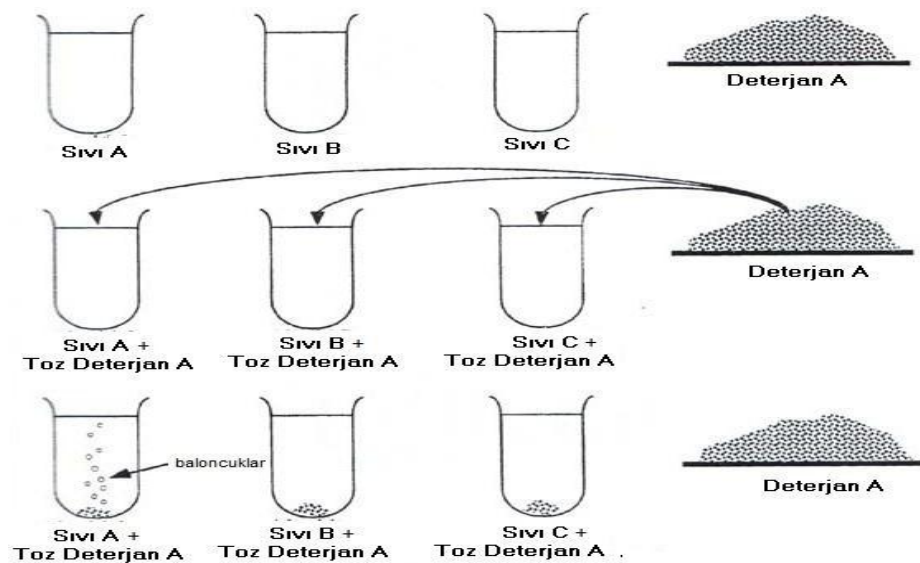
15.Hangi nesnenin altı eşit yüzü, 8 köşesi,12 kenarı ve hacmi vardır?

- a)Küp b)Kare c)Küre d)Altıgen

16.Ayşe, okuldaki sınıflarının şeklini kâğıda çizmek istiyor. Ayşe'nin kullanması gereken uygun ölçek aşağıdakilerden hangisidir?

- a)1 m=1 km b)1 m=1 cm c)1 m=1 mm
d)1 m=1 hm e)1 m=1 m

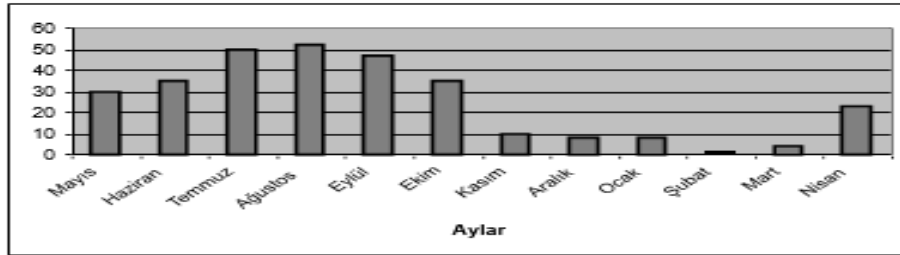
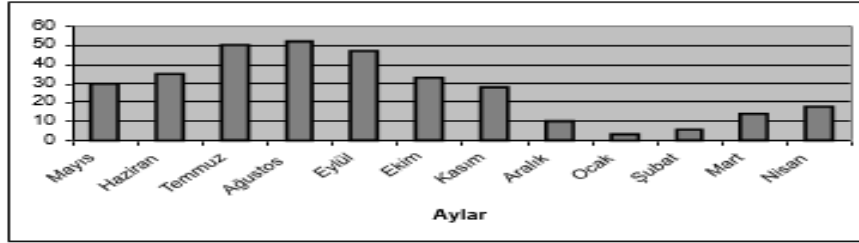
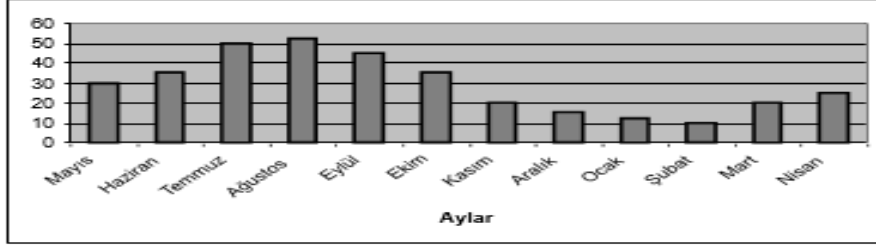
17.Aşağıdaki şekilde bir deneyin üç aşaması gösterilmektedir.



Deneyden elde edilen sonuçlara göre aşağıdaki ifadelerden hangisi en doğrudur?

- a)A ve C sıvıları aynıdır.
b)A ve B sıvıları aynı değildir.
c)A,B ve C sıvılarının hepsi aynıdır.

Tahmin Yürütme



18.Yukarıdaki grafikte son on yılda her ayın ortalama sıcaklıkları verilmiştir. Bu grafiklere göre gelecek yılda hangi ay, yılın en soğuk ayı olabilir?

- a)Haziran b)Eylül c)Kasım d)Ocak e)Şubat

19.Aşağıdaki balonlarda, yoğunluğu havadan az olan, eşit miktarda gaz vardır. Hangi balon daha hızlı uçabilir?



Balonların
Kütleleri kg

A)1000 kg

B)800 kg

C)500 kg

D)200 kg

20. Aşağıdaki resimlerde görülen nesnelere hangisi bir kap suda en hızlı batar?



Boş teneke

B)



Cam Bilye

C)



Tahta Kutu

D)



Sünger Parçası

Değişkenleri Kontrol Etme

21. Ali ile Ahmet iki farklı firmanın ürettiği bisiklet lastiklerinin kaç kilometre gittiğinde eskidiğini bilmek istiyorlar. Ali ve Ahmet bisikletlerinin lastiklerine işaret koyuyorlar. Bu deneyde aşağıdaki değişkenlerden hangisi kontrol edilebilen en önemli değişken olarak ele alınabilir?

- a) Ölçümlerin yapıldığı günün saati
- b) Her iki türdeki lastiğin gittiği kilometre sayısı
- c) Bisikletçilerin fiziksel özellikleri
- d) Hava koşulları
- e) Kullanılan bisikletlerin ağırlıkları

22. Bir grup öğrenci ısıtmanın fasulye tohumlarının çimlenmesine etkisini belirlemek için deney yapıyorlar. Aşağıdaki değişkenlerden hangisi bu deneyde en az önemlidir?

- a) Tohumların ısıtıldığı sıcaklık derecesi
- b) Tohumların ısıtılma süresinin uzunluğu
- c) Kullanılan toprağın türü
- d) Topraktaki nem miktarı
- e) Her tohumun büyümesi için kullanılan saksıların büyüklükleri

23. Murat asit yağmurlarının balık popülasyonu üzerine etkisini öğrenmek istiyor. İki kavanoza aynı miktarda su dolduruyor. Birinci kavanoza 50 damla sirke (asit) damlatıyor, ikinci kavanoza ise hiçbir şey damlatmıyor. Her kavanoza birbirine benzeyen 10 tane balık koyuyor. Her iki kavanozdaki balıklara aynı miktarda yiyecek ve oksijen veriyor. Bir hafta süreyle balıkların davranışlarını gözlemliyor ve gözlemlerinden çeşitli sonuçlara varıyor. Yukarıdaki ifadelerle ilgili herhangi bir değişken eklenmeden deney nasıl geliştirilebilir?

- a)Farklı miktarda sirke (asit) içeren daha çok kavanoz hazırlarım.
b)Her iki kavanoza kullanılan balık sayısından daha çok balık eklerim.
c)Farklı türde balık ve farklı miktarda sirke(asit) olan daha çok kavanoz eklerim.
d)Kullanılan kavanozlara daha çok sirke(asit) eklerim.

Verileri Yorumlama

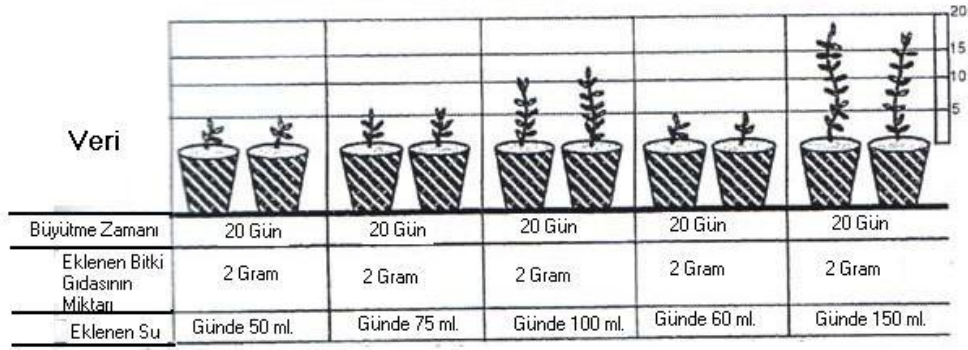
24.Aşağıdaki veriler bir deneyden alınmıştır.

Sıcaklık (Ortalama)	Tohumların Ağırlığı (gr.)	Tüketilen Su (ml./ Gün)	Güneş Işığı Alma Süresi (Dak./Gün)	Bitkinin Boyu (Cm / 20 Gün)
20 °C	2.2	10	20	20.2
50 °C	2.3	10	20	20.3
30 °C	2.3	10	20	20.2
25 °C	2.1	10	20	20.3
25 °C	2.3	10	30	21.9
25 °C	2.2	10	40	22.8
20 °C	2.2	10	30	21.8
20 °C	2.1	20	30	21.9
20 °C	2.2	30	30	22.0

Yukarıdaki verilere göre sizce bitki boyunun büyüme hızına en çok hangi faktör etki etmiştir?

- a)Bitkinin büyüdüğü yerin sıcaklığı
b)Tohumun ağırlığı
c)Bitkinin her gün tükettiği su miktarı
d)Bitkinin güneş ışığı alma süresinin miktarı

25.Aşağıdaki deneyde yer fıstığı bitkisinin 20 gün içinde ne kadar büyüdüğü gösterilmektedir.



Yukarıdaki tabloyu inceleyiniz. Bu deneyden nasıl bir sonuç çıkarabilirsiniz?

- Ne kadar çok bitki gıdası eklenirse, bitki o kadar hızlı büyür.
- Belirli miktarda bitki gıdasına sahip bitkiye ne kadar fazla su eklenirse, bitki o kadar hızlı büyür.
- Belirli miktarda bitki gıdasına sahip bitkiye ne kadar fazla su eklenirse, bitki o kadar yavaş büyür.
- Belirli miktarda suya sahip bitkiye, ne kadar fazla bitki gıdası eklenirse bitki o kadar yavaş büyür.

Hipotez Oluşturma

26.Mert birbiriyle aynı özelliğe sahip iki kâseye şekerli su koyar. Her ikisinin de kapağını açık bırakır. Kâselerden birini karanlık bir yere koyarken diğerini ışık alan bir yere koyar. Mert'in kurduğu düzenekler arasındaki fark aşağıdakilerden hangisidir?

- Işığa maruz kalma
- Kaselerin şekli
- Havaya maruz kalma
- Her birinin içindeki şeker miktarı

27. Aşağıdaki ifadelerden hangisi bir hipotezi en iyi şekilde ortaya koyar?

- a) Bu mıknatıs 12 tane ataç kaldırdı.
- b) Bu şişedeki süt 20 dakikada dondu.
- c) Ev bitkileri çok fazla sulandığından ölmüş.
- d) Bu oranlarla havuz 10 dakikada doldu.

28. Aşağıdaki veri tablosunu incelediğinde çözünme zamanı ve suyun sıcaklığı değişkenlerine en uygun hipotez hangisidir?

Ortalama Çözünme Süresi (Dakika)				
Madde	Suyun Sıcaklığı	Suyun Sıcaklığı	Suyun Sıcaklığı	Suyun Sıcaklığı
	20 °C	40 °C	50 °C	60 °C
20 gr. şeker	80 Dk.	40 Dk.	20 Dk.	5 Dk.
20 gr. Tuz	60 Dk.	30 Dk.	16 Dk.	3 Dk.

- a) Maddelerin çözünme zamanıyla suyun sıcaklığı arasında hiçbir farklılık yoktur.
- b) Suyun sıcaklığı en az olduğunda maddenin erime zamanı en kısa sürede olur.
- c) Suyun sıcaklığı en fazla olduğunda maddenin erime zamanı en az olur.
- d) Tabloda verilen bilgilerle hipotez oluşturmak imkansızdır.

Yaparak Yanıtlama

29. Aşağıdakilerden hangisi yaparak tanımlama olarak değerlendirilir?

- a) Yağ suyla karıştığında, yağın yoğunluğu suyun yoğunluğundan az olduğu için yağ suyun yüzeyinde batmadan kalır.
- b) Süpersonik uçağın hızı ses dalgalarının hızına benzer.
- c) Arabayı saatte ortalama 50 km hızla sürdüğünde durmak istediğin noktaya veya çizgiye 100 metre yaklaştığında fren pedalına basmalısın.
- d) Araba sağa ve sola döndüğünde hızı düşecektir.

Deney Yapma

30. Bir öğrenci kumaşın tuttuğu ısı miktarının kumaşın renginden etkilenip etkilenmediğini denemek ister. Öğrenci bunun için iki tane farklı renkte kumaş aynı miktarda su dolu bardağın üzerine koyar. Bardağın bir tanesini yeşil renkte kumaş ile diğerini ise sarı renkte kumaş ile kaplar. Her iki bardağı da güneş ışınları alan bir yere koyar. Bardaklara sıcaklıklarını gözlemek için termometre yerleştirir. Öğrencinin deneyini gerçekleştirmesi için ne önerirsiniz?

- a) Kumaşlarla kaplanan bardaklara numara ekleyebilir.
- b) Her bardaktaki su miktarını düşürebilir.
- c) Her biri farklı renkte kumaşla kaplanan daha fazla bardak hazırlayabilir.
- d) Bardakları kapladığı kumaş miktarını iki katına çıkarabilir.

31. Derya balıklarının yaşaması için en uygun sıcaklığa karar vermek ister. Buna karar vermek için aşağıdaki işlemlerden hangisini yapmalıdır?

- a) Altı tane akvaryum alarak her akvaryuma altı tane birbirine benzeyen balık koymalıdır. Akvaryumların sıcaklıklarını 25°C'ta sabit tutmalıdır.
- b) Altı tane balığı bir akvaryuma koymalıdır. 10 dakika aralıklarla suyun sıcaklığını 10°C'den 15°C'ye, 20°C'den 25°C'ye, 30°C'ye ve en son olarak 40°C'ye yükseltmelidir. Her sıcaklık değiştiğinde balıkların davranışlarındaki değişiklikleri gözlemlemelidir.
- c) Altı tane akvaryum alarak her akvaryuma altı tane birbirine benzeyen balık koymalıdır. Akvaryumların sıcaklıklarını 25°C sabit tutmalıdır. Her akvaryumdaki balıkların davranışlarını gözlemlemelidir.
- d) Altı tane akvaryuma birbirine benzeyen altı tane balık koymalıdır. Her akvaryumun sıcaklıkları 15°C, 20°C, 25°C, 30°C, 35°C ve 40°C olmalıdır. Her akvaryumdaki balığın davranışlarını gözlemlemelidir.

Bilimsel Süreç Beceri Testi Cevap Anahtarı

1.C	26.A
2.B	27.B
3.B	28.C
4.D	29.C
5.B	30.C
6.D	31.D
7.C	
8.B	
9.B	
10.B	
11.B	
12.B	
13.B	
14.B	
15.A	
16.B	
17.B	
18.E	
19.B	
20.B	
21.B	
22.E	
23.B	
24.D	
25.B	

C.3 Science Attitude Scale

	Her Zaman	Çoğu Zaman	Ara Sıra	Nadiren	Hiçbir Zaman
1. Fen Bilimleri dersleri eğlencelidir					
2. Fen Bilimleri dersleri merakımı artırır					
3. Fen Bilimleri dersinde öğrendiğim şeyler günlük yaşamım için faydalıdır.					
4. Fen Bilimleri dersi sahip olduğum bilgilerimi test etmeme yardımcı olur					
5. Fen Bilimleri dersi öğretmenim sorduğum soruların cevabını bilmediğinde bunu açıkça söyler					
6. Fen Bilimleri dersi okul dışında da kullanabileceğim yetenekler geliştirmemi sağlar					
7. Fen Bilimleri dersinde bilim adamları tarafından geliştirilmiş bilgilerle uğraşılır					
8. Fen Bilimleri dersi heyecan vericidir					
9. Fen Bilimleri dersi sorularımın çözümü için fırsat oluşturur.					
10. Fen Bilimleri dersi öğretmenim beni soru sormaya teşvik eder					
11. Fen bilimlerini herkes anlayabilir ve yapabilir					
12. Bilim adamı olmak eğlenceli olabilir					
13. Bilim adamı olmak kişinin kendisini önemli hissetmesini sağlayabilir					
14. Fen Bilimleri dersleri sıkıcıdır					
15. Bilim adamları kendini yalnız hissedebilir					
16. Bilim adamı olmak kişiyi zengin edebilir					
17. Bilim adamları ilgilerini çeken eğlenceli bazı şeylerden vazgeçmek zorunda kalabilir					
18. Bilim adamları anlaşılması zor buluşlar yaparlar					

C.4 Technology Attitude Scale

		Kesinlikle Katılıyorum	Katılmıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
1	Derslerde kullanılan teknoloji benim bilimsel becerilerimi artırır.					
2	Derslerde teknoloji kullanılması, konuları daha iyi öğrenmeme yardımcı olur.					
3	Derslerde teknolojinin kullanılmasından hoşlanırım.					
4	Derslerde teknolojiyi verimli bir şekilde kullanabilirim.					
5	Derslerde teknolojinin kullanılması ders başarıımı artırır.					
6	Derslerde teknolojinin kullanılması, dikkatimin dağılmasına sebep olur.					
7	Derslerin teknoloji ile daha sık işlenmesini isterim.					
8	Derslerde teknoloji kullanırken kendimi yetersiz hissederim.					
9	Derslerde teknoloji kullanmak, öğrenmemi zorlaştırır.					
10	Derslerde teknoloji kullanılmasının başarıma olumlu bir katkısı yoktur.					
11	Derslerde teknoloji kullanılması beni endişelendirir.					
12	Derslerde teknoloji kullanımında kendime güvenirim.					
13	Derslerde teknoloji kullanılırken kendimi çaresiz hissederim.					
14	Derslerde teknolojiyi başarılı bir şekilde kullanamam.					
15	Teknoloji ile güncel hayattan örnekler verilmesi derse yönelik ilgimi artırır.					

CURRICULUM VITAE

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Undergraduate	Science Education	Boğaziçi University	2014
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WORK EXPERIENCE

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