

## Effectiveness of Teaching Light and Sound with Knowledge Map

Ahmet Bacanak, Salih Değirmenci and Orhan Karamustafaoğlu \*

Education Faculty, Amasya University, Amasya, Turkey

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### Abstract

The purpose of this study is to investigate the effect of knowledge mapping technique upon meaningful learning through the process of teaching light and sound to primary school 6<sup>th</sup> grade students. In this study, pre-test and post-test controlled group experimental design model was applied. Data has been collected by applying “Light and Sound” success test to primary school 6<sup>th</sup> grade students. From the obtained data, significant difference has been noted between experimental and control groups in favor of the experimental group. This finding showed us that using knowledge mapping technique in the subject of “Light and Sound” was effective in increasing the level of success. At the end of the study some necessary suggestions were made to whom it may concern.

**Keywords:** Science Education, Knowledge Map, Light and Sound

### Introduction

Today, the fact that education should be learner-centered is stated on all occasions. In this context, individuals are supposed to reach the information, interpret, and use it after reconstructing the available information and produce new information. To have such qualifications, individuals are to establish awareness of how they have learned. In real sense, learning begins with learning how to learn. For the realization of learning knowledge must be linked to needs and objectives (Gagne, 1998). By this way the individual will be aware on how to use the obtained information, ask and will realize active learning process by exploring the way how he/she learns and improving its capabilities such as the correlating specific information (Karamustafaoğlu, 2009). Understanding how and in what way they learn, reaching to the information, interpreting and using the reached information, and settings new information is possible with learning how to learn or giving meaning to the information presented to them within the framework of learning strategies. Learning strategies are techniques which facilitate self learning with the help of cognitive exercises related with the acquisition and use of knowledge (Weinstein & Mayer, 1986).

When examined the related topic generally learning strategies are classified as; recursion, meaning, organizing, monitoring the learning process, auditory or comprehension (Ozer, 2002; Weinstein, 1988) or attention, increasing storage in short-term memory, increasing encoding, facilitating remembrance and monitoring strategies (Thai, 2007; Gagne, 1998). When steps of this strategy analyzed, knowledge map creation technique which is the scope of strategies increased organizing or encoding, is remarkable as a simplification and

reduce to concrete technique to the complex learning by visually. Knowledge mapping technique is the way of presenting information using the drawings, charts and graphs as well as verbal expression (Karamustafaoğlu, 2003). In other words, knowledge map is a way of showing important verbal information in a text and the relationships between this information as schematic (O'Donnell, 1994). Knowledge map is a two-dimensional visual learning material that gets learning individuals' attention as to form and content. In addition, knowledge maps, also, have a wider flexibility to explain hierarchical relations, in order processes and the other complex relationships (McCagg & Dansereau, 1991). The most important feature of knowledge mapping is to present information as organize and a whole.

As we know, science and technology course, as it contains abstract concepts, is one of the most difficult courses in the students' comprehension. If a learning activity intends for the subjects of science appeal to the student's more sense organ, learning takes place better and forgetting relevant abstract concepts is extremely difficult. As stated by Piaget many of the primary school students are in concrete operational period or passing phase to abstract operational period. Therefore, teaching materials used in science teaching-learning process simplify the abstract subject or concepts, and contribute to permanent learning (Karamustafaoğlu, Yaman & Karamustafaoğlu, 2005). In this context, knowledge maps are among the important teaching materials in science education (Bacanak et al., 2011; Karamustafaoğlu et al., 2010; Heinze-Fry & Novak, 1990; Novak, Gowin & Johansen 1983).

In this study, it is aimed to investigate the effect of knowledge mapping technique to the meaningful learning compared to traditional teaching for the Light and Sound unit at primary school 6<sup>th</sup> grade in science and technology education. For the purpose, answers are sought for the following questions.

- Is there a significant difference between in informal information of the experimental group students', teaching done by knowledge a map, and control group students', teaching in traditional education, according to the pre-test scores about Light and Sound?
- Is there a significant difference between post-test scores, about Light and Sound, of the experimental group students', teaching done by knowledge a map, and control group students', teaching in traditional education?

## **Method**

In this study, the pre-test and post-test control group experimental design model was applied. According to this model, an experimental group and a control group were created by randomly assigning method, and then measurements were made before and after the study by applying the same tests to the both groups.

### *Sample Group*

A total of 30 sixth grade students studying in two different classrooms of an elementary school in the center of Amasya in the spring semester of 2010-11 school year was formed the study group of the research. The experimental group consisted a total of 15 students (9 girls, 6 boys) and control group a total of 15 students (8 girls, 7 boys).

### *Development and Implementation of Data Collection Tool*

The data was collected by applying Light and Sound Achievement Test (LSAT) to the primary school 6<sup>th</sup> grade students improved about the issue given in Appendix-2. LSAT has been created 15 multiple-choice questions with four choices without students' personal information. The suitability of the test questions and LSAT content validity were provided in

line of expert opinion and recommendations of two faculty members and two teachers. Reliability study of LSAT was carried out with twenty primary school 7<sup>th</sup> grade students and KR-21 reliability coefficient was calculated 0.71. The obtained reliability coefficient is considered as a valid reliability for science achievement tests in educational science and field education. During the implementation phase of the study, LSAT was given as a pre-test to the control and experimental groups. Before the application, brief and general information about learning strategies and in particular to schematized information (knowledge map creation) strategy and was given for students in the experimental group.

Then, the Light and Sound unit was described to the experimental group with developed knowledge map with in-class applications. Here in-class applications can be expressed in the form of the unit's name, time, targets and behaviors, tools and materials, concepts and symbols of the unit, teaching methods and techniques, entrance to the course and drawing attention, activities, course overview, assessment questions and home study. The knowledge map related with unit developed by the researchers and used during the course of experimental group was given in Appendix 1. A traditional teacher-centered instruction such as question-answer and expression were processed in the control group lessons.

### Data Analysis

Due to the number of students in experimental and control groups is few, the Levene's test was used to determine whether all of the obtained data from groups are parametric. The level of significance for all data was found as  $p > 0.05$  and it was determined that the data showed parametric features by examining the scatter chart points. Therefore, a parametric statistical method, the independent samples t-test was used. Independent samples t-test was used to test whether there was a significant difference between the average scores of pre-test and post-test scores of unrelated two-groups (Çepni, 2010; Yin, 2009). So in the study, t-test was used to test effectiveness of experimental procedure in a pre-test and post-test control group designs. SPSS 15 program was used for the analysis of the data.

### Findings and Discussion

The findings and interpretations are given, respectively, according to the research questions.

*Is there a significant difference between in informal information of the experimental group students', teaching done by knowledge a map, and control group students', teaching in traditional education, according to the pre-test scores about Light and Sound?*

The independent samples t-test was used to determine whether is there a meaningful difference between pre-test scores of experimental group teaching with the help of the knowledge mapping technique and control group teaching with the help of the traditional methods for teaching the Light and Sound unit at primary school 6<sup>th</sup> grade in science and technology education. The t-test results are given in Table 1.

**Table 1.** t-test results according to pre-test scores

Variables	N	$X_{\text{mean}}$	ss	SD	t	p
Control Group	15	61.83	17.35	28	-0.384	0.705
Experimental Group	15	64.17	11.96			

According to the data in Table 1, there is not any significant difference between experimental and control groups' prior knowledge about the "Light and Sound" ( $t_{43} = -.384$ ,  $p > .05$ ). As a result of the t-test, there is no significant relationship between the two groups' scores at the .05 level, therefore, it is concluded that random assignment can be done between the groups. The mean of pre-test scores of selected control group ( $X_{\text{mean}} = 61.83$ ) and the mean of pre-test scores of selected experimental group ( $X_{\text{mean}} = 64.17$ ) is close to one another. This finding showed that the experimental and control groups pre-information about "Light and Sound" is equivalent to each other.

*Is there a significant difference between post-test scores, about Light and Sound, of the experimental group students', teaching done by knowledge a map, and control group students', teaching in traditional education?*

The independent samples t-test was used to determine whether there is a meaningful difference between post-test scores of experimental group teaching with the help of the knowledge mapping technique and control group teaching with the help of the traditional methods for teaching the Light and Sound unit at primary school 6<sup>th</sup> grade in science and technology education. The t-test results are given in Table 2.

**Table 2.** t-test results according to the post-test scores

Variables	N	$X_{\text{mean}}$	ss	SD	t	p
Control Group	15	65.58	11.13	28	-5.098	0.000
Experimental Group	15	89.25	11.61			

When we analyze the data in Table 2, there is a significant difference in the favor of the experimental group ( $t_{43} = -5.098$ ,  $p < .05$ ) between the experimental and control groups' post-information about "Light and Sound" unit after the applications. The mean of post-test scores of experimental group ( $X_{\text{mean}} = 89.25$ ), teaching with using knowledge map is higher than the mean of post-test scores of control group ( $X_{\text{mean}} = 65.58$ ) teaching with traditional methods. This finding showed that using knowledge mapping technique to the teach the Light and Sound unit is quite effective in enhancing students' level of success.

## Results and Recommendations

Traditionally, learning a wide variety of information at schools is expected from students. However, the knowledge of teaching how to learn this information is often neglected (Senemoğlu, 2007). Whereas, a good education covers to guide the students how to learn, how to remind and how to effectively check and route their learning. In other words, an effective teaching guide to students learns the learning strategies. As one of the two-dimensional visual tools, using knowledge maps provide permanent learning by helping the establishment of links between requested information relating to the issue. In this context, the study conclusions are as follows, respectively.

- The experimental group students taught by knowledge map are more successful than the control group students taught by traditional methods. This result showed that using knowledge map to teach the Light and Sound unit increased the students' achievement at a desirable level.

- Traditional education has been an increase in the average achievement of the control group. However, it is not up to the success teaching with knowledge maps.

- The use of two-dimensional visual aids to the students to have ability of making operations such as information storage and speed up to remind.
- Knowledge map is an effective teaching material used in the Light and Sound unit in science and technology education.
- Teaching a subject takes a shorter time with knowledge mapping technique.

Based on these results the recommendations to teachers, scholars and teacher candidates are as follows:

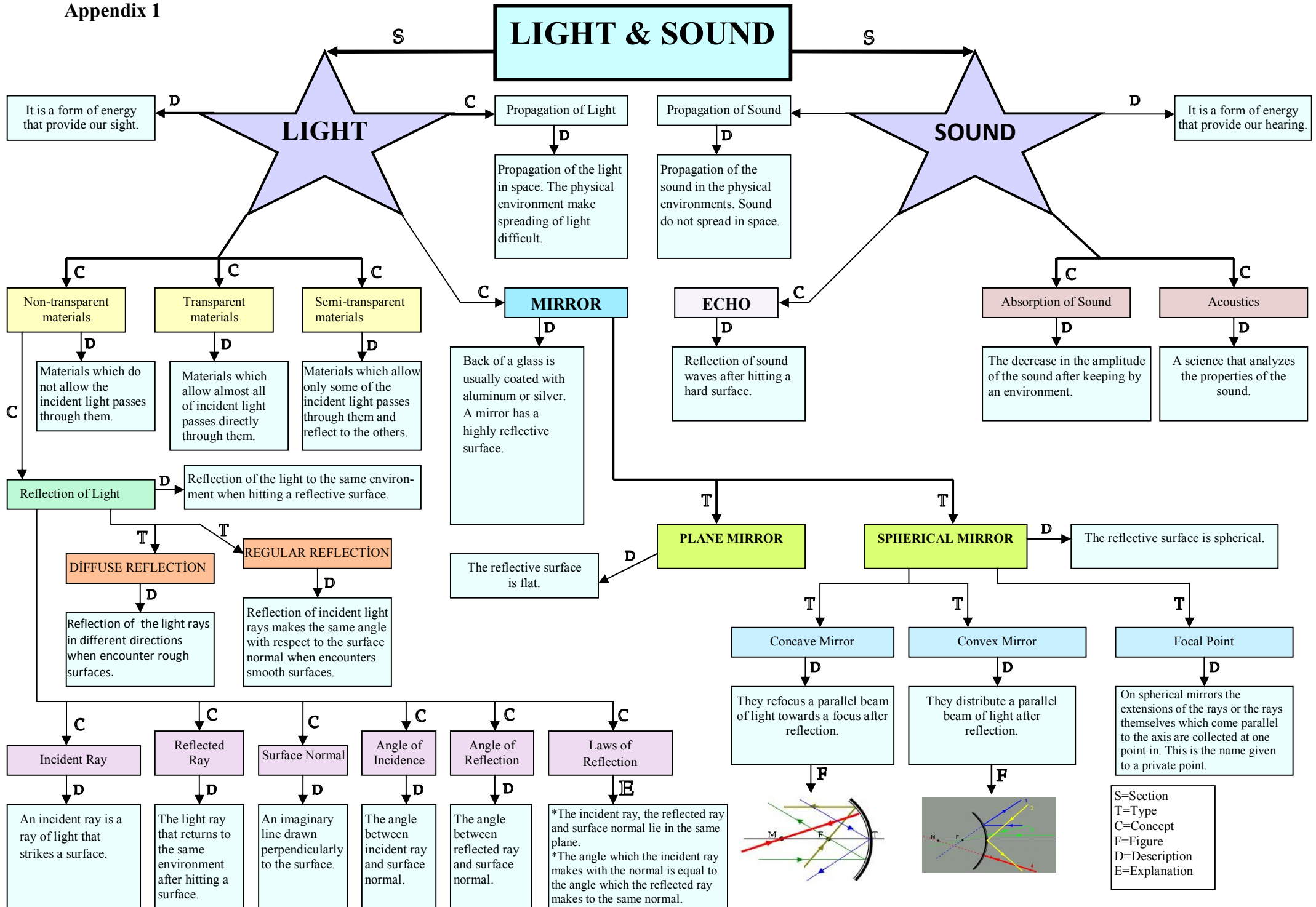
- Teaching the learning, teachers should take the role of a guide and they should present information to students by using the knowledge map and similar teaching techniques.
- Self-knowledge of the subject at the end of each unit in textbooks should be prepared by knowledge map.
- In-service courses about use of mapping techniques should be organized for existing science and technology teachers.
- Knowledge map preparation and design ability should be given effectively to the teacher candidates at the faculty.
- According to the Cognitive Development Theory to elementary school students are gaining a lot of information through the sense organs (Karamustafaoğlu & Yaman, 2011). Therefore, academic environment should be arranged to address many sense of the student's and encouraged to use the knowledge mapping technique which embodies the abstract concepts and a visual representation way of the relations between the ideas.

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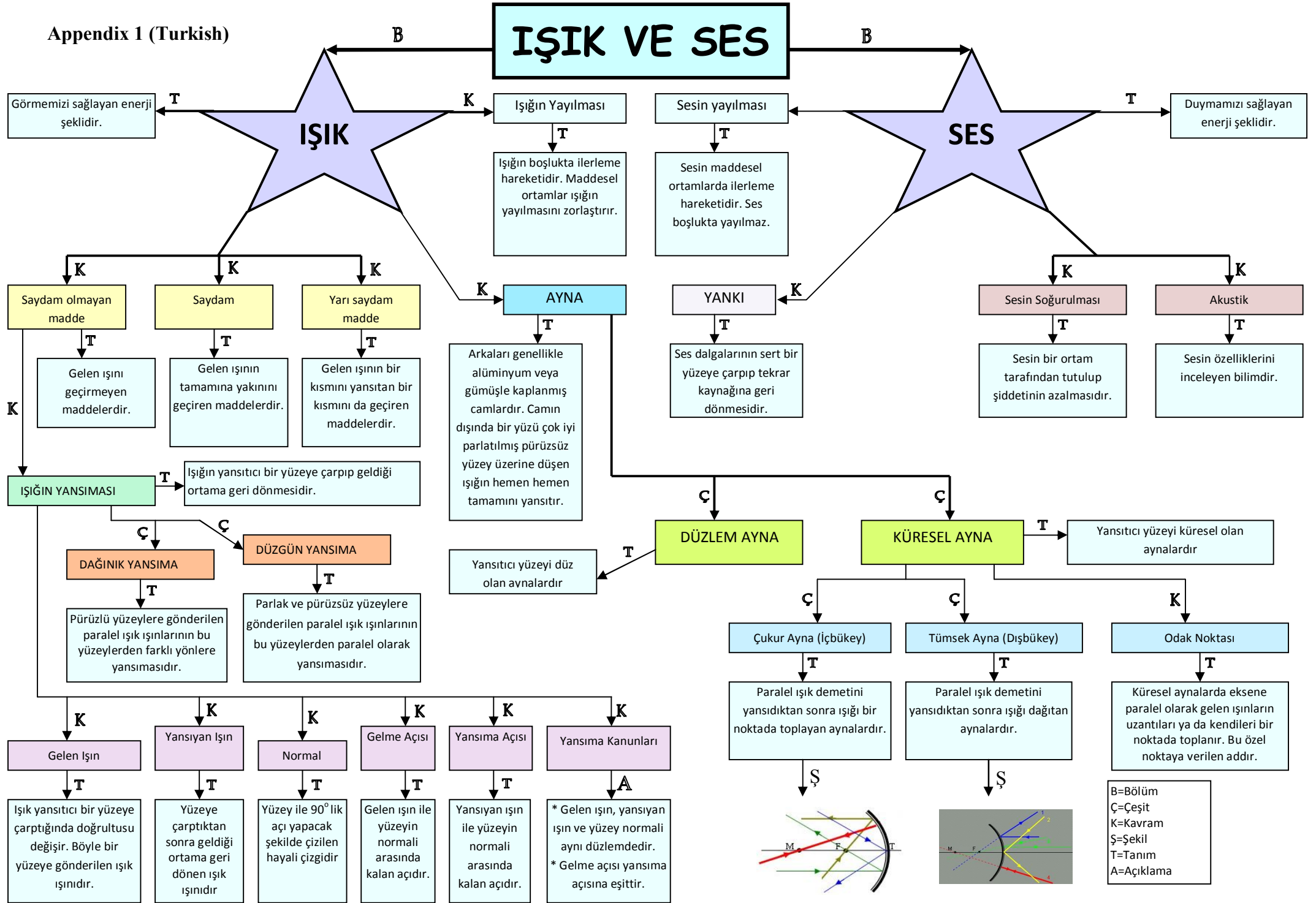
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# Appendix 1



Appendix 1 (Turkish)

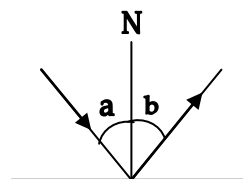




## Appendix 2

### LIGHT AND SOUND ACHIEVEMENT TEST

- 1 - Which of the following mirror distributes the light?  
A) Concave Mirror B) Convex Mirror C) Plane Mirror D) Silver Mirror
- 2 - Which of the following mirrors provides symmetrical image?  
A) Concave Mirror B) Convex Mirror C) Plane Mirror D) Spherical Mirror
- 3 - What name is given to the collection point where rays themselves or their extensions that incident parallel to axis at spherical mirrors?  
A) Normal B) Incident ray C) Focal Point D) Center
- 4 - "If the reflecting surface is rough, incident rays of the light reflected different directions." According to this information, which rays of the light sending to the following object are reflected diffuse?  
A) Full-Length Mirror B) Aluminum Foil C) CD (Compact Disc) D) Abrasive paper
- 5 - Which of the following object is less transparent than others?  
A) Glass B) Glasses C) Air D) Frosted Glass
- 6 - Which of the following environments is spread the light more difficult?  
A) Atmospheric B) Foggy Weather C) Water D) Rainy weather
- 7 - Which data given below is wrong about light?  
A) Light is a form of energy.  
B) Seeing is being by reflecting of the light.  
C) Light is spread easy at the material environment.  
D) Reflection occurs when light encounters with matter.
- 8 - At the figure, the reflected ray on a smooth surface is shown. Accordingly, which of the following information is absolutely wrong?  
A) Incident ray, the reflected ray and normal are at the same plane.  
B) The sum of the angles a and b  $90^\circ$ .  
C) Incident ray exit form a strong source.  
D) a and b angles are not equal to each other.
- 9 - Which of the following is true about the reflection?  
A) Reflection occurs only smooth surfaces.  
B) The non-transparent materials not reflect the light.  
C) Substances except mirrors not reflect the light.  
D) Incident angle is always equal to the reflected angle.
- 10-Which of the following is incorrect about regular and diffuse reflection?  
A) Regular reflection is being smooth and shiny surfaces.  
B) Diffuse reflection is being rough and matte surfaces.  
C) Incident rays are diffusing; reflected rays are parallel at diffuse reflection.  
D) Incident rays are parallel to each other and reflected rays are parallel to each other at regular reflection.



11- Which of the following expression or expressions is correct about spherical mirrors?

I- The image is flat and large at Concave mirror.

II- The image is flat and small at Convex mirror.

III- At Concave mirror, image will grow while the body closer to the center from outside the center.

IV- At flat mirror, image is shrinks while the body away.

A) Only I    B) II, IV    C) I, II, III    D) III, IV

12 - What is the most important reason to use of convex mirror in crowded places such as subway and train station?

A) Provide clear images

B) Diffuse incident light better.

C) Large areas reveal its smaller

D) Prevent light pollution

13 - Which of the following can be said for an object which reflects the light regularly sent to its surface?

I-Bright    II-Smooth    III-Transparent    IV-Curve

A) I and II    B) II and III    C) III and IV    D) I, II and III

14 - Which of the following is given as an example of convex mirror?

A) Full-Length mirror B) Microscope C) Telescope D) Security Mirrors

15- Which mirror can burn a newspaper by collecting the light rays of the sun together?

A) Flat mirror    B) Concave mirror    C) Convex mirrors    D) None

16 - Which of the following is incorrect about the sound?

a) Sound is a form of energy.

b) Sound is spread in space

c) Sound spreads more quickly in solids than in gases

d) The acoustic is sound science

17 – I. Sound is a kind of energy.

II. Sound is a result of vibration.

III. Sound and light are not released in material environments.

Which of the above statement or statements is true?

a) I and II    b) I and III    c) II and III    d) All

18 - In which surfaces the sound is absorbed more?

a) Hard and rough surfaces

b) Hard and smooth surfaces

c) Soft and rough surfaces

d) Soft and smooth surfaces

19 - Which of the following device is a submarine, sailing and in doubt from coordinates, benefit in order to determine its location?

a) Ultrasound b) Telescope c) Periscope d) Sonar

20 - In order to distinguish the sound from any source and with an echo of this sound, at least how many meters must be between the source and obstacle in air for human ear?

a) 340

b) 34

c) 17

d) 170