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SIMPLE PERISCOPE TO OBSERVE LIGHT REFLECTING OFF A FLAT MIRROR

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Abstract. *This simple periscope is made as a tool to help students understand the concept of reflection from two flat mirrors, observe the process of forming an image of an object, and observe the process of reflecting light using a laser as a light source on simple periscope props. The first observation by using the periscope directly, the observation results obtained are that it produces right-left images of objects that are not reversed, the images also look upright and virtual. In addition, the size of the image is also the same as the original object. Based on the second observation, specifically observing the process of reflecting light with a laser, where in this second observation there were two reflections of light. The laser light fired at the first flat mirror is reflected straight to the second mirror, then reflected back straight from the second mirror to the outside at the same angle of 45°.*
Keywords*: Reflection, Two flat mirrors, Periscope, Laser*

Abstrak. Periskop sederhana ini dibuat sebagai alat bantu untuk membantu siswa dalam memahami konsep pemantulan dari dua buah cermin datar, mengamati proses terbentuknya bayangan suatu benda, dan mengamati proses pemantulan cahaya dengan menggunakan laser sebagai sumber cahaya pada alat peraga periskop sederhana. Pengamatan pertama dengan menggunakan periskop secara langsung, hasil pengamatan yang diperoleh adalah menghasilkan gambar kanan-kiri benda yang tidak terbalik, gambar juga terlihat tegak dan maya. Selain itu, ukuran gambar juga sama dengan objek aslinya. Berdasarkan pengamatan kedua, khusus mengamati proses pemantulan cahaya

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dengan laser, dimana pada pengamatan kedua ini terjadi dua kali pemantulan cahaya. Cahaya laser yang ditembakkan pada cermin datar pertama dipantulkan lurus ke cermin kedua, kemudian dipantulkan kembali lurus dari cermin kedua ke luar dengan sudut yang sama yaitu 45°.
Kata kunci: Refleksi, Dua cermin datar, Periskop, Laser.

INTRODUCTION

Some physics concepts are difficult to understand just by describing the material. However, when we take lessons at school, the books we often use as learning resources are usually dominated by formulas and long writings. As a result, students are too lazy to read textbooks that make physics learning difficult to understand. Therefore, media is needed that can help physics learning become more interesting and fun for students.

According to (Pranata, 2016) material in learning is everything that is designed to accommodate learning media so that students can better understand what is informed by educators. Teaching aids are also defined as tools that are made or formed to facilitate and accelerate the learning process, making it more effective and efficient.

Creativity can be understood as a person's ability to create a new product and involves the ability to create new combinations or see new relationships between elements, data, or things that already exist (Yudrik, 2011:35). In the creative process, a person must have high self-confidence, be able to plan and realize new ideas, thoughts or to realize ideas, thoughts or something new to achieve the desired goal. Creativity is one of the potentials of the child that needs to be developed early. Every child has creative talents, and in terms of education. In other words, there must be educational efforts to develop children's creative abilities, including in the learning process of science subjects, especially the material of the properties of light. (Herawati, 2022)

Teaching aids are learning media that help the successful delivery of material and knowledge from educators to students. For example, by using a simple periscope tool that can be used to support and accelerate learning.

At the time, ships did not have the necessary tools to see the riverbank. Doughty then looked for a new way to see the shore by taking a pipe and inserting glass in it. Ultimately, this equipment was able to aid the Osage crew's observation, allowing them to stop an opponent's attack.

The first collapsible periscope design was made by Simon Lake in the late 1800s. Referred to as the Omniscope or Scalomniscope, this design improved upon the first periscope's pipe design. Additionally, it was developed to allow the pipe to be elevated and rotated manually.

Although the periscope design of the time had changed, there were still some drawbacks. Pressure builds up when a ship travels at a low average speed and then picks up speed. This pressure bent the pipe and obscured the periscope. Eventually, the periscope design was modified by adding double pipes. The pipe inside the ship serves as the lens and the pipe outside to withstand the pressure.

Light reflection is one of the physics subjects that requires a thorough understanding of the concept. In this subject, many students who misunderstand the concept. According to Dimyati (1994), in the teaching and learning process, there are 4 important factors that affect students' academic success, including media and learning resources. These four components are important in the learning process, so if one or more of them is weakened, it can hinder the achievement of ideal learning goals. Hamalik (1986) states that the use of media or educational resources in the learning process can create new desires and interests, and can encourage students to learn. The use of media or educational tools in the learning process can generate new desires and interests, and can encourage and stimulate students to learn, and can even have a psychological effect on students. (Sambudi, 2009)

Reflection often occurs on objects that are not transparent and have a flat surface. A mirror is an object whose surface is very smooth and flat so that almost all the light that falls on it can be reflected. The properties of light are can be seen with the naked eye, has a direction of propagation perpendicular to the direction of vibration (horizontal), propagate according to a straight line, has energy, emitted in the form of radiation, can be refracted, interfered, diffracted (bent) and polarized (partially absorbed in the direction of vibration). (Suwarna, 2010)

This simple tool is made as a learning medium to help students understand the concept of reflection from two flat mirrors, and observe objects in a straight line with objects above using a simple periscope.

THEORETICAL STUDY

Light reflection from objects that do not transmit light can be divided into two types: Specular reflection is the reflection that occurs from objects with flat surfaces. Light rays are reflected parallel to the direction of the incident rays onto a flat mirror, these rays can be blinding to the eyes because the reflected light is focused towards an object (e.g. our eyes). The second reflection of light is diffuse reflection which occurs on objects with uneven or irregular surfaces. Diffuse reflection is easier to see because the light rays heading towards a flat mirror are reflected by the surface in various directions so that they do not focus on one object. (Giancoli, 2004)

Light Amplification by simulated Emission of Radiation or better known as a laser. A laser is light that is amplified by excitation radiation produced by a light source. The light produced is reflected many times, so that in certain situations it is emitted in the form of a focused beam on the object. (Wan, 2019)

When light hits the boundary between two media, it is partially or completely reflected. When part of the light is reflected, the other part is either refracted or absorbed by the mirror. The example below shows how light is reflected from a reflected light field. (Viridi & Novitrian, 2014)

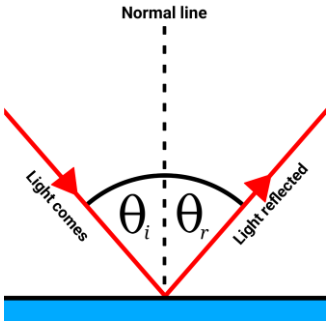

Figure 1. Reflection on a reflecting plane

Image source: Self-made

The law of reflection occurs when the angle of incidence is equal to the angle of reflection and the incident ray, reflected ray and normal line fall on the same plane of reflection. The shadow formed by the mirror due to the reflection of light so as to produce a symptom and has fulfilled the law of reflection. The formation of object A's shadow behind a flat mirror is caused by the incident light through object A which then emits light to a flat mirror, then there is the formation of object A's shadow behind a flat

mirror called maya. The shadow formation process can be described as follows. (Setiawan & Handoko, 2015)

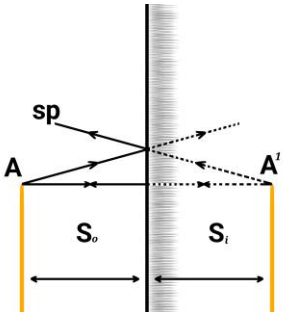

Figure 2. Shadow formation on a flat mirror

Image source: Self-made

A periscope is a common instrument found on submarines as an aid to viewing conditions at sea level. Periscopes utilize the reflective properties of light. (zikri noer, 2021)

METHOD

This simple tool is designed to help students understand the concept of reflection from a flat mirror and observe objects in a straight line with the object above using a simple periscope. The tools and materials used in making simple periscope props are cardboard, two flat mirrors, protractors, pencils, lasers, glue, gadgets, and cutters.

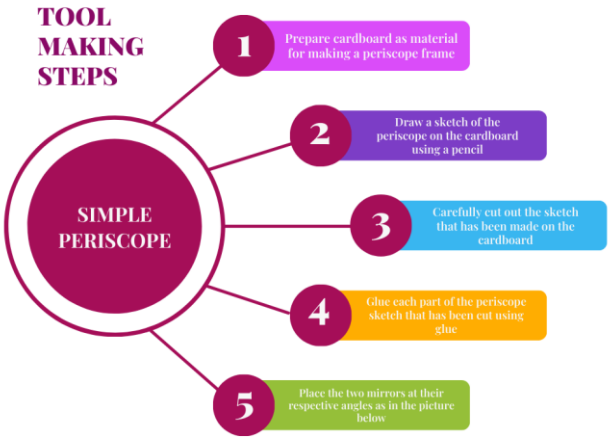

Figure 3. Steps to make periscope

Image Source: Self-made

The first step in making a simple periscope tool is to make a periscope frame with a cardboard base material, then sketch the frame on the cardboard using a pencil, then cut out the sketch that has been made, and glue each part of the skeleton that has been cut using glue, after which the two mirrors are placed with their respective slopes as shown below.

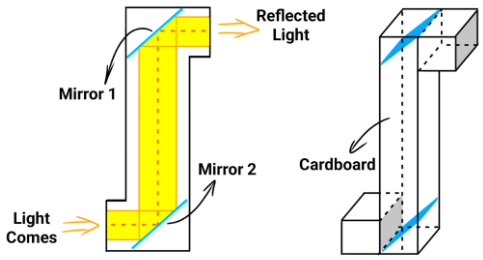

Figure 4. Schematic diagram

Image source: Self-made

There are two observations on simple periscope props that will be made, specifically, observing the process of shading an object and observing the process of reflecting light using a laser as a light source in a simple periscope prop.

Figure 5. Picture of the inside of the Periscope

Photo Source: Documentation during the experiment

Figure 6. Picture of the outside of the Periscope

Photo Source: Documentation during the experiment

How to use a periscope to observe an object that is above it being parallel, specifically, the observer can observe the process from the first flat mirror located at the bottom as shown in the picture above. Then take a picture using the device, then enter the image results into the observation table.

How to use a periscope to observe the reflection of light on a flat mirror is by opening the side cover of the periscope. Then shoot a laser at one of the observing parts of the periscope, and observe the reflection of the laser light that occurs on both flat mirrors. Then take a picture using the device, then enter the results of the image into the observation table.

RESULT AND DISCUSSION

Result

The results of observations of experiments on periscopes directly and using lasers are as follows :

Table 1. The results of observations of experiments on periscopes directly and using lasers

NO	Observations	Figures
1.	Observation process using periscope	

Figure 7. Observation with periscope

Photo source: Documentation during the experiment

2. Reflection process using laser

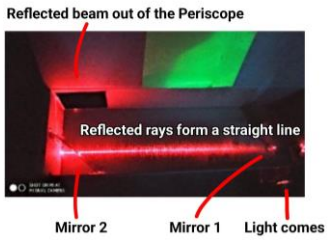

Figure 8. Laser observation

Photo source: Documentation during the experiment

Discussion

Based on the first observation, by placing two pink and purple bookmarks on the bottle cap. With the position of the purple bookmark on the left, while the position of the pink bookmark is on the right. The bottle we observed was placed on the table, then we observed the object using the periscope directly. So that the object that we see by using the periscope directly produces the right - left shadow of the object is not reversed, the shadow also looks upright and virtual. Also, the size of the shadow is the same size as the original object.

Based on the second observation, which is observing the process of reflecting light using a laser, where in this second observation there are two reflections of light. Laser light that shoots towards the first flat mirror will be reflected straight towards the second mirror, then reflected straight back from the second mirror outward, with the same angle of 45°.

According to (Destya, 2013). When people look at objects through a periscope the object seen remains upright, not upside down right side left. The size of objects and shadows are the same, as for the characteristics of the shadows produced by simple periscopes are virtual shadows, not reversed, the same size. Because in a simple periscope with a flat mirror. Then the distance of the object and the distance of the shadow are always the same. Regarding the process from the object to mirror 1, according to the Law of Reflection the light is reflected to mirror 2 and reflected back to the eye.

Analyze from these two observations that the process of light reflection in the periscope uses the principle of two flat mirrors. At an angle of 45° the laser will be reflected straight from the first mirror to the second mirror. As for the shadow results obtained if observed directly using a periscope, the right - left results of the object are not reversed, the shadow also looks upright and virtual. Also, the size of the shadow is the same size as the original object.

CONCLUSION

We can conclude that the periscope applies the concept of light reflection on 2 flat mirrors with a laser as a light source. In accordance with the periscope principle that the light reflected from the object is received by the top mirror then enters forming a straight line to the first periscope mirror, the shadow of the object received by the first mirror is upside down. Then the shadow of the object whose right and left are reversed from the first mirror is received by the second mirror. Then the right and left shadows of the object exchange again in the second mirror. Thus, the image received by the eye is like the original form or not reversed. This proves that mirrors have the property of reflecting light, with the angle of incidence and the angle of reflection being equal, both in the first and second mirrors and the results of this observation are in accordance with the theory of previous research results.

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