

## DEVELOPMENT OF A SIMPLE MICRSCOPE FROM USED GOODS AS A SCIENCE LEARNING MEDIA

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### ABSTRACT

Learning media is very important to facilitate the student learning process. Many schools are still unable to buy light microscopes as a support for learning media, therefore we made a simple microscope from used goods which is expected to be able to develop a microscope from used goods that is used as an alternative mechanism for learning science in schools. This is because there are obstacles in schools that do not have light microscopes due to the high price. Using a simple microscope from used goods can make it easier for educators and students in the teaching and learning process. Furthermore, this research also has a stage in the manufacturing process or called the method. The method used is called the 4D development method, where this method has the stages of Define, Design, Develop, and Disseminate. According to the results of research that has been done, a simple microscope from used goods is very effective as a learning medium. A simple microscope from used goods can also lighten the school's burden of buying a microscope because of the high price of microscopes. The results obtained are quite good and in accordance with the cellphone camera at the time of the research. However, this simple microscope has its advantages and disadvantages. The advantage of this simple microscope is that this microscope is made from materials that are around us so that students themselves have no trouble making them. While the drawback lies in this simple microscope can only see objects with a magnification of 10 times the actual and the resulting quality is in accordance with the cellphone camera used.

## 1. INTRODUCTION

The rapid development of technology in the world has an impact on various fields, one of which is the field of education (Ariska & Alawiyah, 2019). Education has an important role in the progress of individuals and countries. It makes people aware of what is going on in the

world and understands the problem and takes the necessary action to solve it. Quality education is the only important tool to improve human abilities and achieve the desired goals (Shah et al., 2013). At this time, education rarely uses media in the learning process. In fact, the media is needed in the learning process (Ariska, 2018). Media is a component of learning activities that are used to achieve the objectives of learning. In fact, there are some schools that do not have adequate and synchronized teaching tools (Tri Cahyono et al., 2018). Given the crucial role of school supplies, namely as a tool in the teaching and learning process that can provide concrete experience to students by increasing learning motivation in students, simplifying and clarifying concepts that are considered abstract and broad to be simpler so that they are easier to understand. by students. To achieve these learning objectives, a teacher must be able to use the available tools and if they are not yet available, the teacher can develop skills and creativity to produce teaching materials that will be used later (Arianti, 2014). One of the media used is a microscope.

A microscope is a tool used to observe or identify microscopic objects that look bigger than they really are. With the development of science and technology, various types of modern microscopes have emerged. Modern microscopes come in several types including optical microscopes, ultraviolet microscopes, fluorescence microscopes, electron microscopes, and acoustic microscopes (Handayani, 2019). Microscopes are useful tools for research and observation because they can magnify small objects for easier viewing. A microscope is an instrument consisting of two lenses, one near the object (objective) and one near your eye (ocular). The science learning process emphasizes providing direct experience to develop competence. Through the study of science, students gain hands-on experience so that they can increase their power to receive, store, and apply the concepts they learn (Hartanti et al., 2017). According to (Imamah, 2012) science learning is the most interesting study because students learn through their natural environment which of course they are familiar with. Students are invited to be directly involved and understand learning objects, symptoms, problems (application of scientific processes) around students, examine them and find conclusions or concepts about what they are learning.

According to Permendikbud No. 58 of 2014, Natural Sciences (IPA) is concerned with how to understand nature systematically, so that science is not only the mastery of a collection of knowledge in the form of facts, concepts or principles, but also a process of discovery. The learning process emphasizes providing hands-on experience to develop the ability to explore and understand the natural environment scientifically. Learning media is a way to make it easier for students to absorb information. Well-designed teaching materials can help students achieve their learning goals. Learning media also has its own uniqueness and advantages. It is very important to have a well-planned approach when using these tools, to take advantage of their strengths while minimizing their weaknesses. The development of teaching materials must pay attention to Visual Principles (visual, attractive, simple, useful, accurate, legal, and structured), in media planning system wisely (Nurseto, 2011).

The impact of mastering the material needed for fabrication and simple microscopic observations is that students are more aware that scientific learning activities need to be supported by real practice, which can be done with tools that are easily found in the surrounding environment. In one study, it was found that a practical tool called a microscope is quite expensive, so students cannot buy it separately. An alternative is needed to solve this problem. The development of simple microscope learning media from used goods using materials from used plastic bottles is useful for dealing with limited conditions of learning tools or media and also for increasing students' creativity. This study aims to develop a simple microscope that can be used in schools to help students learn about science. and is expected to facilitate educators and students in the learning process. There is also a clear difference between these two microscopes, which lies in the microscope model, magnification.

## 2. METHODS

This research uses the development model developed by Thiagarajan, Dorothy S. Semmel, and Melvyn I. Semmel which is known as the 4D development model. The development model consists of four stages, namely the defining stage, the design stage, the develop stage, and the disseminate stage (Rusnilawati, 2016). The define stage is the stage of defining the problems to be solved, and also explaining what products will be made. The design stage is the stage of explaining the steps of making a simple microscope from used goods as a medium for science learning. The develop stage is the result after testing a simple microscope from used goods as a medium for science learning when it is used to observe onion cells and for comparison we used a light microscope with the same treatment, namely using red onions as an object. Dissemination stage, at this stage is the stage of product dissemination after various stages of expert validation tests and trials have been carried out. Dissemination in this research is still limited within the scope of the agency.

In addition, the reason for using the 4D method is because this model is clearly structured with a systematic sequence of activities in an effort to solve learning problems that are in accordance with the needs and characteristics of students. In addition, this model is specifically used for development. The type of data used in this study is qualitative, where qualitative research is qualitative data which can be in the form of testing the validity of the data according to certain criteria, namely based on credibility, transferability, dependence and certainty (the findings really come from the data, do not highlight the researcher in conceptualizing) (Rijali, 2018). The instrument in this study was an expert validation sheet. The expert validation sheet in this study is as presented in the following table. In the Table 1, the expert can tick (√) one of the tables between appropriate and inappropriate. This validation stage is very important because it is to find out how feasible the product is made.

Table 1 Grid of Expert Validation Sheet Instruments on Simple Microscopes from Used Goods as an Alternative Science Learning Media

No	RATED ASPECT	SCORE	
		In accordance	It is not in accordance with
1	Is the media created it 's appropriate with achievement destination science learning		
2.	Is the learning media easy to apply or easy to make yourself.		
3.	Does the display of instructional media design attract students' interest in learning?		
4.	Can this learning media increase students' creativity?		
5.	Is the microscope learning media easy to use by students.		
6.	Is the material from this learning media easy to find around?		
7.	Are the results of the use of learning media clearly visible.		
8.	Can this microscope learning media be an alternative to light microscopy, if the school has not been able to get it.		
9.	Can the microscope learning media help as a student practicum tool?		

### 3. RESULTS AND DISCUSSION

#### 3.1. Results

To find out whether this simple microscope tool from used goods is feasible or not, we asked the lecturer for help to validate the tool. The following are the results of the assessed aspects and the results of the validation of a simple microscope tool from used goods.

Table 2 Validation Results of Simple Microscopes from Used Goods

No	RATED ASPECT	SCORE	
		In accordance	It is not in accordance with
1	Is the media created it 's appropriate with achievement destination science learning	3	0
2.	Is the learning media easy to apply or easy to make yourself.	3	0
3.	Does the display of instructional media design attract students' interest in learning?	2	1
4.	Can this learning media increase students' creativity?	3	0
5.	Is the microscope learning media easy to use by students.	3	0
6.	Is the material from this learning media easy to find around?	3	0
7.	Are the results of the use of learning media clearly visible.	3	0
8.	Can this microscope learning media be an alternative to light microscopy, if the school has not been able to get it.	3	0
9.	Can the microscope learning media help as a student practicum tool?	3	0

Based on the results of the validation, it can be seen that many aspects are appropriate and only one aspect is considered inappropriate, namely the design of the microscope tool which has not been able to attract students' interest to use the tool.

#### 3.2. Discussion

Based on the method used, the design was developed using 4-D. There are 4 main stages, namely Define, Design, Develop and Disseminate.

##### 1. Define

This simple microscope from used goods was made to support science learning media for students who cannot use a microscope or schools cannot buy a microscope. The process of making a simple microscope from used plastic bottles as a learning tool for observing red onion cells requires several tools and materials, namely used plastic bottles, cellphone cameras, scissors, laser pointer lenses, Foldscope loops, cutters, shallots, reagents, rubber bands, and sticks. The use of reagents serves as a colorant on objects. If the reagent is not given, it does not really affect the results of the observations, it's just that the resulting object is black and white.

## 2. Design

Making a microscope from used goods has several steps and stages, namely:

**Step 1:** Choose a plastic bottle and cut it into two parts. This is because only the top bottle is used because it functions as a placemat or microscope frame.

**Step 2 :** Cut the used cardboard into a 5x5 cm square, then make a hole according to the size of the bottle cap. Then cut the mica according to the diameter of the plastic bottle. Paper serves to keep light straight and not spread in other directions. While mica serves as a substitute for preparations.



Figure 1 A Simple Microscope Tools That Have Been Glued Together

**Step 3:** Glue the scraps of old cardboard to it using hot glue. Do the same with the mica paper to the plastic bottle pieces. Until like the picture below.

**Step 4:** Take the lens from the laser pointer and glue it to the old cardboard with masking tape and glue as shown below. The lens functions as a microscope lens, then the lens can be attached to the cellphone using a rubber band.



Figure 2 Laser Pointer Glued to Paper

Or you can use the Foldscope Lup as shown below.



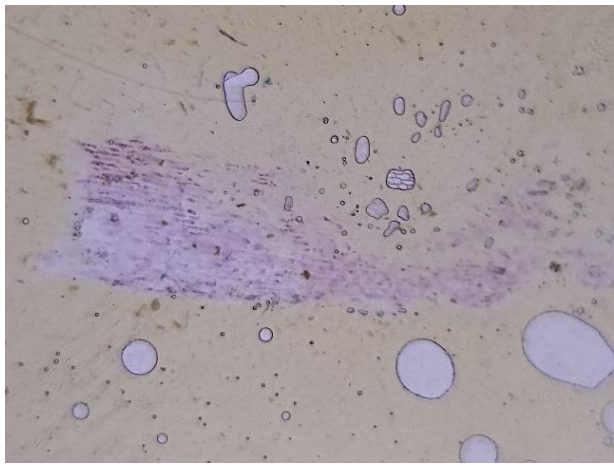
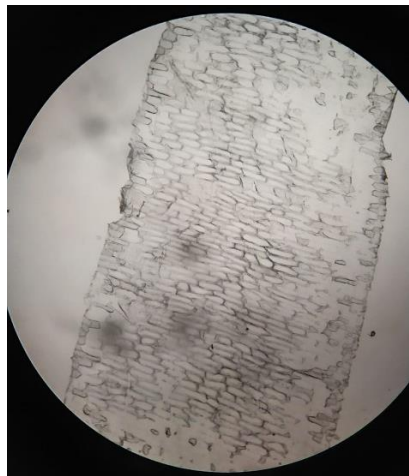
Figure 3 Foldscope Lup

The use of a simple microscope from used goods can be used to observe various kinds of observations, such as observations on onion cells. The use of a simple microscope from used goods that have been made has several steps, namely:

- 1) Cut the onion, then take a thin white membrane on the inside. Place it on top of the mica with the help of a stick and then drop the reagent (the reagent can be betadine, dragon fruit juice, or so on as a dye on the onion cells) to cover the onion cells. Cover with cover glass.
- 2) Prepare a flashlight under the microscope from an old plastic bottle.
- 3) Attach the lens from the laser pointer/Foldscope Lup that has been glued on the paper to the cellphone camera with the help of a rubber band, then focus on the object.
- 4) Bring the Foldscope loupe or lens from the laser pointer to the cellphone camera and observe the object.

### 3. Develop

A simple microscope can be used to observe a variety of cells, for example we use the red cell under this simple microscope experiment. The following are the results of the onion cell observations that we have carried out, namely the onion cells that have been observed to have a neat checkered shape, even though the box is not perfect. This checkered shape is part of the epidermis. If we look at the color of the red onion epidermal cells that have been studied and observed, the cells are purplish because they contain chloroplasts. Meanwhile, in the red onion epidermis cells, there are several organelles that can be observed, namely the chloroplast and protoplasm cell walls, although it is not clear in the image results. For more details can be seen from the image below.

5x magnification with the help of a cellphone camera	5x magnification using a Light Microscope
	
10x magnification with the help of a cellphone camera	10x magnification using a Light Microscope

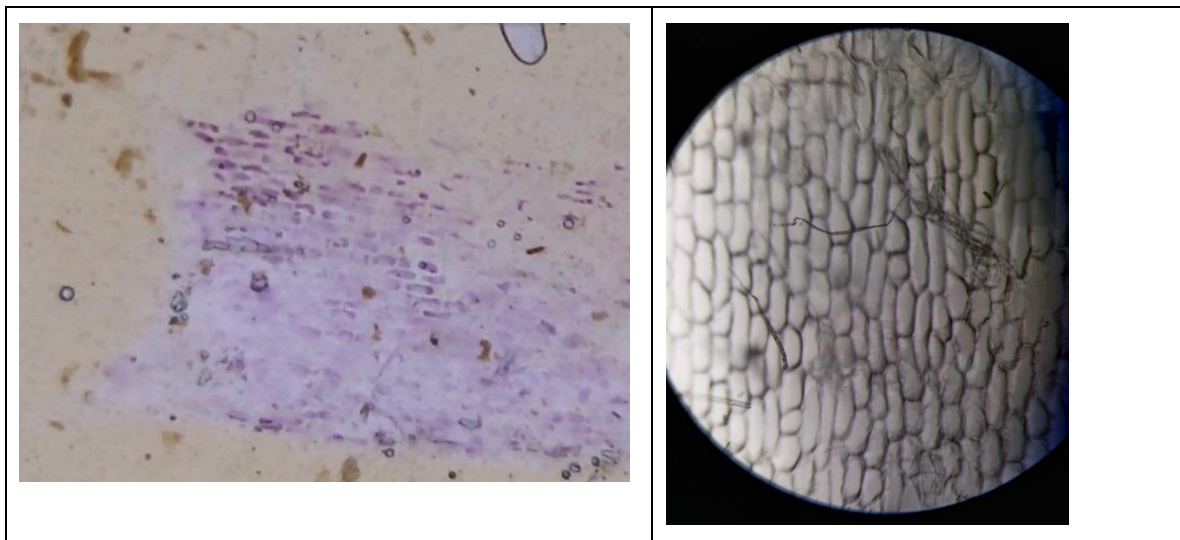


Figure 4 Observations of a Simple Microscope from Used Goods with the help of a cellphone camera and Observations with a Light Microscope

While the picture on the right is the result of observations using a light microscope as a comparison of observations between a simple microscope from used goods and observations from a light microscope. In experiments using a light microscope, a clearer image is produced, the shape of the cell is perfect. It's just that the preparations are not dripped with reagents because the colors produced are not appropriate and are clear enough when not using reagents. The disadvantage of using a light microscope is that it is quite expensive and takes a long time to focus the object.

As a further comparison, we tried to use a simple microscope from used goods with the help of a cellphone camera without using a magnification on the cellphone used. Here are the photos without being enlarged with the help of a cellphone camera.

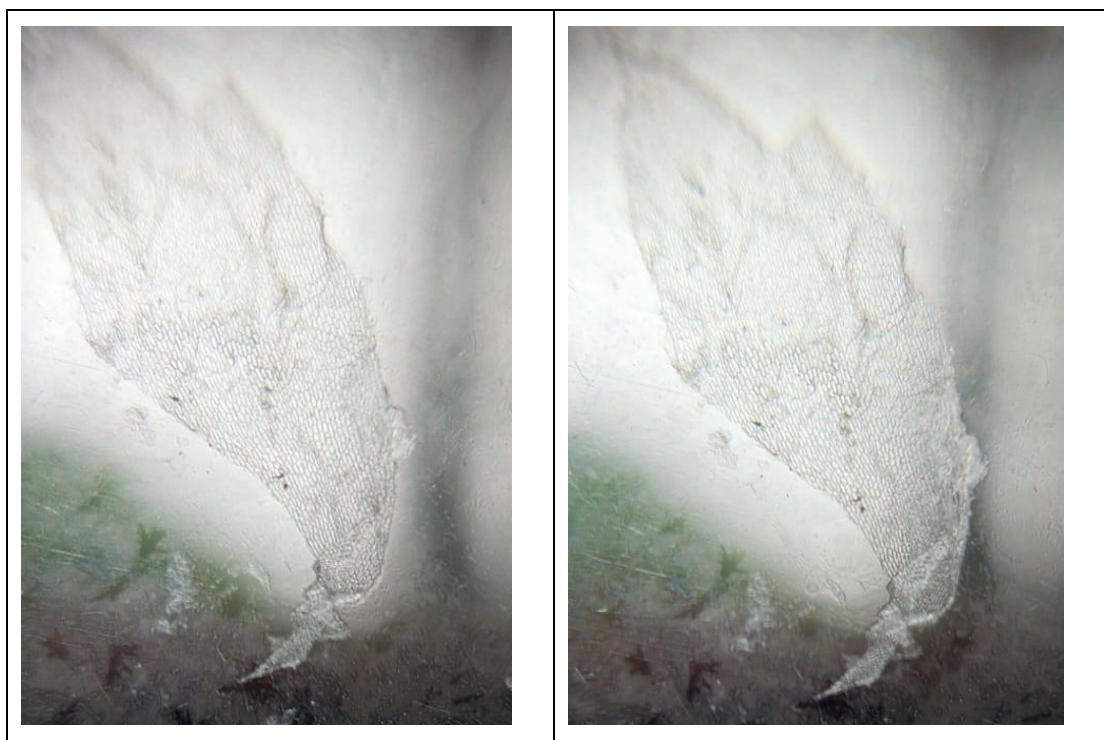


Figure 5 Simple Microscope Observation Results from Used Goods without Magnification Using a Cellphone Camera

It can be seen in Figure 5 that without magnification on the cellphone camera, a fairly clear image of the epidermis can be produced, especially the epidermal wall which is very clearly visible. In this experiment we did not give reagents to the onion cells, therefore black and white colors were produced. Based on the experimental results from a simple microscope from used goods on observing onion cells, the resulting magnification can be caused by several obstacles, namely the incision is too thick, the lack of light obtained, and the lack of focusing when making observations. Based on the observations, the cell wall, protoplasm are clearly visible. In this observation, a very important part in using a microscope is the lens, we use a lens from a laser pointer and also a Foldscope Lup.

On the observations that have been obtained from a simple microscope tool from used goods, we use a cellphone camera as a tool for using a simple microscope from goods. The use of a cellphone camera is also very important in carrying out simple microscope observations, because the lens of the laser pointer is so small that it is not possible to see it directly with the eye. That's why we use cellphone cameras as a distraction tool. The quality of the cellphone camera used is 43 MP, where the smaller the MP quality of the cellphone used, the better the photos obtained.

This simple microscope from used goods as a science learning medium is effective as an alternative to learning media for schools that do not yet have an actual microscope. This simple microscope media developed has its advantages and disadvantages. The advantage is that this microscope is made of materials that are easy to find in the environment and the manufacturing process is not difficult so that students are able to make their own. Then, the disadvantage of this simple microscope is that it is only able to see at a magnification of 10 times its proper size and the quality is also influenced by the cellphone camera used later.

#### 4. Disseminate

The last stage is dissemination. At the dissemination stage, this research is carried out so that this research can be accessed by readers. This research will be distributed in a limited way within the scope of the Tasris IPA study program.

## 4. CONCLUSION

Based on the results of research that has been done, a simple microscope from used goods is very effective as a learning medium. A simple microscope from used goods can also lighten the school's burden of buying a microscope because of the high price of microscopes. The results obtained are quite good according to the quality of the cellphone camera used. The advantages of this simple microscope, among others, are that it is made of materials that are easily processed from the surrounding environment, the manufacturing process is not difficult so that educators and students are able to make them themselves. The disadvantage of this simple microscope is that it is only able to see objects with a magnification of 10 times their actual size, then the resulting quality is also in accordance with the cellphone camera used. Learning media is very important for students and educators. This is because learning media is very helpful for educators in carrying out learning. Educators must pay attention to the use of appropriate media to achieve learning objectives. Educators need to use components of teaching media so that there are no errors in the process of delivering learning information, so that they can carry out the teaching and learning process effectively. The use of learning media can improve and utilize students' senses as much as possible according to the learning material provided.



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