Interactive Learning Media for Lenses and Their Applications Using Macro Visual Basic in Microsoft PowerPoint

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Abstract. There are two types of lenses are used, namely a convex lens and a concave lens. Microscope is a tool that uses two convex lenses as the eyepiece and objective lens because it can form a magnified image. Instead concave lens is usually used as a spectacle lens for nearsightedness patients because the distance of image formed is closer than the distance of the object. Just like a mirror, the image formation by lenses also can be conveniently determined with ray diagrams. Therefore, this research aims to create a simulation of ray diagrams in the process of image formation by lenses and their applications using Macro Visual Basic in Microsoft PowerPoint. Lenses applications made are the microscope simulation and the combined lenses which consist of a concave-convex lens combined and a convex-concave lens combined. This research begins with the preparation of material on the image formation by lenses and their application. Second, made an appearance on the program which consists of a PowerPoint slide, CommandButton, Textbox, OptionButton, Shape and others then wrote programs in Macro Visual Basic procedure to active the command to do. Input of this simulation can be given in the form of object distance, focal point distance of lens and height of objects. The data will be processed according to commands contained in macros procedure to result image distance, image height, image magnification and the properties of image. In addition to result the data, media can also provide output in the form of ray diagrams simulation on the image formation that can be used to assist students understanding the image formation by lenses.

1. Introduction

Physics is one of science that studies about nature. Physics makes significant contributions in human life. Much existing technology development can not be separated from physics. Nevertheless, most of students assumed physics as a difficult and terrify subject [1].

Physics is a natural science based on experiments, measurements and mathematical analysis to find quantitative physical laws or theory. As natural science based on experiments, teaching physics at school is usually equipped with simple laboratory activities. But in fact, laboratory activities of physics in school still have a lot of experience barriers. Based on a survey conducted by Yennita et al [2], the barriers are reinforced by reluctance of teachers held laboratory activities because of limited lab equipments. In addition, laboratory activities require a lot of time.

One of topics in physics that have lab activities is image formation by lens. Lens is an optics device for gathers or diffusing light beam [3]. Lenses are commonly used to form images in optical instruments, such as microscope. Microscope is a tool that uses two convex lenses as the eyepiece and objective lens because it can form a magnified image. Another kind of lens is a concave lens that commonly uses as a spectacle lens for nearsightedness patients. The image distance that formed by concave lens is closer than the object distance. Therefore it can help the nearsightedness patients to see the distant object.
Some learning medias and learning methods on the topic of the lenses have been developed. This media aims to help students, especially first grade students on senior high school, to figure out about lense and the process of image formation by lenses. Sambudi and Mosik [4] using media tools to teaching about optics, include the topic of lenses. Nowadays, computer-based learning media of lense has been developed. Fakhriyah, et al. [5] teached about lense through development of geometrical optics learning media, using Macromedia Flash CS5. But there is no studies that use Visual Basic macros in Microsoft PowerPoint to develop a learning media of lenses.

1.1 Microsoft Power point 2010

PowerPoint is a Microsoft’s presentation tool widely used in education. PowerPoint has some slides that can be changed by simply clicking one button. So that PowerPoint can visualize text, images, animation, sound, and video in the form of presentation. Even the last few years PowerPoint has been equipped with hyperlinks and buttons to give more interactive presentation appearance [6].

Microsoft PowerPoint has encountered several renewal. Each of these programs that have been updated are named according to the renewals, for example, Microsoft PowerPoint 1995, 1997, 2003, 2007, 2010, and 2013. This interactive-learning media using Microsoft PowerPoint 2010. The initial view of Microsoft PowerPoint 2010 can be seen in Figure 1.

![Initial view of Microsoft PowerPoint 2010](image)

Although it has many advantages, PowerPoint also has limitations. One of them is users have to use a lot of slides in a presentation that will spend a large enough memory capacity. To overcome these limitations, users can use Visual Basic for Applications (VBA).

1.2 Visual Basic for Application (VBA)

Visual Basic for Application (VBA) is a programming language based "object oriented" by using the Visual Basic that can be used to support the functions of Microsoft Office, one of them is PowerPoint. Basically VBA is integrated with Microsoft Office and used by writing a script or procedure on macro sheet. The macros are usually referred to Visual Basic macros [5].

Although integrated with Microsoft Office, VBA by default not displayed in Microsoft Office window. If you want to use VBA, you must bring up the Developer tab first. Developer tab contains menus necessary to make macros procedure. How to display the Developer tab is shown in Figure 2. After displaying the Developer tab, then the user can write macros in a VBA macros sheet.
2. How to Make Interactive Learning Media

Developer tab generally contains three main parts, namely the Code, Controls and Modify. In Controls, there are several tools that are often used to create macros procedures. Macros procedures written in Visual Basic Editor by:

1. Click Macros in the Developer tab.
2. Type the name of the procedure that will be written (for example, "Hello") under Macro Name in the Macros dialog box.
3. Click "Create" button, and the Visual Basic Editor will appear as shown in Figure 4. Macros procedure is ready to written.

Figure 2. How to display the Developer tab in Microsoft PowerPoint.

Figure 3. Appearance of Macros dialog box

Figure 4. Visual Basic Editor PowerPoint 2010
Macros procedure also can be run using the Shapes. We can find the Shapes on the Insert tab in PowerPoint. The use of Shapes as a button requires user’s creativity to create macros procedures. By using Shapes as a button we can set the size, shape, and color are more varied. Make a button using Shapes can be done by:

a. Create a macros procedure in the Visual Basic Editor.

b. Choose one of Shapes on Insert Tab (eg. oval).

c. Click the choosen Shapes, then click Action in Insert Tab. On Run Macro, choose the procedure will be run using Shapes.

d. Click ok.

Figure 5. Choose the Shapes on Insert Tab

Figure 6. Choose the procedure will be run using Shapes on Run Macro

Figure 7 is one of macros procedures on program of Interactive-Leraning Media running by Shapes.
3. Interactive Learning Media for Lenses and Their Applications

3.1 Image

Image formed when light rays encounter flat and spherical surfaces. We know two kind of image formed by a lens, they are virtual image and real image. Virtual image cannot be displayed on a screen and real image can be displayed on a screen. In this interactive-learning media Virtual image is simulated by dotted line and real image is simulated by straight line. To be able to show the image formation by lenses, this interactive learning media can do the commands to rescale image formed. If the image are formed exceeds the screen, the program will automatically reduce the size of the simulation so the image can be displayed completely on screen.

3.2 Image Formation by Convex Lens and Concave Lens

Convex lens is a thin lens that its refractive surface can converge the parallel rays (convergent lens). Just like in a concave mirror, parallel rays on convex lens will also be collected at the focal point in the main axis, which is behind the lens. So that the focal point of the convex lens is positive.
Concave lens is a thin lens that its refractive surface can diverge parallel the parallel rays (divergent lens). Parallel rays in a concave lens also will spread and seems to come from a gathering point located in front of the lens. Therefore, the focus of a concave lens is negative and located in front of a concave lens.

The lens equation is
\[
\frac{1}{f} = \frac{1}{p} + \frac{1}{q}
\]

And lateral magnification of lens is
\[
M = \frac{h'}{h} = -\frac{q}{p}
\]

To determine the image formation of the lens we can use the geometric approach, using diagram rays. The following diagram rays for lens are:
1. Ray 1 is drawn parallel to the principal axis. After being refracted by the lens, this ray passes through the focal point on the back side of the lens.
2. Ray 2 is drawn through the center of the lens and continues in a straight line.
3. Ray 3 is drawn through the focal point on the front side of the lens (or as if coming from the focal point, if \( p > f \)) and emerges from the lens parallel to the principal axis.

![Rays diagram of convex lens and concave lens](image)

Figure 9. Rays diagram of convex lens and concave lens

Simulation of the image formation on interactive learning media that have been made located on the simulation slide. On simulation slide, user can see the result of the integration between VBA and PowerPoint. VBA is used to activate the command in order to produce the desired output. You can change any value of \( f, p, \) and \( q \) by click the red button. After that you can click “Gambar Bayangan” button to active macros procedure.

![Simulation of convex lens after “Gambar Bayangan” button clicked](image)

Figure 10. Simulation of convex lens after “Gambar Bayangan” button clicked
3.3 Applications of Lens

This media have two kind application of image formation by lens. They are microscope and combined lens. Just as simulations for the formation of a shadow on the convex lens and a concave lens, simulations for lens applications were also made to process input into output is numeric and numeric simulations. Making the application simulation lens also uses shapes as buttons, textbox, CommandButton, and option button.

![Image](image1)

Figure 11. One of image formation application

3.4 Simulation Test

A short field test consists of testing a convex lens and a concave lens that is presented in two different slides.

![Image](image2)

Figure 12. A short field test consists of testing a convex lens after the "Periksa Jawaban" is clicked

On each slide a short field user can change the amount of which is given in the matter, namely by replacing the value of $F$, $P$, or $h$. To answer each question, the user can write the answers on a black textbox and click one of the options for the properties of the image produced. If the user has been convinced by the answer, the user can correct their own answers by clicking the "Periksa Jawaban". Automatically media will give the mark “√” if the answer is correct and the "x" if the answer is wrong and the value box will appear on the user earned value questions. Simulation of the formation of shadows remain displayed on this test to inform the correct answer from the given problem.
4. Conclusions

Interactive learning media for lenses and their applications using Macro Visual Basic in Microsoft PowerPoint has been created and can be used by students to figure out the process of image formation by thin lenses and their applications in several optics devices through a simple simulation. The following are some things that media can do:

1. Visualize simulation
2. Simulation test
3. Rescale simulation

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