Development of Sound Interference Props with Phyphox to Support Sound and Waves Learning in Senior High School

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ABSTRACT. This research aims to develop sound wave interference props to support sound wave interference learning in high school. This study uses the research and development method with the ADDIE model which consists of 5 stages, namely analyze, design, develop, implementation, and evaluation. The props is intended to assist students in visualizing sound waveforms and seeing differences in sound wave forms before and after interference. The props consist of an audio generator, smartphone and tripod. The application used in this research is phyphox. Phyphox allows the use of sensors on the phone for physics experiments. The phyphox app as an acronym for physical phone experiments and released it on the Google Play Store and Apple App Store The tools and materials used are easy to obtain and not complicated. This tool is expected to help students understand the concept of sound wave interference.
Keywords: *sound wave, interference, phyphox.*

1. INTRODUCTION

Physics examines the natural phenomenon or material in the scope of space and time, so that the application of this physics can function to learn how this natural phenomenon occurs. In understanding the basic concepts of physics, beside requires a systematic thinking ability, to need a tool to lead to mastery itself is the visual media. students who still regard physics as a subject still less easy to understand, will be more interested when in understanding the existing concepts with assisted with visual media in classroom learning.

In the sound wave material students need tools display to help student understanding, especially in understanding sound wave interference. Props are referred to is a sound interference visual aid. In this digital era, many media have been developed to help the learning process. One of them is a smartphone.

Smartphones are used recently quite often as a tool for taking and recording measurements in physics experiments, as much as, in university labs and classrooms or school laboratories [1].

There are many smartphone applications have been developed to support education, including phyphox. Phyphox is designed for physics education and allows to record data on the phone, which can be downloaded or the data can be sent to a laptop and displayed on a browser [2]. The phyphox app (as an acronym for physical phone experiments) and released it on the Google Play Store and Apple App Store in September 2016. In case to support users worldwide, Phyphox can be accessed via http://phyphox.org, which offers detailed instructions, demonstration videos and technical information in English and German [3].

Phyphox is designed for physics education and supports recording data on the phone, which can be downloaded or the data can be sent to a laptop and downloaded on a browser [2]. Research conducted by Theodoros Pierratos and Hariton M Polatoglou shows that the use of phyphox specific functions leads to valid and reliable data across classes in real time, without the need to analyze the raw data provided in a form in a spreadsheet [1].

This phenomenon of interference is not only physically interesting but also very important from the practical engineering point of view [2]. The combination of separate waves in the same region of space to produce a resultant wave is called interference [3].

The analysis step is the first step that must be taken to assess the real conditions as expected condition.

This process uses a questionnaire to get the data needs of the use of props as learning aids. Analyze is carried out to determine the learning needs in the field, both by teachers and students. The analysis includes the following: (a) analysis of user needs (students and teachers), (b) high school physics curriculum analysis, (c) analysis of the characteristics of high school students, (d) analysis of technology requirements for product development. Based on the results of the needs analysis conducted by the author in 2020 to 21 teachers, as many as 85.7% of schools had physics teaching aids.

However, as many as 73.7% of teachers only use teaching aids less than 2 times a month. There are 87.5% in 21 schools do not have sound wave interference teaching aids. As many as 26.3% of teachers said that they did not use teaching aids due to various reasons, among others: (1) insufficient facilities, (2) no teaching aids, (3) unavailability of laboratories and equipment warehouses, (4) insufficient tools, many students, and insufficient teaching and learning time due to limited teaching aids, (5) props are incomplete, and damaged. There are many demands for the completion of the physics syllabus and lesson plans in learning, many teachers feel that they lack teaching time. Therefore, this research aims to develop sound wave interference props for senior high school.

2. METHOD

The ADDIE model is rooted in the design of the teaching system and despite many conflicting arguments it is still a relevant method for developing learning programs [4]. ADDIE is an acronym for analyze, design, development, implementation, and evaluation. ADDIE is a product development concept. The ADDIE concept is applied to build performance-based learning. Because ADDIE is a process that serves as a guideline framework for complex situations, it is appropriate for developing educational products and other learning resources [5]. The stages in the ADDIE model can be described as in the chart below.

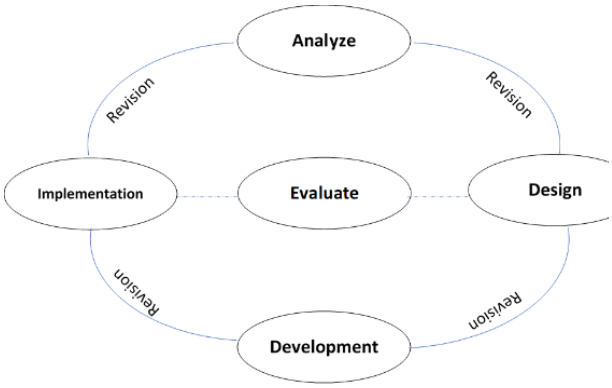

Fig 1. ADDIE Model Process

The data collection technique used in this study was a questionnaire using a Likert scale. The Likert scale used by respondents to answer questions that ask the extent to which he agrees or disagrees with a statement [8]. Quantitative methods must be used to augment the best qualitative procedures for implementing translations and evaluating the outcomes [6]. a five-point Likert scale using 5: Strongly Agree, 4: Agree, 3: Neither Agree nor Disagree, 2: Disagree, 1: Strongly Disagree.

Converting the average score into a qualitative value according to the literature shown by Table I below.

TABLE 1. Quality Category

Percentage	Category
90% - 100%	Very Good
75% - 89%	Good
65%-74%	Fair
55% - 64%	Poor
0 – 54%	Very Poor

3. RESULT AND DISCUSSION

3.1 Design

The tools and materials needed to build this sound interference props include smartphones, cellphone buffers, audio generator,speaker, and phyphox applications as shown Fig 1.

Fig 2. Tools for build up sound wave interference (a) smartphone (b) phone holder (c) audio generator (d) phyphox app (e) speaker

We use smartphone to operate phyphox app and to display how wave form occurs. Phone holder is used to sustain the smartphone. Audio generator is used to generate sound frequencies. Phyphox app to show menu that used in this props, like audio scope and tone generator. The speaker has a function as a tool that converts electric waves, from sound reinforcing devices to vibrational waves that will emit the sound itself.

First, we should know the wave form before interference occurs, for example we take 700 Hz as in Fig 3 below and we call it first condition.

Fig 3. Tools set up for first condition

If we start the audio generator in first condition, and we would get result on Fig 4.

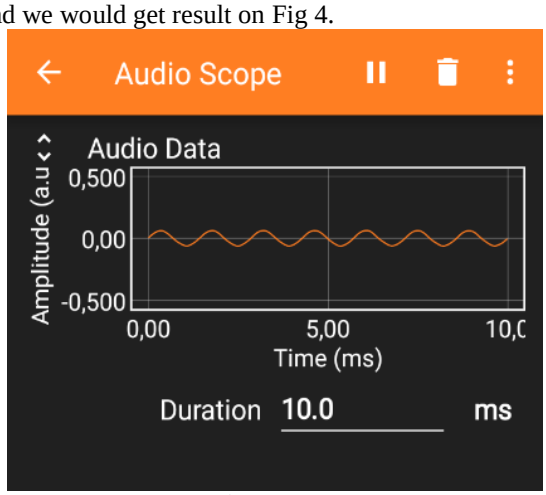

Fig 4. Wave form result at 700 Hz

After that, we use another smartphone to generate another frequency, example 1.500 Hz to look wave form after another sound is on and we are looking for 1.500 Hz wave form result on Fig 5 and the tools set up to looking for interference in Fig 6.

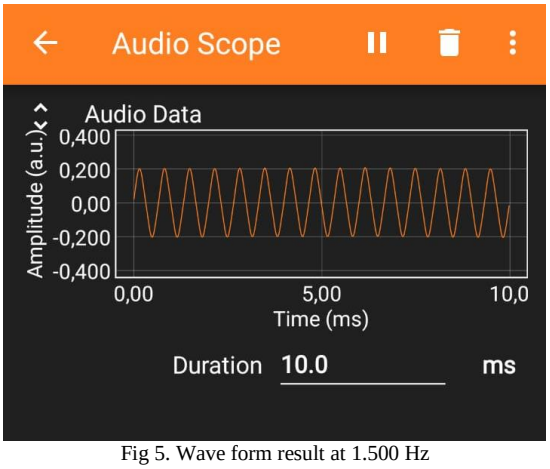

Fig 5. Wave form result at 1.500 Hz

Fig 6. Tools set up for second condition

As seen in Fig 7, after the addition of the sound frequency of 1500 Hz, the 700 Hz wave experiences interference, so that the shape becomes irregular.

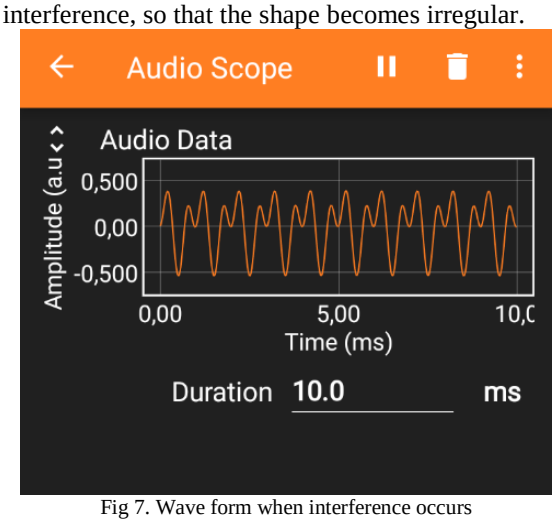

Fig 7. Wave form when interference occurs

4. IMPLEMENTATION

The result of the questionnaire answered by 15 physics teachers that have experienced in using

interference sound wave as a learning media is shown by Table II below.

TABLE 2. Results For Two Aspects Assessment From The Questionnaire

	Aspects	
Average Scores	Content	Media Design
	95%	91.5%
Category	Very Good	Very Good

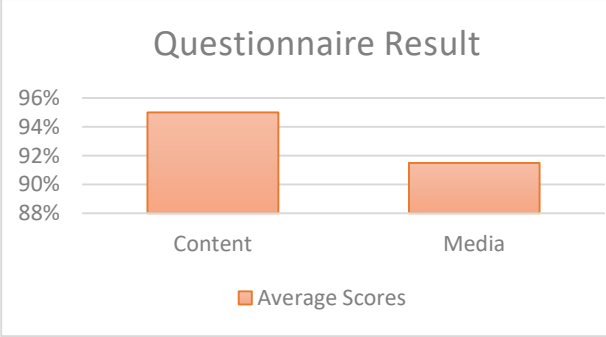

Fig 8. Results For Two Aspects Assessment From The Questionnaire

From the result, all aspects scored are in the category of very good quality. The content aspect scored the higher average with 95%, and the overall media design scored the lower average with 91,5%.

5. CONCLUSION

The development of sound wave interference, which is a smartphone-based props has been done successfully. From the two aspects that has been scored by 15 physics teachers, the content aspect scored the higher average with 95%, and the overall media design scored the lower average with 91,5%. Because of the quality that it has, sound wave interference can support the physics learning in sound wave chapter in senior high school.

6. IMPLICATIONS

For further research, we hope sound wave interference can be integrated with correct teaching method to improve the learning outcomes of students. Hopefully, there will be another topics in physics or other subject that can be presented by using phyphox application.

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