



## NEEDS ANALYSIS FOR THE DEVELOPMENT OF ARDUINO MICROCONTROLLER-BASED HOOKE'S LAW TEACHING TOOL GUIDEBOOK

Yeni Novita Lestari<sup>1,\*</sup>, Iwan Setiawan<sup>2</sup>, Rendy Wikrama Wardana<sup>3</sup>

<sup>1,2</sup> Science Education, Universitas Bengkulu, Bengkulu, Indonesia

Corresponding author email: [yenninovita33@gmail.com](mailto:yenninovita33@gmail.com)

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### Abstract :

This research is a type of research and development (R & D) which has a focus on the goal of producing a product and testing its effectiveness and feasibility. This research model adopts the 4D research model with stages namely Define, Design, Develop, and Disseminate. This needs analysis aims to determine what teaching materials are needed on Hooke's Law material at SMA Negeri 1 Bengkulu Tengah. The research was carried out in October 2022. The research sample consisted of 40 students who were in class XI. The research instruments were interviews and student response questionnaires consisting of 18 question items regarding the need for a Hooke's Law visual aids guidebook based on the Arduino microcontroller which contained 4 aspects, namely aspects of student and teacher needs, aspects of the need for teaching materials, aspects of learning media, and aspects of interest/motivation. The results showed that most of the students were interested in developing an Arduino-based Hooke's law teaching aid guidebook.

Keywords: Arduino Microcontroller, Effectiveness, Physics

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## INTRODUCTION

Various developments and breakthroughs have been made to improve the quality of education in line with the increased understanding of technology and information. The presence of various student-centered learning concepts and methods is a sign that innovation has entered and developed the quality of learning. However, in the field said the opposite of the theory that was disclosed. There are still many obstacles that make conventional or traditional learning methods and concepts more often used by educators (Prince & Felder, 2006; Wu et al., 2023; Rasmidita et al., 2020).

The use of appropriate learning methods by making improvements and innovations in the teaching and learning process is needed to deal with various problems in learning physics. One method that can be used in learning physics is the method of demonstration and experiment. However, the experimental method through practicum activities is considered more capable of providing empirical experience to students because it focuses more on student learning (Capps & Crawford, 2013; Legaki et al, 2020). Physics learning needs to carry out practicum activities so that students can improve their abilities in the aspects of knowledge, attitudes, and skills. Practicum is a method that invites students to be more active and directly involved in the process of understanding physics theory by trying and practicing and testing the truth of a physics theory. Practicum activities make it possible to apply a variety of science process skills as well as develop a scientific attitude that supports the process of acquiring knowledge in students. Practicum activities require practicum guidance in order to achieve goals, where in the practicum guide students are required to carry out practicum activities independently (Nuziani, et al 2019).

The use of teaching aids that are appropriate to the material in learning is highly recommended, because students can absorb learning material optimally, deeply and intact. In addition to listening to material explanations, students can also be directly involved through seeing, touching, and experiencing it for themselves. Teachers can also be more creative and prevent verbalism in conveying material if they use visual aids so that physics learning will be more effective (Indrasari, 2020).

Technological advances in the digital field are currently increasing rapidly, one of which is marked by the development of microcontrollers that are capable of digitizing conventional equipment. Digitization technology certainly makes it easier to use and reduces the risk of parallax errors so that it can be used to overcome the problems in learning above so that the process becomes more effective, especially in practicum activities (Hollis et al, 2015; Litvinenko, 2020; Rahmatullah et al., 2022).

The development of teaching aids is intended to improve students' understanding and skills, especially science process skills. Science process skills (KPS) are skills that can equip students to be able to carry out various physical activities during the discovery process (Hands on Activities) as well as thinking process skills (Minds on Activities) and instill a scientific attitude (Heart on Activities). The goal of KPS is not only to train every student to become a scientist, but also to help and facilitate them to think like scientists so that they understand scientific topics. KPS will help students become problem solvers, so that students are able to apply these skills in real-world contexts (Darmaji et al, 2019; Dewantara et al, 2019; Harahap et al, 2019).

Similar research was conducted by Alkautsar and Suprijadi (2012) in their research on measuring spring constants using digital image processing methods. However, this research can only be carried out in a perfectly black environment, so it is not yet effective in other environments. In addition, Fatmawati & Sulisworo (2021) has also determined the spring constant using the Phyphox application. The advantage of this application is that it can be owned without having to pay, but there are several simulations contained in this Phyphox that cannot be simulated if the smartphone does not have simulated sensors.

## RESEARCH METHOD

This research is a type of research and development (R & D) which has a focus on the goal of producing a product and testing its effectiveness and feasibility. This research model adopts the 4D research model with stages namely Define, Design, Develop, and Disseminate. The research was conducted in October 2022 at Central Bengkulu 1 Public High School. The research sample was 40 students who sat in class XI. The research instrument was a student response questionnaire consisting of 18 question items regarding the need for an Arduino microcontroller-based Hooke's Law visual aids guidebook which contained 4 aspects, namely aspects of student and teacher needs, aspects of the need for teaching materials, aspects of learning media, and aspects of interest/motivation. The data collection process was carried out by means of observation, interviews with Physics teachers and distributing student response questionnaires directly which were then analyzed descriptively.

## RESULTS AND DISCUSSION

Analysis of the needs for the development of a guidebook was carried out through interviews and observations at SMA Negeri 1 Bengkulu Tengah. This is intended to find out the learning process that takes place and see how the characteristics of students during the learning process. The needs analysis in developing the guidebook is as follows:

### Basic Competency Analysis and Learning Material Objectives

Analysis of the high school physics syllabus and the relationship between KD in the process material and products of Hooke's law teaching aids based on Arduino microcontrollers. This analysis aims to find out how the learning process has been going on. The KD in Hooke's law material, namely KD 3.2 and 4.2 found in class XI SMA as follows:

Table 1. Basic Competency and Material Indicators of Hooke's Law

Basic competencies	Indicator
3.4 Analyzing the elastic properties of materials in everyday life.	3.4.4 Presents the results of classifying the type of material based on the observed value of the elastic constant.
4.4 Conduct experiments on the elasticity properties of materials along with a presentation of the experimental results and their benefits.	4.4.2 Identify the elasticity constants of materials through experiments.

Based on KD above, the analysis of the characteristics of students begins with interviews and observations. Interviews were conducted with Physics teachers at SMA Negeri 1 Bengkulu Tengah. The material that will be developed in the guidebook is material on basic competencies 3.2 and 4.2 on analyzing the elastic properties of materials and planning and conducting experiments.

#### Teaching Material Needs Analysis

Analysis of the needs of students and teachers is carried out by distributing questionnaires to teachers and students to find out how much the teachers and students need for the results of the research to be carried out. The results of the analysis that has been carried out can be seen in the image below:

##### 1. Indicator needs analysis

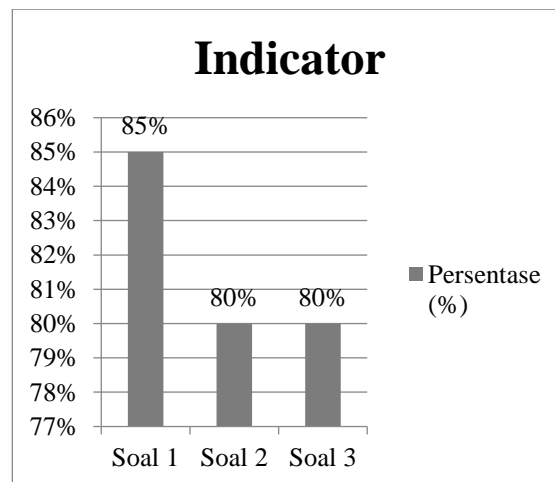


Figure 1. Indicator Needs Analysis

Based on graph 1 above, it can be concluded that the results of the needs questionnaire on the aspect of student indicators averaged 82% using a practicum guidebook on Hooke's law material, but the manual Hooke's law props guidebook.

## 2. Analysis of the needs of teaching materials

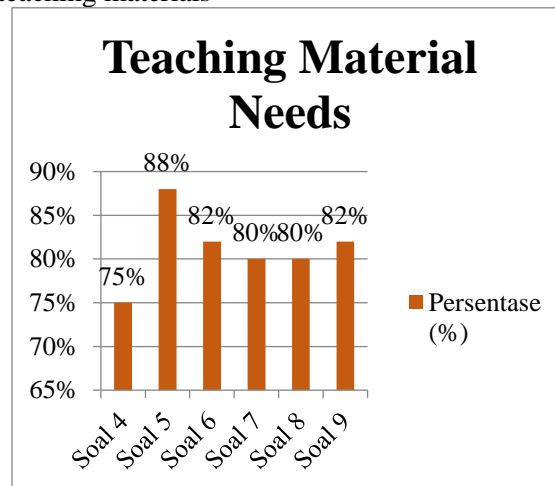


Figure 2. Graph of Teaching Material Needs Analysis

Based on graph 2 above, it can be concluded that the result of the need for the aspect of student teaching material needs on average 82% of students find it difficult to study physics in Hooke's law material with teaching materials used by teachers, students need teaching materials that can be used to study legal material More interesting Hooke.

## Instructional Media

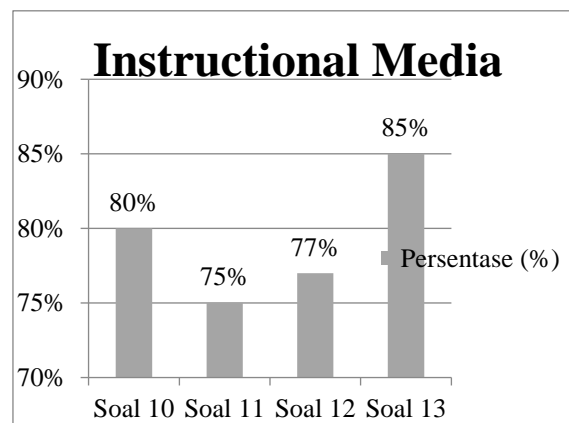


Figure 3. Graph of Learning Media Needs Analysis

Based on graph 3 above, it can be concluded that the results of the needs questionnaire on aspects of student learning media on average 79% of students need a guidebook for practicum in the laboratory.

## Interest Motivation

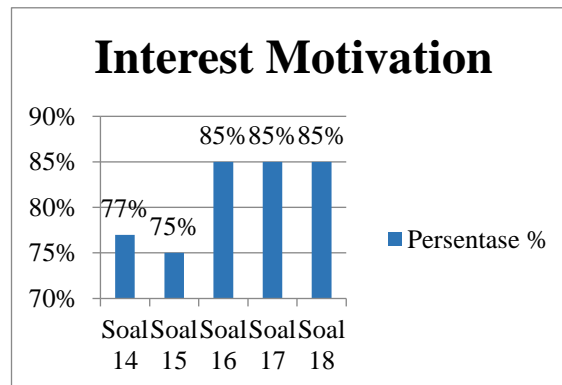


Figure 4. Graph of Motivation/attraction Needs Analysis

Based on graph 4 above, it can be concluded that the results of the needs questionnaire on the motivational aspect of student interest on average 81% are interested, and enthusiastic about learning physics if a guidebook and Hooke's law teaching aids are developed based on the arduino microcontroller for physics learning on the subject of Hooke's law material so that students better understand Hooke's law material

## CONCLUSION

Based on the results of the research above, it shows that the lack of enthusiasm of students in participating in the physics learning process being taught, the teaching materials used have not maximized students in obtaining material and developing students' skills processes. Therefore, a guidebook for Hooke's law teaching aids based on the Arduino microcontroller is needed and it is hoped that the guidebook developed can improve students' science process skills.

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