

# THE DEVELOPMENT OF PHYSICS MANUAL BOOK AND EXPERIMENT SETS

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## Abstract

A physics experiment sets and manual books was developed and created based on Discovery Inquiry learning method for students in Junior High School. This study aims to design and construct manual books and experiment sets of mechanics, heat, electric and optics as its topic. The effectiveness of the manual books and experiment sets are tested on the ability to understand the manual books and the skills used in the set experiment. The research method used is research and development with two stages which are theoretical and empirical. From the result of the validation test, small-scale field test, and large-scale field test, it can be concluded that the manual books and experiment set is appropriate to be tested widely (implementation). Based on the implementation of 20 students of education program and three senior high school in Jakarta shows that the user feels easy and understandable using the manual since it has easy language, EYD-compliant spelling, equipped with drawing tools and instructions of set experiments.

Simple experiment set is perceived by user as user friendly, portability, as well as safe to be used independently.

**Keywords:** Manual books, Experiment Sets, Mechanics, Heat, Optics, Electric

## 1. Introduction

The rapid development of science and technology today has created many benefits for humans needs. As a branch of knowledge, science is formed from the interrelation between attitudes and the process of science, the investigation of a natural phenomenon, and scientific products. (Carin, 1997).

The nature of learning science is not simply remembering and understanding concepts which scientists has found. But rather, it is more the science process skills in finding concepts through experiments and scientific research. As stated in Permendiknas no.22 year 2006 on Competency Standards and Basic Competencies of Education Unit Level Curriculum, science is related on how to understand nature systematically, thus, creating a process of discovery and not limited to just the collection of knowledge in form of facts, concepts, or principles alone.

The process of science should be taught through experiment, but it is rarely done by teachers. Teachers rarely do experiment through class lessons because of several reasons such as the lack of time for class experiment, insufficient tools and lab materials, and the lack of laboratory competency. Whereas, experiment plays an important role in learning science (OomRomlah, 2009:1). The science learning process should emphasize the provision of immediate experience so that learners can

discover their own concepts and hence, they received direct experience.

Learners can use laboratory activities as a means to discover concepts in the science process through direct experience. This is in accordance with Yaqin's opinion (2005) which states that the skills of conducting experiments can be enhanced by conducting laboratory activities and Suskandani (2001) which states that laboratory activities can improve students' understanding.

Beyond doubt, laboratory activities cannot be separated from the knowledge of experiment tools and their uses. Adequate knowledge of experiment tools and their uses will make students easier to carry out experiments and to prevent accidents in the laboratory.

To do this, learners will need a manual book about the experiment tool to guide them throughout the experiment. Based on the discrepancies between the actual and desired conditions, need assessment is needed to remove these discrepancies.

Need assessment is accomplished by developing assessment questionnaires, collecting data and analysing the data collected to help produce manual books and experiment sets that will give a positive effect to the user.

The result of the need assessment are as follows:

**Table 1.** The Manual books

No.	Indicator	Total	Respondent who answer "yes"
1	Does physics experiment set already have a manual book?	20	0
2	Manual books can help user using the experiment set.	20	7
3	The language used in Manual Book is easy to understand by the user.	20	5
4	The language used in Manual book is appropriate.	20	6
5	The step-by-step instructions in the manual book are systematic.	20	7
6	The images used in Manual book ease user during the experiment.	20	4
7	The method section in the manual book is easy to understand.	20	5
Average		20	8

**Table 2.** Experimental Sets.

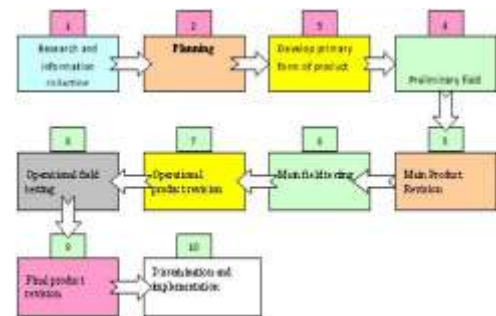
No.	Indicator	Total	Respondent who answer "yes"
1	Are the currently existing experiment sets user friendly?	20	20
2	Does the currently existing experiment sets include many different experiment?	20	9
3	The maintenance of the experiment sets is easy and efficient.	20	17
4	Experiment sets portability (the shape of the sets is portable)	20	20
5	The experiment sets is safe to use (does not endanger user and the surroundings).	20	20
Average		20	17.2

From the needs assessment that has been done, it can be conclude that the manual books need to co-exist with the experimental set as it will help the user understand more about the experiment. In the preliminary study it is also found that the book should have an easy-to-understand language, as per correct Indonesian spelling and appropriate, as well as the steps in using the manual book should be explained systematically so that user will not be

confused, and the last is by defining the experiment method in sequence of steps which include drawings to explain how to assemble and use the experiment tools.

## 2. Methods

The research method used is research and development (RND) method. This method aims to produce and develop manual books and experiment sets. The manual book and experiment sets supports the process of science with physics experiment skills.



**Diagram 1.** RND Research Flowchart

- Research and information collecting*; include in this step are literature studies related to the issues and preparation to formulate research frameworks.
- Planning*; include in this step is formulating skills and expertise related to the problem, determine the objectives and what will be achieved at each stage and if possible or necessary can also conduct a test on a limited basis.
- Develop preliminary form of product*, which develops the initial form of the product to be produced. This step include preparation of supporting components, preparing guidelines, and evaluating supporting equipment.
- Preliminary field testing*, is conducting initial field trials on a limited scale, which involve 6 to 12 people as a subjects. In this step, data collection and analysis can be done by interview, observation or questionnaire.
- Main product revision*, is to make improvements to the initial product produced based on the initial test results. This improvement is more likely to be performed more than one, depends on the result shown in the limited trials.

- f) *Main field testing*, is the main product testing involving all students.
- g) *Operational product revision*, is to make improvements or revision to make the product ready to be validated.
- h) *Operational field testing*, is to validate the product that has been developed.
- i) *Final product revision*, is to finalize the model developed and produce the final product.
- j) *Dissemination and implementation*, is the process of disseminating product or the model that has been developed.

Manual books and experiment sets that has been developed is then validated by content and media expert before continuing to the next step, implementation. The Instrument rating scale uses in validating the manual books and experiment sets that has been developed is a five scale shown as below:

**Table 3.** Instrument Rating Scale

No	Alternative Answer	Score	
		Positive (+)	Negative (-)
1	Excellent	5	1
2	Very Good	4	2
3	Good	3	3
4	Fair	2	4
5	Poor	1	5

### 3. Result and Discussions

#### 1. Small-scale field test

Small-scale field test is tested to 4 university students semester 6, State University of Jakarta.

##### a) Manual Book

No.	Indicator	Manual book developed (%)
1	The module is named "Basic physics experiment manual"	85
2	Manual books can help user using the experiment set.	63
3	The language used in Manual Book is easy to understand by the user.	69
4	The language used in Manual book is appropriate.	74
5	The step-by-step instructions in the manual book are systematic.	67
6	The images used in Manual book ease user during the experiment.	56
7	The method section in the manual book is easy to understand.	62

#### b) Experiment Sets

No.	Indicator	Set experiment developed (%)
1	The experiment sets developed is user friendly	73
2	The experiement sets developed include many different experiment.	65
3	The maintenance of the experiment set is easy and efficient.	86
4	The experiment sets developed is portable.	77
5	The experiment sets is safe to use (does not endanger user and the surroundings).	86

#### 2. Large-scale field test

Large-scale field test is tested to 20 university students semester 6, State University of Jakarta.

##### a) Manual Book

No.	Indicator	Manual book Developed (%)
1	The module is named "Basic physics experiment manual"	85
2	Manual books can help user using the experiment set.	70
3	The language used in Manual Book is easy to understand by the user.	77
4	The language used in Manual book is appropriate.	74
5	The step-by-step instructions in the manual book are systematic.	79
6	The images used in Manual book ease user during the experiment.	74
7	The method section in the manual book is easy to understand.	75

##### b) Experiment Sets

No.	Indicator	Set experiment developed (%)
1	The experiment sets developed is user friendly	80
2	The experiment sets developed include many different experiment.	80
3	The maintenance of the experiment set is easy and efficient.	86
4	The experiment sets developed is portable.	77
5	The experiment sets is safe to use (does not endanger user and the surroundings).	86

### 3. Product Implementation

The product implementation is tested to 20 physics education students from State University of Jakarta and 3 different schools in Jakarta.

#### a) Manual book

No.	Indicator	Manual book developed (%)
1	The module is named "Basic physics experiment manual"	85
2	Manual books can help user using the experiment set.	87
3	The language used in Manual Book is easy to understand by the user.	79
4	The language used in Manual book is appropriate.	83
5	The step-by-step instructions in the manual book are systematic.	82
6	The images used in Manual book ease user during the experiment.	83
7	The method section in the manual book is easy to understand.	86

#### b) Experiment Sets

No.	Indicator	Set experiment developed (%)
1	The experiment sets developed is user friendly	87
2	The experiment sets developed include many different experiment.	83
3	The maintenance of the experiment set is easy and efficient.	86
4	The experiment sets developed is portable.	77
5	The experiment sets is safe to use (does not endanger user and the surroundings).	90

### 4. Conclusions

A manual book and sets experiments has been developed using research and development methods which include needs assessment, product development, and product trial stage. The manual books that has been developed is then validated and tested to expert (content, media, and teachers) to indicate whether the manual books are effective or not, thus making users feel a lot easier when doing experiments.

The manual books that has been developed has some advantages such as presenting instructions of the experiment sets and the

stages on how to assemble the experiment sets which include picture. Each of the component in the experiment sets are explained thoughtfully so that the user will feel at ease in using the experiment sets.

The instructions used in the manual book is a step-by-step systematic explanation that would make users understand the concept of the experiment.

The manual books and the experiment sets has been validated and tested to media expert and users which result in 83.6% for manual books and 84.6% for experiment sets. Based on the validation and field-test data, it can be conclude that the manual books and experiment sets that has been developed is effective to use.

The Manual books and experiments sets that has been developed has been used by university students and high school students for training experimental skills.

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