

# Development of Physics Learning Device Based on Modified Free Inquiry as a Supporting Curriculum 2013 at Senior High School

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**Abstract**—The research aims to obtain related information: (1) the characteristics of teaching aids of physics learning based Modified Free Inquiry (MFI); (2) feasibility of teaching aids of physics learning based MFI; and (3) the level of achievement activities physics of learning-based MFI. This research is research development focused on developing of teaching aids of physics learning based MFI such as learning of materials, worksheet for students (LKPD), learning implementation plan (RPP), the assessment instruments, and form validation, feasibility sheet teaching aids of physics learning. The development model used in this study refers to the 4-D model of development which consists of stages define, design, develop, and disseminate. Trials conducted at SMA Negeri 3 Takalar in class XI MIA with the number of sample students as much as 36 students. The results showed that the teaching aids developed include: materials, RPP, LKPD, assessment instruments include of the validation sheet, feasibility of teaching aids sheet, the activity of the student sheet, and the results of the study revealed very valid Content Validity Value (Vc) of the test through Gregory assessment for all devices are in the range of  $3.5 \leq x \leq 4$ . The results for the feasibility of teaching aids is done entirely on the category with the highest average of 1.75. Learning outcomes for learners who are taught through learning physics-based MFI obtained an average score of 10.59. Next activity learners generally appear at each meeting. On the activities of the wants, the learners learning activities that have the highest percentage of visual activity and activity is metrics. Whereas, in the discussions and activities of the project have the highest percentage is a visual activity.

**Keywords**—*curriculum 2013, modified free inquiry*

## I. INTRODUCTION

Education in Indonesia currently faced with several strategic issues, among others: (a) the study should involve students actively in finding and establishing his own material learning; and (b) learners must have a high level of thinking ability, reason, applying conceptual and procedural knowledge to solve problems, and presents the concept of interconnectedness of learning material learned effectively and creatively. In the face of such issues, the Government of Republic Indonesia through the Ministry of education and culture in the face of the strategy devised several has been forming K 13 as the strategy of education in learning. One step taken was to make changes and refinement the curriculum ranging from primary and secondary education curriculum through 2013.

In this context, one of the important elements of the curriculum changes is teachers and students. Teachers required in compiling learning materials should involve students in daily life. In addition, the learning device used by the teachers also affects the reached learning objectives. To answer the demands above in Permendikbud Number 59 Years 2013 2014 related curriculum at secondary school (SMA), hinted about the need for the learning process that is guided by a scientific approach (scientific). Through the application of a scientific approach, learners are trained to discover the scientific truth in seeing a phenomenon of science. Based on Permendikbud numbers 22 years of 2016 about standard processes, to strengthen the scientific approach needs to be applied the model of learning which enables learners to actively find new concepts or inventions of his own through observation, exploration, research, and procedures. One of the learning models to suit the demands of the curriculum inquiry learning model is 2013 [1].

The learning process by using a model of inquiry learning model with very appropriate based on the characteristics of the scientific approach to curriculum in 2013. Sund and Trowbridge (2000) suggest there are three types of inquiry learning model that are (1) guided inquiry; (2) free inquiry; and (3) modified free inquiry. the three types are learning of inquiry model; the researchers chose the non-modified inquiry model (modified free inquiry) on the grounds that this model is at mid-level of the inquiry model. Another consideration is that the model of inquiry social interactions it has often been performed and the results are good that needs to be improved through physics-based learning Modified Free Inquiry (MFI) in order to eventually learners can investigate freely [2].

Inquiry-based learning is a process of learning by engaging students in the learning process. Learning inquiry is a dynamic approach that engages learners in investigating, ask questions, create a hypothesis and test the hypothesis to get new understanding. There are four levels in the inquiry of which is a level confirm by giving learners issues, procedures and solutions to be found. The second level is a level structured inquiry by giving the learners the problems and procedures, third level guided inquiry which only gives the learners the problems only. The last level is an open inquiry with just give learners a theme that will be studied [3].

**TABLE I. SYNTAX MODEL OF LEARNING THAT IS ADAPTED FROM THE NONMODIFIED INQUIRY (MFI)**

Stage	Learning of Activities	Time (minutes)
<b>Initial Activities</b>	a. expressions greetings b. check for the presence of the learners c. preparing learners to follow the learning process with good	5-10
<b>Core activity</b>		
<b>Stage 1</b> Orientation	a. deliver learning objectives. b. demonstrating/tells the natural symptoms associated with the problem will be investigated (observed)	5
<b>Stage 2</b> Formulating the problem	a. give problems related to early demo b. give the learners a chance to ask a clarity problem (ask yourself)	5
<b>Stage 3</b> Formulate a hypothesis	a. allows learners to propose hypotheses. b. guiding learners in determining the hypotheses that are relevant to the problems and prioritize which hypothesis is a priority in the investigation.	10
<b>Stage between</b> Plan	a. share LKPD (by group) b. provide an opportunity to understand commands in LKPD c. directs learners to make the draft according to the instructions in Guide LKPD/questions	5
<b>Stage 4</b> Doing experiments	a. redirect learners doing experiments in accordance with the plan made in LKPD.	20
<b>Stage 5</b> Evaluating the hypothesis	a. direct the students to analyze the experimental results/data information that has been collected to look at anything to do with the problems examined.	25
<b>Stage 6</b> Make inferences	a. guide students in making conclusions that will be used to build a concept/theory.	10
	b. presenting the results of observations (communicate).	
	c. give practice reserved as an application of the concept has been studied.	30
<b>Closing Activities</b>	a. make a summary of the material b. give the task as a follow-up to the application of the concept that has been learned. c. close the learning by giving greetings	15

The authors hope that the application of the learning model of MFIS is expected to support learning in physics class. Therefore, the author thinks very necessary to conduct research with the aim to find out: (1) the characteristic device of learning physics-based model of learning physics-based MFI; (2) material of learning device in physics-based MFIS; and (3) engagement (learning activities) learners in the classroom during the implementation of the model of learning physics-based MFI.

## II. RESEARCH METHOD

This research includes research development by using the 4-D model (Four-D Model) developed by s. Thiagarajan (1974) includes a definition phase (Define), arrangements (Design), development (Develop), and dissemination (Disseminate). In this case, researchers only up to at this stage of development.

The development phase is carried out by fixing device of learning appropriate advice from the validator, and the results of the tests are limited. The device has been fixed then tested on the class who has specified. Subject tests of the devices made at SMA Negeri 3 Takalar Regency 2017/2018 school year. Testing is done to obtain information device characteristics of learning, implementation, and the activity of learners.

To assess the **practicability** of learning devices obtained by analysis data implementation learning device physics-based MFIS with a category implementation every aspect or all aspects of the set as follows. Adapted from [4].

$$\begin{aligned}
 1.5 \leq M \leq 2.0 & \quad \text{done entirely} \\
 0.5 \leq M < 1.5 & \quad \text{done most,} \\
 0.0 \leq M < 0.5 & \quad \text{not done.}
 \end{aligned}$$

The criteria used to decide that learning device physics-based MFI have a sufficient degree of completed is the value  $\bar{A}_i$  and  $\bar{X}$  at least be partially fulfilled in the category. If the value of M is in other categories, then it needs to be

done by looking at the revision back aspects that are worthless [5].

## III. RESULT AND DISCUSSION

Development of learning physics-based MFI in the research that has been done refers to the 4-D model of development that consists of four stages. However, this study was limited to the third stage, i.e., the stage of definition (define), design (design), and development (develop). The third stage of the description as follows.

### A. Result

#### 1) Stage of Definition

Activities performed in this stage is to conduct an analysis of the characteristics of learners. Analysis of the learners performed to find out the characteristics of learners in accordance with the design and development of learning. The subject of the test was class XI MIA 1 SMA Negeri 3 Takalar.

#### 2) Stage of planning

This stage is intended to design a prototype device based on MFI learning material optical tools. A device composed of: (1) learning materials; LKPD (2); (3) the RPP (4) assessment Instrument in the form of sheets, sheet implementation validation of the device, sheet activity of students, and the test results of the study are developed and validated by two experts.

#### 3) Stage of development

The development phase is intended to obtain the device learning of physics has been revised based on input from experts or after a trial. The purpose of this stage is to produce a final product in the form of a learning device physics-based MFI a viable use. As for the device of learning that has been developed are as follows.

a) *Learning device developed*

1. *Learning materials learners*

In the preparation of learning materials learners, some aspects to note invalidating the device, i.e., the format, content, language and writing, benefits/usefulness. The following complete validation results can be seen in Table 2.

TABLE II. SUMMARY OF THE RESULTS OF THE VALIDATION OF LEARNING MATERIALS LEARNERS

No	Aspects of assessment	$\bar{x}$	Information
1	Format	3.9	SV
2	Content	3.8	SV
3	Language	4.0	SV
4	Benefit	3.8	SV
	Total of Average	3.8	SV

The results of the analysis are shown in Table 2. above average value for total valid learner materials acquired  $\bar{x} = 3.8$  and based on the criteria of valid; this value is included in the category of "very valid" because it is on the range  $3.5 \leq \bar{x} \leq 4$ . If the terms of the four aspects of the above in its entirety, then the material teach the learners can be expressed valid so that it can meet the criteria used in conducting research.

2. *Implementation Plan of Learning*

The aspects noted in the implementation plan of learning are: validate the format, content, language, time, and method of cereal. The results of the validation of the experts can be summarized in table 3.

TABLE III. SUMMARY OF IMPLANTATION PLAN OF LEARNING OF VALID VALUE

No	Aspects of assessment	$\bar{x}$	Information
1	Format	3.8	SV
2	Content	3.4	V
3	Language	3.4	V
4	Time	3.6	SV
5	Method	3.4	V
	Average of the total value	3.5	SV

Based on Table 3, the average value valid total of the implementation plan of learning obtained  $\bar{x} = 3.5$ . This value includes in category "highly valid" because it is on the range  $3.5 \leq \bar{x} \leq 4$ . If the review of the five aspects of the above in its entirety, then the RPP can be expressed valid so that it can meet the criteria used in conducting research. Although the overall aspect, as well as each of the aspects already meets the criteria valid, however, there are some suggestions from the experts to consider the revision of the device as well as RPP in the use of the tests in the field.

3. *Student Worksheets*

In drawing up the student worksheets, some aspects to note invalidating the device: format, language, and content. To test the feasibility of internal consistency test used student worksheets condition value  $V_c \geq 0.75$ . The statement gave through sheet validation with sixteen items statement. The complete validation results can be seen in Table 4.

TABLE IV. SUMMARY OF STUDENT WORKSHEETS OF VALIDATION VALUE

No	Aspects of assessment	$\bar{x}$	Information
1	Form	3.8	SV
2	Language	3.4	V
3	Content	3.3	V
4	Benefit	3.4	V
5	Time	4.0	SV
	Total of Average	3.6	SV

Based on the results of the analysis are shown in Table 4 average value for a total of valid student worksheets obtained  $\bar{x} = 3.6$  and based on the criteria of valid, this value is included in the category of "highly valid" because it is on the range  $3.5 \leq \bar{x} \leq 4$ . If all four of the above aspects as a whole, then this can be stated student worksheets meets the criteria valid so it can be used in research.

4. *Instrument of research*

The instruments used in this study consists of sheet implementation sheet device validation, device, device activity sheet against learning, and test the results of the study. Analysis of the results of the validation of learning instruments shown in Table 5.

TABLE V. RECAPITULATION OF THE RESULTS OF THE VALIDATION AGAINST THE RESEARCH INSTRUMENT

Instrument of Research	$\bar{x}$	Information	R
Materialization of observation sheet aids to physics learning based MFI	3.42	V	1
The activity of observation sheet aids to physics learning based MFI	3.54	SV	1
The test results of the physics learning based MFI	3.42	V	0.81

Based on Table 5, the assessment of the experts against the instrument is at a valid category and very valid and can be used without revision, and the reliability index value from both the validator (R) is in the high category.

b) *Analysis of the results of Trial Observations*

1. *Observations completed Learning Devices*

The main purpose of the data analysis learning device is to see the extent to which the level of the completed device in the learning process. In observing the completed device, the researchers use two educators partners as observers at each meeting. Based on the results of observation data analysis of observer about completed learning devices from five times the meeting can be summarized as shown in Table 6.

TABLE VI. THE OBSERVATIONS WERE CARRIED OUT A LEARNING DEVICE

No	Aspect of assessment	$\bar{x}$	Information
1	Check for the presence of the learners.	1.80	Done entirely
2	Preparing learners to learn.	1.88	Done entirely
3	Deliver learning objectives	2.00	Done entirely
4	Read LKPD which had been distributed in groups.	1.88	Done entirely
5	Ask if there are things that have not understood from LKPD	1.75	Done entirely
6	Design inquiry	2.00	Done entirely
7	Investigations	2.00	Done entirely
8	Data of Analysis	1.25	Half did
9	Conclusions	1.25	Half did
	Total of average	1.75	Done entirely

Based on the data in Table 6 shows that the completed device of learning physics-based MFIS are on average 1.75 M = which indicates that all aspects were observed on observations were carried out in the category entirely.

## 2. Results of the analysis of the activity of students

Learners learn activity data obtained using sheets of observations made by two observers observed every five minutes of learning. Data analysis activity learners aimed to see how the image of the learners learning activities that appear in learning physics-based MFI. The learning activities composed of several aspects, namely: 1) visual Activity in learning that is read, 2) oral Activity in learning include ask, issuing opinions, and discussion, 3) drawing in learning, Activity 4) Activity metrics in learning that is doing the experiment, 5) the activity of writing in learning.

Following this table recap of the percentage of learners who do structured learning activities on the learning at each meeting.

TABLE VII. RECAPITULATION OF THE PERCENTAGE OF STUDENTS WHO DO STRUCTURED LEARNING ACTIVITIES

Activity	Result of Observation		
	Meeting 1 (%)	Meeting 2 (%)	Meeting 3 (%)
Visual activity	100.0	100.0	100.0
Oral activity	43.3	37.0	38.3
Metric activity	100.0	100.0	0.0
Drawing activity	20.0	22.2	40.0
Writing activity	30.0	33.3	60.0

## B. Discussion

As already expressed earlier that this kind of research including research development (research and development) which aims to produce a learning device physics-based Modified Free Inquiry with a valid, practical, and effective so worthy of use in schools especially in SMA Negeri 3 Takalar. Organized learning devices may not necessarily be used in learning; quality assessment needs to be done to obtain maximum results.

The results of the assessment of the two validators, suggesting that the overall device component of the learning and research instrument was declared valid with little revision. If this assessment is analyzed and put into a range of categories valid, then the result obtained is valid on categories and very valid. Based on the results of the calculation of the reliability of devices and also obtained a research instrument. The results obtained for the whole device and instrument of both validators rated reliability. Based on the results of the analysis as well as learning devices research instrument in the process of the feasibility study. This is in accordance with the theory advanced by the Borich Gregory that the instrument is declared feasible if the reliability coefficient has  $\geq 0.75$ .

### 1) The application of learning devices

Device application of learning results data obtained from observations by two observers who had been appointed to assess the extent to which such learning devices can be implemented.

#### a) Implementation of a learning device

As has been outlined previously that he has met the criteria stated learning valid, whereas the designation implementation device retrieved from implementation level devices are the result of observation of the observer who has

been appointed to assess the extent to which the MFI-based learning devices can be implemented.

From the observations, the observer implementation learning devices are in the category were carried out entirely with a high level of reliability. This means that devices that have been developed can be used in learning physics-based MFI, especially at the optical material. The level of implementation of the device into the ground that the device that was developed was able to be carried out by educators as well.

Implementation of learning devices for components, there are some aspects that are assessed on learning activities. As for the aspects of observation that votes on preliminary activities namely (1) check for the presence of the learner with the value  $\bar{x}$  of 1.80 (done entirely); and (2) preparing students to learn with a value  $\bar{x}$  of 1.88 (done entirely). At the core of learning activities, namely (1) to deliver learning objectives with a value  $\bar{x}$  of 1.88 (done entirely). (1) read student worksheets which has been distributed in a group with a value  $\bar{x}$  of 1.88 (done entirely); (2) ask if there are things that have not understood from student worksheets value  $\bar{x}$  of 2.00 (done entirely); (3) designing the investigation with a value  $\bar{x}$  of 1.75 (done entirely); (4) conducting inquiry with a value  $\bar{x}$  of 2.00 (done entirely); (5) analyze data by value  $\bar{x}$  of 1.25 (partially implemented); and (6) draw conclusions with a value  $\bar{x}$  of 1.25 (partially done). A total average value judgment is 1.75 are in categories was effected entirely. Although aspects of analyzing data and drawing conclusions obtained an average value of 1.25 is partially implemented in the category.

Based on the results of the implementation learning device it can be shown that in terms of implementation each phase of the learning activities of the physics-based MFI are able to run by educators, or in other words components in device the study was designed to afford followed properly by educators to drive the implementation of learning physics-based MFI well anyway. Although it has not yet been fullest because of time limitations. The time available to work on the experimental method of investigation based student worksheets just 45 minutes, and that happened in the time it takes to complete approximately 60 minutes of student worksheets

### b) Result of study

Based on the results of the descriptive analysis on the class taught by learning physics-based MFI with a class taught by conventional learning indicates that the score results studied physics learners in class XI MIA 1 higher compared to the control class. This is in accordance with the theory that States that *inquiry learning as learning models for students to do their own experiments extensively in order to see what happens, wants to do something, ask questions and look for the answer, as well as linking to other new discoveries, compare what it finds with other learners are found* "

Based on the above description, it can be concluded that the use of a model of learning physics-based MFI can improve the results of learning physics students of Class XI MIA SMA Negeri 3 Takalar 2017/2018 school year with the material of optical instruments.

### c) Students Activity

In the implementation of the process of learning physics-based MFI can help learners understand the learning material through the activities of the investigation whether through experimentation, discussion or project. Learning physics-based MFI encourage learners to learn the subject matter of activity matches the topics will he had learned. Based on the results of data analysis, generally all learning activities students appear at every meeting. On the activities of the wants, the learners learning activities that have the highest percentage of visual activity and activity is metrics. Whereas, in the discussions and activities of the project have the highest percentage is a visual activity. It shows that the hypothesis has been compiled previously proven on-site truth research.

## IV. CONCLUSION

Based on the analysis results and discussion conclusion Learning Device physics-based MFI that is developed in this study consists of learning materials, Student worksheet, Implementation Plan of Learning and instruments in the form of sheet implementation sheet devices, activities and student learning outcomes tests developed have been

declared valid by two experts with little revision on aspects of grammar. The level of reliability of the device is in the categories high. Thus a device developed fine and decent stated use. Learning Device physics-based MFI is expressed practically in accordance with the results of the analysis of observations of implementation devices that are in the category were carried out entirely. Learning physics-based MFI declared effective by referring to the increase in score study results of students taught by using model-based learning, student learning and activity of MFI in each meeting.

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