The development of the PhET learning program's learning support worksheet

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Abstract. Research and development had been done to produce a product in the form of PhET Learning Materials Application Support Worksheet. The feasibility of worksheet is also described in this study. The feasibility of the worksheet was reviewed from the validity, practicality, and effectiveness of the worksheet. This study used a modified 4D development model with Define, Design, and Development phases. The developed worksheet was tested on 39 students of class XII IA 2 SMAN 1 Muara Teweh. The instruments used in this study consisted of worksheet validation sheet, test of learning result, and student response questionnaire. The analysis results showed that validity of worksheet category was valid (76.00), practicality of worksheet was categorized good (75.00), and worksheet was effective because there was difference between pretest and posttest score of learners (sig <0.05). The conclusion is that the PhET Learning Materials Application Support Worksheet on Electrical Power Materials is feasible for use in learning.

1. Introduction

Technological developments in communication include two rapidly growing technologies, namely mobile phones or hand-phones and computers with the Internet network. Global demands require education to adapt technological developments in improving the quality of education. Especially, the adjustment of the use of learning media such as the use of computer media with the Internet network. The use of computer multimedia can be used as an alternative to improving students' science process skills [1].

Physics which is part of science developed as applicative-oriented education, develop the mindset, learning ability, and curiosity of learners (Law No 20 Year 2003). Based on the interview with the subject of physics at SMAN 1 Muara Teweh stated that learning is still centered on the teacher. In addition, the tools of the laboratory are rarely used and less well maintained most of the tools there are not worth using. In fact, the lab plays an important role in science education [3]. This makes the teacher must think of other ways that the competence to be achieved by learners can be met. This is because a good teacher should learn how to engage students in scientific practice [4].

This causes the need for a learning media that is able to replace tools that have been unfit to use earlier. The computer device at the school where the study is adequate and its internet network. Computer devices can help students to research additional information and attract students' attention. PhET Media Simulation is one solution to solve the above problem. PhET is a site that provides a wide range of sciences simulations that can be used for free either for individual interest or classroom

teaching [5]. PhET uses dynamic graphs to animate the visual and conceptual models used by experts [6]. Simulations with computers like this is enough to help physics teachers [7]. PhET is used so students learn to discover, showing, communicating, applying, or testing an idea [8]. Through PHeT, students will engage in learning simulations and enjoy them to grow results [9].

Students need a worksheet to support the use of the media. This is so that the competence to be achieved in a learning can be fulfilled. Student 'worksheet should contain the title, basic competencies, completion time, tools and materials used, brief information, steps of activities, tasks to be performed, and reports to be worked on. A worksheet is a tool used in learning to help learners in doing activities in sequence [10]. Student's Worksheet can also be a guide to cognitive training or a guide to developing learning in the form of a practicum or demonstration guide [11]. Student's Worksheet is very important because, through Student's Worksheet, students seek information and conclusions in groups [12]. Student's Worksheet based guided inquiry allows students to apply learned concepts and solve problems based on science process skills (SPS) [10]. Student's Worksheet is also useful in improving process skills, scientific attitudes and learning interests and students [13]. This is consistent with Phet media itself, which can develop SPS students [14]. By using Student's Worksheet, learners are able to practice by using PhET media so that the competence to be achieved in this Static Electric material can be achieved.

Student's worksheet is used in a guided inquiry model in which learners play an active role in learning. Inquiry learning has the potential to train students' process skills [15]. This is in line with the demands of the 2013 Curriculum that require learners to play an active role in learning. According to Lewicki, the guided inquiry is defined as the interaction of learners with a particular object of the guidance of teachers to be able to solve the problem [16]. While the National Science Education Standards (NSES) mentions that inquiry includes a wide range of activities including observation; planning an investigation; using tools for collecting data, analyzing, interpreting data, submitting answers, predicting, clarifying, and communicating results [17].

Therefore, researchers develop Student's Worksheet that can support the use of PhET learning media. In this article, researchers describe the feasibility of Student's Worksheet supporting PhET learning media in Electrical Power materials with guided inquiry method, in terms of the validity, practicality, and effectiveness of the Student's Worksheet.

2. Method

The type of research used is research and development. The goal is to develop a student's worksheet that is capable of supporting PhET learning media in Static Electric materials with guided inquiry models. The research and development steps were carried out using a modified 4D model to Define, Design, and Development.

In the defining stages of preparation for the creation of student's worksheet ranging from identifying learning objectives, analyzing student characteristics, and analyzing learning materials. The activity at the design step is to explain the details of the Student's Worksheet developed based on the analysis of the characteristics of the students, the competencies to be achieved, and the characteristics of teaching materials. Development stage begins with developing Student's Worksheet, then validates the Student's Worksheet. If the Student's Worksheet developed has been validated, then proceed to the final step, which is to simulate before the researchers plunge the space.

The place of research is at SMAN 1 Muara Teweh is located at Jl. Tomonggong Surapati no. 43 Muara Teweh, Barito Utara, Central Kalimantan, Indonesia. The subjects of the study were Student's Worksheet for the subjects of the experiment of 39 students of class XII SMAN 1 Muara Teweh academic year 2017/2018. The object of research is the feasibility of Student's Worksheet physics of SMA XII class of the subject of Static Electricity.

The data collection technique begins by validating Student's Worksheet. Validation is done by the validator to know the validity level of Student's Worksheet. This is seen from the appropriateness of Student's Worksheet with the theoretical foundations of its development as well as to know the quality

of the Student's Worksheet developed. Validity is known from validation questionnaires filled by validators. The average scores of validators are tailored to the device scoring criteria as follows .

Table 1. Student's Worksheet Rating Criteria

No	Interval	Category
1.	$X \geq 3.25$	Very Good
2.	$2.5 < X \leq 3.25$	Good
3.	$1.75 < X \leq 2.5$	Enough
4.	$X \leq 1.75$	Poor

Student's worksheet's validity criterion shows the fit between Student's Worksheet's compilation theory and Student's Worksheet. If it is not valid or valid based on validator theory and input, then the Student's Worksheet needs to be fixed. Percentage of Student's Worksheet Validity obtained the equation as follows:

$$P = \frac{\sum K}{\sum N} \times 100\% \quad (1)$$

P = Percentage of validity
$\sum K$ = The number of aspect scores observed
$\sum N$ = Maximum number of aspects observed

The practicality level of Student's Worksheet is seen from the response questionnaire given to the learner. Student's response analysis to Student's Worksheet is calculated using the equation (2)

$$P = \frac{\Sigma x}{SM} \times 100\% \quad (2)$$

There are two criteria in the student's questionnaire response to Student's Worksheet, the response criteria and the reaction criteria [18]. The response criteria relate to the format and relevance of Student's Worksheet. It includes the contents of the Student's Worksheet, presentation style, and the appropriateness of Student's Worksheet with teaching materials, everyday life, and thinking patterns of learners. The criterion of the reaction relates to how students react to the Student's Worksheet they are using. This includes the attention, satisfaction, and confidence of learners.

The effectiveness of learning is measured from the test results of learning by doing pretest and posttest. Effectiveness is analyzed using *paired sample t-test* [19]. The hypothesis consists of two hypotheses namely H_0 and H_a. H_0 is that there are differences in pretest and posttest scores of the students. H_a there is no difference between the students' pretest and posttest scores. H_0 accepted if the probability value obtained is smaller than the level of significance. Conversely, if the probability value is greater than the level of significance, then H_0 rejected and H_a be accepted.

3. Results and Discussion

The researcher produced the product of Student's Worksheet supporting PhET learning program application. The material on Student's Worksheet was static electricity. Student's Worksheet was applied to the guided inquiry model. Student's Worksheet was used to support PhET learning media. Student's Worksheet consists of 4 subsections for 4 meetings on the subject of force and electric field, electric potential, and capacitor. Each material was equipped with facts or events that quite often students encounter in everyday life so that learning can be more contextual. Based on this, students were guided to explore their own knowledge through experiments and observations. Through such experiments and observations, students practiced using science process skills and scientific attitudes in the process of recognition of theories of physics. By guiding students to find these theories, students could play an active role in exploring knowledge so that learning could be more meaningful and memorable by students.

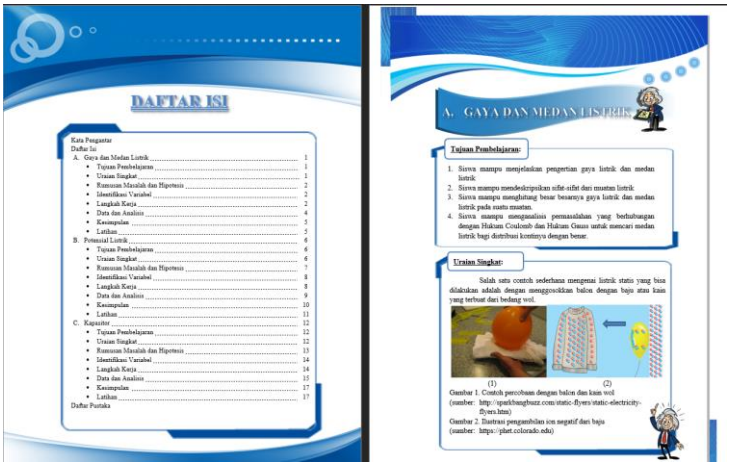

Figure 1. Display of student's worksheet developed.

3.1. Student's Worksheet Validity

Instrument Validation was done by requesting two experts as Validator. Validation was done on the Student's Worksheet that has been developed. It aimed to see the level of validity of the instrument to be used. The results obtained were as follows.

Table 2. Student's worksheet validity analysis.

No.	Aspect	Category
1.	Student's Worksheet Format	Good
2.	Contents Student's Worksheet	Good
3.	The language in the Student's Worksheet	Good
Average Score	76%	Enough Valid

Based on Table 2 it was found that the validity of Student's Worksheet developed was 76%. Student's Worksheet developed into a category Enough Valid. Student's Worksheet validity had 4 aspects, namely content component, linguistic component, the component of the presentation, the component of the graph [20]. Based on the validity test results, the Student's Worksheet content component and the Student's Worksheet language component had a good category. As for the components of presentation and graph could be seen from the aspect of Student's Worksheet format with the results of analysis stating that this component had a good category. Since these four components were fulfilled, it means that the Student's Worksheet developed was valid, ie true and correct format, content, and language based on the experts.

3.2. Practicality of Student's Worksheet

The results obtained from the student response questionnaire after using Student's Worksheet are as follows.

Table 3. Student Response Questionnaire Analysis

Aspect	**Category**
Response Criteria	Good
Reaction Criteria	Good

According to [18] there were two criteria in the student's questionnaire response to Student's Worksheet, the response criteria, and the reaction criterion. Table 3 shows that the criteria of responses had a good category. That is, the response that students give to Student's Worksheet is good. While the criteria for the reaction of each indicator had a good category. The result, as a whole, obtained a practical percentage of 75%. The results of this study indicate that the practicality of student's worksheet developed was categorized good.

Student's worksheet developed by researchers is practical. Student's Worksheet was practically used in inquiry learning on static electricity because it facilitates and benefits students. Other research results showed that student's worksheet used in the application of virtual lab media makes it easier for learners to understand learning [21]. Other studies had shown that Student's Worksheet could increase learners' activity during the learning process, allowing teachers to direct students to discovered the concepts they were learning [13].

Good Practicality was also because PhET itself appeals to students in science learning [8], [9]. *PhET provides dynamic access, and makes multiple experiments possible* [8]. Students become motivated in following the lessons using PhET [22]. *PhET also describes things that are not seen directly by students* [6]. Example on Worksheet 1 on PhET simulation "Sweater-Balloon", students can see the electric charge.

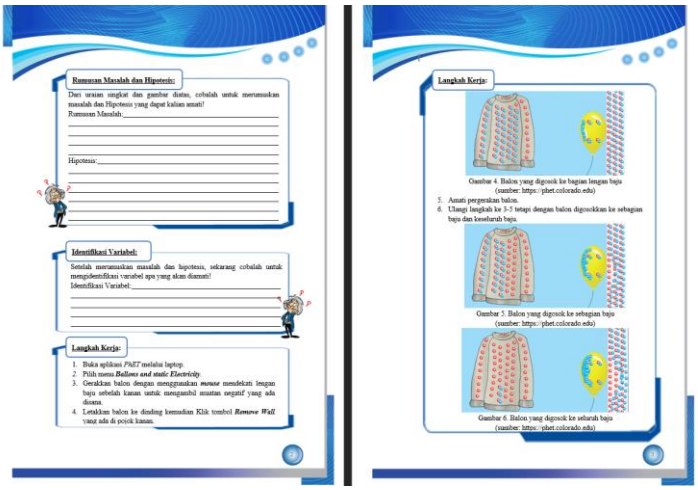

Figure 2. Display Worksheet 1

3.3. Effectiveness of Student's Worksheet

Meaningful learning was learning that involves cognitive processes. The effectiveness of Student's Worksheet was seen from the cognitive outcomes of learners as measured by providing pretest and posttest. Pretest and posttest itself consist of a total of 15 questions consisting of 10 multiple choice questions and 5 essays. Before the paired sample t-test is done, normality test was done first. This was done to see whether the data obtained is normally distributed or not. This was a requirement to test the paired sample t-test on SPSS. The result was as follows.

Table 4. Results paired sample T-Test.

	Sig. (2-tailed)	Conclusion
Pretest – Posttest	.000	there is a difference between the student's pretest and posttest score

After the normality test, we could do the paired sample t-test to find whether there was a difference between the pretest and posttest values of the students. The degree of confidence used was 95% or with a significance level of 0.05. The results obtained are as in table 5 with a probability value of

0.000 whose value was smaller than the significance level of 0.05 so that it can be interpreted that there was a difference between the value of pretest and posttest learners. This means that there were differences in the value obtained from the learner from before the given material until after given the material. This difference occurs because students had used Student's Worksheet to support the application of PhET learning programs on developed Static Electric materials.

Based on the results, Student's Worksheet supporting the application of the learning program successfully helped the learners in understanding the learning. The used of Student's Worksheet and supporting learning media will make learning more meaningful [23]. Other studies have also shown that Student's Worksheet based on guided inquiry using virtual labs can influence student learning outcomes [24].

4. Conclusion

Based on the results of the development, it can be concluded that the Student's Worksheet supporting the application of PhET learning program on Static Electricity materials with guided inquiry model is feasible to be used based on the following data: (a) Student's Worksheet validity developed by category is quite valid with 76% percentage; (b) The practicality of Student's Worksheet is categorized either by percentage of 75%; (c) Student's Worksheet is said to be effective because there are differences in pretest and posttest values obtained by learners with a significance value of <0.05.

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