Validity and Practicality of the Students' Worksheet Based Multiple Representations on Dynamic Electricity Material

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Abstract. This Research has the purpose to get high validity and practicality on students' Worksheet. The method used was research and development (R&D) following Borg and Gall's steps, which simplified into three phases: literature study, planning and development, and field test. Literature study phase was used to review the curriculum, do observation, review the relevant theory, determine the purpose, and interview the interviewees. The result of this phase produced early data related to students' worksheet preparation. Planning and development phases were used to arrange students' worksheet, lesson plan, making media, assessment, sheets of observation, questionnaire and validation expert sheets. This phase produced an early product of students' worksheet based multiple representations through four steps. Field test phase was used to do a limited field test. Limited try out was chosen from one class, taken random sample proportionally. Data collection tools in this research were the observation sheet of students' worksheet implementation, students' activities, and students' worksheet legibility questionnaire. Data were analyzed through descriptive analysis. In this stage, it resulted in the students' worksheet which had high practicality shown by the high implementation of students' worksheet, student's positive response towards students' worksheet based multiple representations.

Keywords: Validity, Practicality, Students' Worksheet, Representation

1. Introduction

2013 curriculum emphasizes students' learning activities, such as observation, asking, data collecting, associate, and conclude it after accepting the lesson. Besides that, 2013 curriculum acknowledges that knowledge cannot be transferred from teacher to students directly [1]. Physics is a very important subject in the education system around the world. Because physics is a science which underlies the development of science and technology. It has an important role in some science fields and to advance human's thinking. Physics considered as difficult lesson for students to understand [2]. That is why, physics is taught in every stage of education, starts from based education to high education. In learning physics, students must understand and be active in building up new knowledge from experiences and knowledge they have before. One of the physics materials is dynamic electricity. Dynamic electricity is abstract material and has high complexity so that students often get into trouble especially in applying dynamic electricity concepts [3].

Learning Physics does not only depend on what had been taught, but it also depends on how physics taught or how students study. Therefore, students must be given the freedom to avoid them from being stressed when studying. Based on interviewed and observation in 2017 towards the implementation physics learning at XII grade of SMA Al Kautsar Bandar Lampung, it found that students' worksheet used is still consist of the summary of materials, examples, and exercises. Exercises tend to have the same types with precede questions even some of them are the repetition of the last questions. Students said that the worksheets used to make them bored to finish the questions given. Some students also said that they do not understand about the materials and questions given, and sometimes they get lazy to do all the exercises. One of the reasons is the monotonous and not attractive form of the students' worksheet.

Besides, students only receive the materials, not active to ask, tend to be busy talking with friends while the teacher is explaining, and often get sleepy in the learning process. This thing causes students cannot understand the materials. In dynamic electricity students still get confused to understand it. Because students do not get the freedom to investigate by themselves about the difference between dynamic electricity so that the concept of dynamic electricity does not really settle in students' mind. Teachers' role is as the facilitators, as well as prepare the learning devices [4]. Students' worksheet is one of the means to help and make easy in learning and teaching activities [5]. Therefore, it needs to make an interesting students' worksheet, then gives a chance to them to investigate what is needed in finishing problem so that students will get a good learning experience, an understand the whole concept, as well as help in reaching learning purpose. According to Mayasari, et al. [6] students' worksheet is sheets consist of an order to be done by students, in the form of steps to finish a task. Students' worksheet multiple representations is chosen as alternative teaching material in learning physics, because students' worksheet has advantages that are supporting the learning process, reaching learning purpose. The practical material can attract as well as motivate the learning [7].

Learning model also influences in a learning activity. One of the ways to understand physics concept is through multiple representations material. Explanation with proper picture or chart to the electricity material will be more easy for students to understand. One of the learnings that can support the learning is multiple representations [8]. Students use representation to support the understanding when they solve the problem or studying new concepts to be proficient in solving the problem. It can use some representations or multiple representations.

Students' worksheet REAL seeks the advance representation of ability from investigation and application result in solving the problem. This students' worksheet is supported by constructivism learning theory as well as the research result which stated that solving problem has relation with representation knowledge, topic, and experience [9]. It needs to have the ability to interpret or build a representation, and the ability to translate [10], as well as switch among; and multiple representations have the role in physics solving the problem [11].

Multiple representations have three functions; they are: as complementary, limitation of interpretation, and understanding builder [12]. The role of multiple representations is as the core of the science learning process [13]. Then material with one form of representation cannot explain the meaning of material [14]. The representations used such as verbal representation, picture or diagram, and chart representation is still lack of using in learning. The format of multiple representations is grouped into verbal, picture/diagram, mathematical, and chart [15]. Verbal representation has the function to define a concept; picture or diagram format has the function to help the abstract visualization concept; mathematical format has the function to solve the quantitative problem based on qualitative representation, and chart format has the function to present a long explanation of a concept. In this research, students' worksheet was used to support learning the worksheet and other learning media which allows students to study alone or in groups with a physics teacher's guiding. Students' worksheet is packed orderly following REAL strategy, that is recognizing the concept, explaining the concept with some representations, applying concept through the example of solutions, and looking

back the correlation between the concepts [16]. Therefore, the abstract material will be easy to understand by students. It needs so much to develop students' worksheet about dynamic electricity material based on multiple representations, to enhance metacognition ability and problem solving on dynamic electricity material. Students can search for the information from surrounding by the helping of students' worksheet. It will make students get interested because they can study as well as play. So, there is a correlation between students' worksheet with a REAL model, they both have the support in teaching and learning process to reach the purpose of learning. As for students' worksheet development is to produce students' worksheet for learning with the REAL model on valid, practical, and effective dynamic electricity. Students' worksheet validity is based on the result of validation for practical aspect based on students' worksheet implementation, and students' response towards students' worksheet.

2. Method

This research is about research and development, that is to develop dynamic electricity of students' worksheet based multiple representations to increase metacognition ability, and problem-solving of students grade XII. The method used in this development research is Research and Development (R&D). In this research and development, the researcher used Education Research and Development (R&D) model by Borg & Gall [17]. This research was conducted in odd semester 2017/2018 in physics subject related to electricity dynamic. The research emphasized on analyzing validity and students' worksheet practicality to enhance students' metacognition ability, by doing the analysis the students' worksheet validity level theoretically, such as content and construct validity. Content validity covers compatibility between material and curriculum, material description, question order and arrangement, and evaluation; construct validity covers: compatibility of letter and picture, material order, and writing consistency. Students' worksheet practicality covers students' worksheet implementation, students' activities and responses towards the model.

Data Analysis
Data analysis in this research and development basically related to descriptive analysis. Students' worksheet appropriateness as what it has been defined, consists of students' worksheet validity and practicality.

2.1. Validity and Reliability

2.1.1. Validation test
Before applying all the learning devices like Learning Implementation Plan or *Rencana Pelaksanaan Pembelajaran* (RPP), students' worksheet, observation sheet, chart, and evaluation tool, they have to be validated by experts first. Learning device is validated by expert lecture based on his study field, that is an expert lecture in physics education, the expert in physics evaluation and expert lecture in technology education.

The result of validation was analyzed with product compatibility instrument, that is characteristic of the material, and design. The instrument used to do characteristic product assessment is chart instrument. Chart assessment instrument of material and design addressed to design expert and material expert has four answering options based on question content, for example: "very appropriate, appropriate, less appropriate, and not appropriate."

Special for the test instrument, besides being validated by an expert, it is also validated by using Pearson correlation test to know how far the correlation between answer in the test item which is given mark dichotomy with test score totally. Validation test on the question items to benchmark reference assessment or *Penilaian Acuan Patokan* (PAP) is by doing correlation test between x variable (item score) and y (total score) by using product moment correlation used SPSS v. 17 programs. The interpretation of coefficient correlation (r_{xy}) for validation test according to Arikunto [18], is shown in table 1.

Table 1. List of the coefficient of validation test criteria

Validity coefficient	Explanation
$0.80 \leq r_{xy} \leq 1.00$	very high
$0.60 \leq r_{xy} \leq 0.80$	high
$0.40 \leq r_{xy} \leq 0.60$	average
$0.20 \leq r_{xy} \leq 0.40$	low
$0.00 \leq r_{xy} \leq 0.20$	very low

Instrument test criteria considered good if validation level is minimally average. If validation achievement is under the average category, so the questions have to be revised or changed. Next instrument revision is tested again until getting minimally average category.

2.1.2. Reliability Test
The testing of test instrument reliability has the purpose to know the constancy of the questions. Questions which tested the reliability are metacognition ability test, and problem-solving ability. All kinds of the instruments are kinds of non discrete score instrument The testing of the instrument reliability non discrete score by using benchmark reference assessment (PAP) and counted using SPSS v.17 program. Reliability test is done to test the constancy level of instrument used. The counting of reliability in this research use Cronbach's Alpha with formulation:

$$r_{tt} = \left(\frac{n}{n-1} \right) \frac{S_t^2 - \sum S_t^2}{S_t^2}$$

(1)

Note :
r_{tt} = reliability coefficient test of Cronbach's Alpha
n = the number of question item
S_t^2 = total score variant
$\sum S_t^2$ = the number of a variant score of each item

The using of Cronbach's Alpha formulation used with the reason that the counting is easy to do and prevalent procedure to estimate reliability from internal consistency test based on the correlation among items. The interpretation of reliability uses Arikunto's interpretation [18], as it is stated in table 2.

Table 2. Coefficient reliability criteria

Coefficient reliability	Explanation
$0.80 < r_{tt} = 1.00$	very high
$0.60 < r_{tt} = 0.80$	very high
$0.40 < r_{tt} = 0.60$	average
$0.20 < r_{tt} = 0.40$	low
$0.00 < r_{tt} = 0.20$	very low

Instrument test criteria have good reliability level if achievement level is under the average category, so the questions need to be revised or changed. Next instrument revision is tested again until the instrument gets reliable.

2.2. Students' worksheet analysis practicality
Students' worksheet practicality based multiple representations is determined by students' worksheet implementation based on multiple representations in learning. After getting the data, the next step is to

analyze the data the result of data observation is made as the background of this research. Students' worksheet practicality is determined by students' worksheet implementation based on multiple representations use the REAL model in learning. Students' worksheet implementation is determined by the consistency between intended-perceived (IP) done by an expert and *intended*-operational (IO) done by the observer.

Students' worksheet practicality is determined by an expert (IP) has been explained clearly in students' worksheet validity part and its devices. Students' worksheet practicality by an observer (IO) is determined based on observation towards teacher who done the learning. Students' worksheet has good practicality level if IO category level is minimally good. If the level of students' worksheet practicality achievement is under the good category, so it must be revised based on a suggestion from observer and learning activity is repeated until getting good students' worksheet practicality level.

The analysis of students' worksheet practicality is by using learning implementation and students' response toward student's worksheet given.

2.2.1. Data analysis of observation sheet of learning achievement
The implementation of learning is measured through observation towards learning implementation. For the analysis of learning implementation, done the steps as follows:

a) Count the number of scores given by observer for every observation aspect, then counted the achievement percentage with the formulation:

The instrument used has five answering options so that the assessment score can be searched by using formulation based on Sugiyono [19]:

$$\text{evaluator score} = \frac{\text{the number scores on the instrument}}{\text{the number of high total scores}} \times 100\%$$

(2)

b) Interpret the data by achievement criteria learning implementation. Assessment scores from each answering option can be seen in table 3 based on Arikunto [18]:.

Table 3. Assessment statement of conversion scores of practicality quality scores

Answering options	Scores
Excellent	81-100%
Good	61-80%
Enough	41-60%
Poor	21-40%
Very poor	0-20%

Then the average of The result of score assessment is counted from some try out samples and converted to an assessment statement to determine the quality and practicality level of the product produced based on learning implementation using products.

3. Result and Discussion

3.1. Expert Validation towards student's worksheet

Students' worksheet consists of content and constructs validations. Content validation contains about newness or upgrades of student's worksheet. Meanwhile, construct validation, students' worksheet is designed logically, supported by learning theory, devices, and learning media. Three experts do Student's validation hypothetical, they are:

Table 4. Expert's assessment of students' worksheet (content validation)

No.	Student's worksheet	Validator's assessment			average	explanation
		I	II	III		
1.	I	81.00	80.00	78.00	79.67	Valid
2.	II	69.00	82.50	82.50	78.00	Valid
3.	III	82.50	81.00	81.00	81.50	Valid
average		77.50	81.17	80.50	79.72	Valid

Table 5 Expert's assessment towards students' worksheet (construct validation)

No.	Student's worksheet	Validator's assessment			average	explanation
		I	II	III		
1.	I	69.00	79.00	75.00	74.33	Valid
2.	II	63.60	82.00	85.40	77.00	Valid
3.	III	72.00	85.00	82.00	79.67	Valid
average		68.20	82.00	81.00	77.00	Valid

Based on table 4 and 5, average marks for every students' worksheet has very high content and construct validations. This result shows that the design of students' worksheet has content validation, such as material summary, observation question, and activity as well as suitable experiment with the curriculum guide and the purpose of learning achievement. In construct validation, There is a connection between theory, questions, observation activity, experiment connection; there is no overlap question or statement. However, there still need revision. Validator's assessment towards students' worksheet covers some component aspects. Some of them are students' worksheet characteristic aspect, consistency, language, list of libraries, and multi-representation learning. For students' worksheet improvement that has been developed, the researcher must consider validator's suggestion to revise the student's worksheet, so that the students' worksheet looks more ready to be tested by students.

The result of early Try Out (limited try out)

Limited try out is done to4 years grade XII IPA 2018/2019 SMA Al Kautsar Bandar Lampung. The steps of activities done are planning of learning, implementation, observation, and reflection.

3.1.1. Planning
In the planning of learning, activities done are to prepare learning devices, like syllabus, RPP, students' worksheet, and RPP instruments which is prepared to refer to a REAL learning model. Students' worksheet and questions test are arranged suitably for formulated indicators in RPP. Before using, All learning devices must be validated by the expert first and meet the requirements to do in learning. Questions test based on the result of the statistic test used in learning has met the requirements, that is valid and reliable.

1)   Implementation
Learning implementation discusses electricity dynamic subject which is done in 3 times meeting in 3x45 minutes for each meeting. The learning process is done based on RPP. Learning activity consists of three parts, they are:

a)   Early activity

Early activity (introduction) is done ±15 minutes, started with appreciation, deliver the purpose, ask questions related to material that will be discussed to motivate students to be active in learning.

b)   Main activity
This activity takes place ±120 minutes, started with introducing the target concept, guide the students to know analogy concept, which is the most similar concept to target concept. Students make groups and discuss in groups, make the relation between the target concept and analogy concept. Next, every target concept is explained through some representations. Students work in small groups to explain target concepts verbally, visually, and symbolically. The next step is to understand some problems related to the material. At first, students know the problem well by displaying model (problem identification and formulation), second, make analysis, that is writing the formulation and solving the problem, students look for the information through the most similar solution examples in the student's handbook or other literature which discuss the material. The last step is students make prediction, monitoring, and evaluating for what has been done through self-reflection. Teacher's guidance does Self-reflection in this learning through questions and presentation in class done by one of the groups. Meanwhile, the other groups must give attention, whether the group's presentation is right or wrong. Next, students know their minuses and pluses in problem-solving.

c)   Closing
Last activity is done ±5 minutes, the teacher gives strengthening towards students' opinion, concludes together with students, and gives advanced task.

2)   Observation
Two observers do the observation towards learning activity, like teacher's ability in learning management, students' worksheet implementation, and students' activities.

a)   Students' worksheet practicality based multiple representations
practicality means something that is easy and pleasant. Students' worksheet practicality means that the students' worksheet is easy to do, and interesting for students. Students' worksheet practicality is measured through student's worksheet implementation in learning. Students' worksheet implementation is measured through five observation aspects; they are a step of activity, social system, the principle of reaction, supporting system, and instructional impact, the result of student's worksheet implementation displayed shortly in table 6.

Table 6. Students' worksheet implementation based on multiple representations

Meeting	Observation aspect	Observer		Average	Each meeting average
		I	II		
I	Step of activity	76.00	80.00	78.00	80.80
	Social system	80.00	85.33	82.67	
	Principle of reaction	80.00	80.00	80.00	
	Supporting system	80.00	80.00	80.00	
	Instructional impact	80.00	86.67	83.34	
II	Step of activity	84.00	80.00	82.00	80.67
	Social system	81.33	81.33	81.33	
	Principle of reaction	80.00	80.00	80.00	
	Supporting system	80.00	80.00	80.00	
	Instructional impact	80.00	80.00	80.00	
III	Step of activity	80.00	80.00	80.00	81.47
	Social system	86.67	88.00	87.34	
	Principle of reaction	80.00	80.00	80.00	
	Supporting system	80.00	80.00	80.00	
	Instructional impact	80.00	80.00	80.00	

Meeting	Observation aspect	Observer		Average	Each meeting
		I	II		average
	Implementation average				80.98

Students' worksheet implementation from I, II, and III meetings has 80.98 average. It includes a very high category. It means that students' worksheet has the good step of activity, social system, the principle of reaction, supporting system, and instructional impact. The first meeting, the implementation of the step of activity is still less compared with other components, this thing influences the interaction between teacher and students as well as the interaction between students and students (principle of reaction). After revising the first meeting, especially the implementation of the step of activity in the second and third meeting, the implementation becomes better. Students' worksheet implementation is described in picture 1.
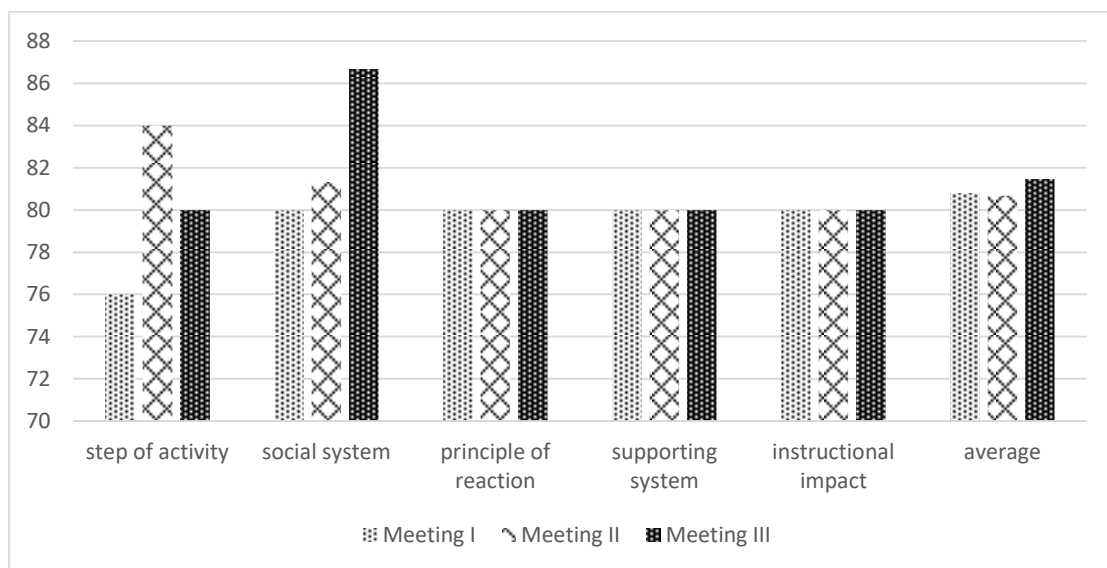
Picture 1. Students' worksheet implementation based on multiple representations

b) Students' activities during learning

Students' activities during learning were relative the same either in the first, second, or third meeting. Students' activities during learning which considered not maximal by the observer are on the oral activity and emotional activity indicators.

Table 7. Students' activities during learning

Meeting	Aspects of observation	Observer		Average	Average of
		I	II		each meeting
I	Listening Activities	80.00	80.00	80.00	81.00
	Oral Activities	80.00	80.00	80.00	
	Writing Activities	90.00	80.00	85.00	
	Visual Activities	80.00	80.00	80.00	
	Emosional Activities	80.00	80.00	80.00	
II	Listening Activities	80.00	80.00	80.00	82.67
	Oral Activities	86.67	80.00	83.34	
	Writing Activities	90.00	90.00	90.00	
	Visual Activities	80.00	80.00	80.00	
	Emosional Activities	80.00	80.00	80.00	
III	Listening Activities	80.00	80.00	80.00	86.00
	Oral Activities	80.00	80.00	80.00	

Meeting	Aspects of observation	Observer		Average	Average of each meeting
		I	II		
	Writing Activities	80.00	90.00	85.00	
	Visual Activities	100.00	80.00	90.00	
	Emosional Activities	100.00	90.00	95.00	
	Average				83.22

Some students tend not to give any responses if they are not appointed, and part of the active students are asking and giving opinions. The result of students' activities during learning is shown in table 7. Students' activities in the I, II, and III meetings are 81.00, 82.67, and 86.00. The average of students'activities in learning is 83.22, including very active category. In learning, students were very active to do learning activities, like experimenting with electric current and Ohm's law through visualization, discussion, and presentation. The enhancement of students' activities in learning because there is the enhancement of teacher's ability in learning management, like guiding the students to do experiments, guiding the students to ask with a very active category.

Based on the learning validity and practicality with student's worksheet of multiple representations showed that the result of validation that had been described before. It is stated that the student's worksheet which has been developed as valid. Based on the result of the limited tryout, the result of charts assessment for each student's worksheet stated as getting a positive response from students, so generally students' worksheet which has been developed stated as practical.

The practicality of Students' worksheet multiple representations is based on that every phase can be done well by teachers and relevant students'activities in every phase of learning.

The result of this research shows that every phase of students' worksheet multiple representations can be done by teachers well as it is displayed in table 6 it shows that every phase of students' worksheet multiple representations of the REAL model which poured in one unit learning program can be run well. The result has fulfilled the criteria of students' worksheet practicality, which it can be applied in the field [20]. Students got involved actively in learning. Even though there was a little bit of obstacle in learning implementation, it was found that there was still difficulty in assembling the tools. However, teachers can overcome by giving guidance about how to assemble the tools well. It means that the obstacle means nothing. This thing is suitable with groups management's theory [21], that is the learning implementation without obstacle is not always better, teachers must be able to use certain techniques to overcome the obstacles found.

4. Conclusion
Based on the result of research and discussion above, it can be concluded that learning physics with students' worksheet multiple representations on the dynamic electricity subject to enhance physics metacognism ability, had been proven. It is valid, showed through validation result from three experts, and practical (can be applied in learning), shown by (a) every phase of students' worksheet multiple representations learning REAL model can be done by teachers with good category, (b) students' activities percentage on every learning phase were relevant category.

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