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Module of physics bases on process image for learning of momentum and impulses in senior high school

F L Mi'rojiyah^{1*}, Sutarto², I K Mahardika³

¹Student's Department Magister of Science Education, University of Jember, Indonesia and Physics Teacher in MAN Lumajang

²Lecturer's Department Magister of Science Education, University of Jember, Indonesia

³Lecturer's Department Magister of Science Education, University of Jember, Indonesia

* E-mail: gogoprasetyo@gmail.com

Abstract. Start your abstract here The necessity of this research was aimed to develop momentum and impulse module form based on process image which valid, practice, and effective at physics learning in senior high school to understand the students. The aim of developing module is one of instructional material can help the student thinking systematic about the physics concepts so that it can learn by students independently. Design of the study is research and development with stages Define, Design, Develop, and Disseminate. The limited test was conducted to 10 students and the test of class level was conducted on class XMIPA7 SMAN 2 Jember in 2018. The results validation of the product, through the average of three experts' judgment stated that the product was valid. The practicality of product showed that students gave positive responses and learning can be very good implemented. The effectiveness of the products is known from an increased understanding the topic of momentum and impulses by using a normalized gain. Expectations of the research are produced appropriate (valid, practice, and effective) students module based on process image for learning of momentum and impulse topic on students grade ten at senior high schools.

1. Introduction

Physics consists of the concepts. The concepts basically categorizing something into presenting non verbal, so the concepts usually abstract so that the mental image needed. Physics concepts has a character appropriate with physical and mathematical logic so that both of them have an individual character. The character of that knowledge was not easy for student so that the students must have basic knowledge. Basic knowledge can formed by new experience to the environment daily based on Siregar (Sutarto, 1999). For students, physics module can be assumption that help their process on learning physics systematically about physics concepts, so that it can be learned by self. For teacher, module form can make physics learning easily for planning and implementation on learning because at module form there are include indicators, learning goals, material, and evaluation of learning goals. Physics module will valuable if the students easily on learning by it self. Learning by module can accelerate students capability for their studies and finishing completely base competencies on learning among students. So that module must be describe some base competencies will be achieve by students, serve with a good language, interest-learning was needed. Instructional material there were a package of material which systematically for helping students learning.

Instructional material divided by five group it is instructional material by printed, for example student module, handout, a book, module, brochure, leaflet, chart, etc.; instructional material on audio visual for example film/ video and VCD; Instructional material audio form, for example cassette, radio, CD; Visual, for example image, picture, models ; Multimedia, for example CD inter-



active, computer based learning, online (Hamdani, 2011). Printed material can be showed by some formed. If the printed material systematically, so that material will give some advantages there are statement from Steffen Peter Ballstaedt (Majid, 2012) it is printed media usually showing list components so that make easier for teacher to teach their students; The cost was cheap; Printed media use full ad flexible; More creativity for each students; use full everywhere; can motivated the reader to act some activities like write notes or sketch. Module is one form of teaching materials that are packed in a complete and systematic, in it contains a set of planned learning experience and is designed to help students specific learning objectives (Daryanto, 2013).

The module serves as an independent learning tool, enabling a learner who has a high speed in learning to moreing, and complete illustrations. The views about urgency of classifying methods or another learning media for solving the weakness of duration on learning was short and another media for supporting teaching and learning of physics suitable with process product by nature of physics. Student center learning was needed for learning physics used module. Process image was suitable for physics module because of this character it is two dimension (include the paper), so that developing process image for helping the implementation of teaching and learning physics and student center quickly complete one or more basic competencies compared to the other participants. Thus, the module should describe the basic competencies to be achieved by the learners, presented using a good language, interesting and equipped with illustrations. A module will be meaningful if learners can easily use it. Learning by module allows a learner who has a high speed in learning will be faster to complete one or more Basic Competencies (KD) compared to other learners. Thus, the module must describe the KD that will be achieved by learners and presented using a good lan-guage, interesting, and equipped with a clear illustration (I Ketut Mahardika, 2012). According to Indriyanti (2010) the advantages gained from learning with the application of modules are as fol-lows: Increase the motivation of students, because every time doing a lesson that is clearly defined and in accordance with the ability; After the evaluation, teachers and students know correctly, the modules that have been successful and on the module which they have not been successful; Students achieve results according to their abilities; The subject matter is more evenly distributed in one semester, and Education is more efficient, because the subject matter is organized according to the academic level.

Tompkin (on Akbar, 2013) Identifies the module composing steps as follows: (1) prewriting by limiting topics, formulating goals, defining the form of writing, determining who the reader is, choosing materials, and organizing ideas; (2) drafting-pouring ideas related to the topic of writing by letting in advance technical and mechanical matters; (3) revising - reviewing the text by focus-ing on the contents of the text by adding, moving, deleting and re-writing; (4) editing - editing spell-related writing, word choice, sentence structure, and others with improved formatting; (5) pub-lishing-publish writing to obtain reader response, revision, editing, and publishing.

Images can be developed as a medium to support the implementa-tion of learning, known as the image media. Images include visual media that can: 1) facilitate understanding of a complex or complex subject matter, 2) present an interesting elaboration of the structure or organization of a thing, thus strengthening the memory, and 3) foster student interest and clarify the relationship between the content Learning with the real world (Sadiman, et.al .: 1996). The image media among others have advantages: 1) Its concrete, more realistic picture shows the subject matter compared to the verbal media alone; 2) Images can overcome boundaries of space and time; 3) The picture media can overcome the limitations of observation; 4) Can clarify a problem, in any field; And 5) Cheap price, easy to get / held, and usefull. (Purwanto & Alim: 1997).

The process image are identified with the chart, with the notion of a series of images that can visualize a basic fact or idea in a logi-cal, orderly way, and help the reader to understand quickly, to show relationships, comparisons, relative numbers, developments, processes, classifications, and Organization (Sudjana, 1996; Ha-malik, 1989; Arsyat 1997). Based on the definition of the image, the understanding of the process, and added with the understand-ing of the image of the process, the process image can be inter-preted as a series of images of objects (objects, events, or phe-nomena), the images in the series between each other always look no relative difference in Things (status, position, form, or combi-nation) which as a whole describes a coherent stage and a unified whole.

2. Main Body

Research on model development (process image- module) is implemented in 4D model format developed by S. Thiagarajan et.al (1974: 6-9) consisting of 4 main stages; 1) Define (Limitation), 2) Design (Design), 3) Develop (Development) and 4) Disseminate (Spreading). In general, the four stages can be described as follows.

2.1. Research Methods

The first was Define, at this define stage, the activities carried out include: Analysis Media model implemented in KBM; Conducting an analysis of the learning models that have been implemented in High School; Learning Model Analysis needed for the implementation of SCL-based and product-based school learning; Perform characteristic analysis of teaching materials model based on SCL and students able to produce the product. The second was Design. Review the theories of the experts relevant to the model to be developed (expert against the model); Validate initial pattern design (prototype) to perfect the design so it is ready to apply; Pre-liminary study to define the developed model; Undertake studies related to the model to be developed and preliminary studies to identify material characteristics; Design the initial pattern of the image process module (prototype) that is tailored to the material characteristics and test is limited to the school; The initial pattern design of the process-image process module is based on relevant theories; Gather theories that support the design of the developed model; Prepare a design to review the model (module- process image); Assess the model (process-image module) based on conformity with the designed design.

The third was Develop. Creating an planning of learning (RPP) with a model design (module-process image); Constructing a customized RPP with the model (process image module); Implementation test on physics subjects; Testing (process-image module) through the action research cycle includes: plan, action, observe, and reflection to see the design consistency (prototype); Teaching Materials Products; Prepare the teaching materials so that the model guidebook (process module-image). The fourth was Disseminate. Testing module-image process that aims to see the consistency of products produced through action research cycles include: plan, action, observe, and reflection through deployment to school. The overall design as follows. Validity is a reference to declare an instrument can measure what should be measured. Validation of image-based module process on collision material is a module that has been through the validation phase by several experts and has been declared categorized as valid. This research uses a modified R and D design from 4D model (Thiagarajan, et al., 1974) as in Figure 1.

This research uses a modified R and D design from 4D model (Thiagarajan, et al., 1974) to 3D ie; Define, Design, Development as in Figure 1.

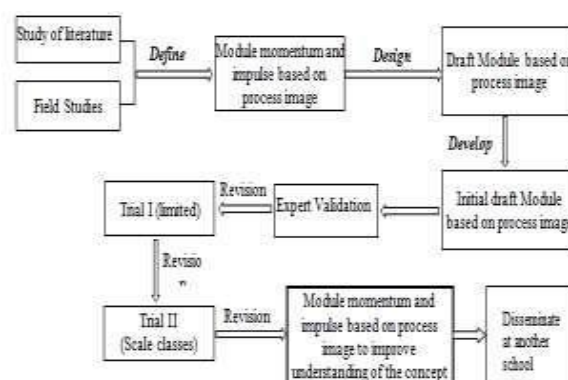


Figure 1. Design Research and Development of student module science BasedImage Process

Validity of logic or validation of experts is a validation performed after the instrument concerned has been designed and prepared properly. Logical validation can be achieved if the instrument is compiled in accordance with existing provisions. Thus logical validation is obtained after the completed instrument is completed. According Thiagarajan et. Al (1974: 28) expert validation is still divided into two namely instructional validation and technical validation. Here are some aspects that are in each of the instructional validation and technical validation

Empiric validity or development test is the validation obtained after tested. Empirical validity can not be obtained simply by the preparation of instruments under the provisions only, but must be proven through experience in the form of field trials. An instrument is said to have empirical validation when it has been tested from experience (Arikunto, 2011 :66).

The population of this study is a sample of students of class XI in Senior High School 2 Jember. The sampling technique used is random sampling. The sample is analysed using the consideration that the resource person is the one who knows best about the information that the researcher expects. Activities undertaken to analyse the resource is to make observations about the needs, characteristics of students, academic value and provide tests to measure the ability of students' procedural knowledge skills. Based on the observation result, the sample used for valid image-processing test of SCL learning and the effect of the process-image module implementation on the students' skills is class X in Senior High School.

Data types, data collection techniques, data collection instruments, and data analysis techniques are presented in Table 1.

Table 1. Data Types, Data Collector Instrument, and Data Analysis

Stages	Data Types	Instrument	Data Analysis
Phase I Development (Validation)	Qualitative data validation of module based on process image	Expert validation	Expert
Phase II (Uji Coba I)	Qualitative data of practically module science based on process image	Observation of learning implementation interview	Descriptive
Phase III (Uji Coba II)	Quantitative data of effectiveness module based on process image to the result of learning momentum and impulse concept Data Qualitative effectiveness of module based on process image for momentum and impulse concept	The students' concept comprehension text Observation sheets of learning effectiveness interviews and user response questionnaires (students and teachers)	%N-Gain Descriptive
Phase IV	School give quantitative data of module based on process image for momentum and impulse concept	Observation sheets of learning effectiveness interviews and user response questionnaires (students and teachers)	Descriptive

Determination of internal validation/logical both construct validity and content validity is done by expert of science education (expert judgment), that is a lecturer of Magister of Science Education of University of Jember by conducting analysis, tracing or testing according to relevant theory or

competence which are expected. Internal/logical validation indicates the extent to which the student module science based on process image are structured on the basis of relevant theory and existing provisions. Assessment guidelines and complete engineering techniques are included on the validation sheet. The data is loaded in a table of eligibility scores and a description of suggestions. Assessment includes: (a) content feasibility, (b) presentation components, (c) language, (d) image feasibility. Furthermore, the description of the suggestion is summarized and summarized and described narratively as the basis for revision of each component of the student module science based on process image that has been developed and developed. The results of the validation student module science based on process image were analysis with the following calculations and criteria:

$$\text{Average Score} = \frac{\text{The number of scores from the validator on each aspect}}{\text{resultan of assesment aspects}}$$

Table 2. Scoring Criteria Validation of science based student module on Process Image

No	Mean Interval	Characteristic
1	$4,20 < \text{mean} \leq 5,00$	Very valid
2	$3,40 < \text{mean} \leq 4,20$	Valid
3	$2,60 < \text{mean} \leq 3,40$	Enough valid
4	$1,80 < \text{mean} \leq 2,60$	Less valid
5	$\text{mean} \leq 1,80$	No valid

Student module science based on process image is considered valid if at least meet the criteria "enough valid" so it is worth using. The trial I (limited) at the development stage was conducted in 10 students of grade X SMAN 2 Jember in 2018. The trial I student module science based on process image was analyzed based on data observation of the implementation of learning by two observers and the mean value is analyzed to determine the result of the assessment by equation (Arikunto: 2012):

$$P = \frac{\sum A}{\sum N} \times 100\%$$

With: P = percentage of learning activity
 $\sum A$ = number of aspect scores performed
 $\sum N$ = Total score of all aspects observed

Implementation of learning using student module science based on process image is determined by comparing the results obtained and the criteria in table 3, the following:

Table 3. Criteria for the Implementation of Learning

No	Interval Percentase	Kriteria
1.	$80\% \leq P \leq 100\%$	Very Good
2.	$60\% \leq P < 80\%$	Good
3.	$40\% \leq P < 60\%$	Enough Good
4.	$20\% \leq P < 40\%$	Less Good
5.	$0\% \leq P < 20\%$	Not Good

Trial II (class scale) was conducted in class XMIPA7 SMAN 2 Jember year 2018 as many as 34 students using one group pretest-posttest design, ie the research was conducted in one class group by looking at differences in preliminary and final test results. Analysis of concept comprehension aims to determine the level of understanding of momentum and impulse concept by students as a

basis for determining the level of mastery learning. The concept comprehension test is structured to determine the effectiveness of the use of student module science based on the process image of momentum and impulse concept in learning. Improved conceptual understanding is measured based on pre test and post test values, and analyzed through normalized gain. N-gain is used to analyze achievement criteria before and after learning (adapted from Hake, 1998).

$$(g) = \frac{\text{actual gain}}{\text{maximum gain}} = \frac{\text{post test score} - \text{pre test score}}{\text{maximum score} - \text{pre test score}}$$

With N-gain level achievement criteria as Table 4:

Table 4. N-gain Performance Level Criteria

No	Mean Interval	Characteristic
1	$0,70 \leq (g) \leq 1,00$	High
2	$0,30 \leq (g) \leq 0,70$	Medium
3	$0,00 \leq (g) \leq 0,30$	Low

The use of N-gain to avoid the tendency that students who have a small pre test score will get a large actual gain and vice versa that has a large pre test value will obtain a small actual gain (Hake, 1998).

The effectiveness of the student module science based on process image is also analyzed based on the response of the product users, both by teachers and students. Assessment of student module science based on process image by users with indicators: (1) writing approach, (2) language, (3) clarity of sentence, (4) implementation, and (5) physical appearance (picture / graph). The scoring uses numbers with the likert scale of 5 choices, namely: 5 = very good, 4 = good, 3 = good enough, 2 = less good, and 1 is not good. Instruments that have been filled then sought the average score according to the equation and the following criteria:

$$\text{average user response score (R)} = \frac{\text{Resultan of scores from users in each aspect}}{\text{maximum score of assesment aspect}}$$

Table 5. Criteria for Assessment of student module Science Based on process image

No	Interval Rerata	Kriteria
1.	$4,20 < R \leq 5,00$	Very Good
2.	$3,40 < R \leq 4,20$	Good
3.	$2,60 < R \leq 3,40$	Enough Good
4.	$1,80 < R \leq 2,60$	Less Good
5.	$0,00 \leq R \leq 1,80$	Not Good

2.2. Result of Research

Student module science based on process image is valid and feasible to be used in the learning based on the assessment of two expert validator/lecturer of science University Science Teacher, namely component of student module science based on process image including feasibility of content, presentation, language, and kegrafisan. These four components determine the quality and feasibility of student module (Hartono, et al., 2013). The results of the validation as table 6 below.

Table 6. Results of student module science Based on Process Image Validation

No	Aspect of Assesment	Interval Score		Interval Average	Criteria
		Validator I	Validator II		
1	Feasibility of Content	4,40	4,50	4,45	Very Valid
2	Serving Components	4,43	4,29	4,36	Very Valid
3	Language	4,33	4,33	4,33	Very Valid

4	Grafics Feaibility	4,29	4,14	4,21	Very Valid
	Average	4,36	4,32	4,34	Very Valid

Based on validation result of two validator got result from each aspect of assessment have criterion "very valid". So as a whole it can be said that student module science based on process image that have been made can be used for learning momentum and impulse concept in senior high, especially on momentum and impulse concept. But from the validator there is a little revision that must be fixed, namely; (1) cover images to suit the concept and the work itself, (2) on one page please can use the colors that are not contrast with each other, (3) the image of the process pre-sented to be able to use different colors, so that mentally (4) the font used between headings, subheadings, and contents to be dis-tinguished, (5) note the description of an object or process of events to consider the scale used, so as not to cause a double per-ception or Confusion of students, and (6) provide sufficient space for writing / drawing results of student discussions and answers.

Result of trial I conducted to know the implementation of learning using student module science based process image. Trial I conducted on 10 students grade X SMAN 2 Jember. Based on the observation sheet of the implementation of the experi-mental results I found that the student module science based pro-cess image momentum and impulse material process can be used for learning in senior high school, but still need improvement between that is; (1) ambiguous sentences, (2) the need for wider space or space for drawing, and (3) reducing the competency test by not reducing the material / concept essence given to the stu-dents, since the time provided 3 x 45 minutes sufficient. These results are also supported by interviews conducted on the students. Students stated that they were happy with the science lesson using student module science based on process images because they can know the process of momentum formation of objects through the image in the student module, so that they can understand the con-cept more clearly and clearly. One student stated that he enjoys learning by using student module science based on process imag-es because they do not need to do lab work in the laboratory to understand the concept of momentum and impulse, but they declare that the 3 hour lesson used to solve the student module is less, because they require precision and accuracy in drawing, especially In describing the concept to avoid misconceptions. Learning out-comes can be seen in table 7.

Table 7. The Outcomes of Teaching and Learning Implementation I

No	Learning Steps	Wisdorm				Average
		WS 1	WS 2	WS 3	WS 4	
A	Ability to open lesson	2	3	3	4	3,00
B	Learning Process	4	4	4	6	4,50
C	Mastery of subject matter	2	3	3	3	2,75
D	Evaluation of learning	1	1	2	2	1,50
E	Ability to close lessons	4	4	4	4	4,00
	Result	13	15	16	19	15,74
	Percentage of implementation	68,42	78,95	84,21	100,00	82,89

Based on the result of trial I, it can be seen that the percentage of learning using student module science based on process drawings has increased from first learning using student module 1, student module 2, student module 3, and student module 4. Mean percent-age of learning activity is 82,89%, this means criteria 'very good'. So that the student module science based on process image can be continued for Test II with little improvement.

Trial II student module science based on process image is imple-mented on the students of class XMIPA SMAN 2 Jember, amounting to 34 students by using one group pretest-posttest de-sign. The

effectiveness of based process image is analyzed based on the result of concept test before and after learning. The average of pretest, posttest, and normalized gain results in the comprehension of the concept of momentum and impulse material obtained will be compared with table 4. Learning is said to be effective if N-gain is minimal in the medium criterion. In addition, learning is also said to be effective if eligible mastery of learning outcomes. Students are said to be thorough learning when reaching the minimum criterion value of completeness (KKM) is set, that is 75. Classical completeness is achieved if the number of students who are able to reach KKM at least 85% of the number of students (Mulyasa, 2007: 99, Depdiknas, 2008). At the time this article was written experimental trials effectiveness is on the way, so can not be presented results from trial II.

3. Conclusions

Student module physics based on process image of momentum and impulse concept stated 'very valid' and can be used for learning in senior high, this is based on the average assessment of two validator of 4.34. Student module science based on process image of momentum and impulse concept has practicality based on the percentage of learning activity in the first test of 82.89%. This is supported by the results of student interviews stating that they are happy with the learning of science using student module science based on process image because they can know the process of momentum forming objects through images in the student module physics where the vector momentum and impulse concept can not be seen in real, so with the process image of their process Can understand the concept with more real and clear. The effectiveness of module physics based on process image is known from the improved understanding of the concept of momentum and impulse using the N-gain average in trial II.

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