

# The Development of The Physics Module with Scientific Process Skill Approach (SPS) to Uniform Circular Motion Learning Materials 10<sup>th</sup> Grade at MAN 1 Magelang District

Arimbi Rachmayani<sup>1</sup>, Widayanti<sup>2</sup>

<sup>1</sup>Physic Education Departement, Faculty of Tarbiyah and Teacher Training, UIN Sunan Kalijaga,

<sup>2</sup>Physic Departement, Faculty of Science and Technology UIN Sunan Kalijaga,

Jl. Laksda AdiSucipto, Yogyakarta 55281, Indonesia. Tel. +62-274-540971, fax. +62-274-519739. Email: <sup>1</sup>arimbirachmayani@gmail.com

<sup>2</sup>widayanti@uin-suka.ac.id

**Abstract.** The purpose of scientific research is to develop a module with a skills process approach to enhance cognitive, affective, and psychomotor concurrently. This study also aims to see the quality of the modules that have been developed. The method used is a research-based development or development method with the 4D model developed by Thiagarajan, Shivasailam, et.al. The physics module is developed using a science process skills approach. The instruments used in this study were questionnaires, observation sheets, validation sheets, and sheets. The analysis used in the validation sheet is descriptive. Assessment of the quality and response of students to the physics module using a scale of 4 made in the form of a checklist. The results showed 1) the physics module has been developed with a science process skills approach. 2) the physics module with the science process skill approach according to the criteria is very good seen from the results made by material experts with an average of 3.55; a media expert with an average of 3.36, and a physics teacher with a score of 3.52. Also, the results of the limited test student response state that this physics module agrees to be used.

**Keyword :** Development; Physics Module; RnD model; Scienctetic Process Skill Approach (KPS); Uniform Circular Motion.

**Running title:** The Physics Module With Scientific Process Skill Approach (SPS)

## INTRODUCTION

Learning is a series of processes carried out by the human body to gain changes in the domain of competencies, skills and attitude (bell-graadler, 2011: 1.5). These are performed from a person's infancy to the end of his or her life gradually, thus learning throughout his life. This lifelong learning series is done throughout his life. This lifelong learning series is done through formal, informal, and/or informal education. It is what defines human from other creatures of god.

According to Wertheimer in Djaali (2007:62) the learning process to acquire three domains at once is not only a method of memorizing, but it is better for the individual to explore and thus gain his own understanding of what he has done. In this process the individual observes, emulates, tries new things that will bring about a change in him. With good learning comes meaningful learning. Meaningful learning in humans is learning that allows that individual to have the ability to connect any information with a preexisting concept or understanding.

This meaningful learning is essential for learners in understanding physics. Because in physics it is the students is invited to be able to explain the natural phenomena that are occurring in the surrounding environment. These phenomena can be explained by concepts, theories, and law to be accepted by human reason. Learning physics means studying nature with the concepts it contains. The concept can be abstract or concrete. Concept understanding is one of the keys to learning that involves thinking skills. (Ida, 2017: 24).

Based on Rivalia's Study (2016:350) states that learning learners must be masters of fact, concepts, principles, and law through the process of discovery and skill. The process of discovery and skill can be enhanced by

students through the process of scientific inquiry. That it is necessary for the study of physics to emphasize the skills of the scientific process.

According to Rustaman in Agung (2016: 3) claim that these scientific process skills involve three skills at once, namely their cognitive skills, their affective skills such as using tools, measuring, and psychopathic skills as having multiple interactions such as discussions and so making them think. Because of this, Rizal in Rivalia (2016: 351) claims that this scientific process skill is necessary because it enhances scientific thinking ability to solve a problem in the study of physics.

According to Trianto (2010:148) states that scientific process skills are a series of activities that use structured scientific skills to acquire a concept or principle or theory. Rather than merely developing a physical concept that has already been held and can deny any previous theory. So with the development of these scientific process skills students will be able to discover and develop facts and concepts and grow and develop embracing value attitudes.

Along with this the skills of the scienc must always be improved. This is supported by the study of PISA (Program for International Student Assessment) conducted by Organisation for Economic Cooperation and Development (OECD). Stated that in the field of science, Indonesia ranked 73rd in every 79 countries. Meanwhile, in the 2015 PISA evaluation, Indonesia ranks into 69 out of 76 countries. According to lela (2017:651), the relationship of PISA to science lies in scientific prosess skill as well as observation, interpretation, and so forth.

One to achieve the purpose of learning especially to increase the scientific process skill requires a supportive teaching material in the learning process. Teaching materials are all materials that can be used to help educators

teach in the learning process and one form of the teaching material is the module. Prastowo (2014:208) states that the module is a book written by design educators in the best possible way to enable students to understand their own material or use as little as possible the help of others.

Based on observation in MAN 1 Magelang district, the curriculum used is the 2013 revision. On the curriculum it emphasizes the competence of knowledge and skill competence, while for the competence of spiritual and social attitudes is achieved through indirect learning. The physics of the school involves lecture, discussion, question and practice.

In the study of physics in uniform circular motion materials are done only by lecturing by teacher and discussions among students. Because the time has only three hours of learning so students can't do the practice. It affects the processing / thinking skill of the student. Even more students are struggling to conclude and make a hypothesis. Based on the value data of 10<sup>th</sup> grade in uniform circular motion, only 0,619% of 256 completed students from the established KKM. Students struggle with the massive physical use to solve the circular motion at a constant pace. Aside from that, students have never had this material before in Junior High School.

This conforms to Iqbal's study (2015:2) and Syafi'i (2016:87) claim that the uniform circular motion is widely found with the phenomenon in life but the concept is difficult for students to understand. The uniform circular motion material is a basic material in mechanics that requires a strong concept understanding and proper analysis so that it can project objects in motion and use them accurately. Then it would be appropriate to use a scientific process skill approach in this learning, for in the scientific process skill require students to observe, find, and analyze what they do themselves. So that the students gain knowledge of what they do.

Based on the observations it can be concluded that the 10<sup>th</sup> grade students at MAN 1 Magelang has not been able to improve his process skills properly so that it is still difficult to understand the uniform circular motion concept. Thus, researchers bring research topics to the title "The Development of The Physics Module with Scientific Process Skill Approach (KPS) to Uniform Circular Motion Learning Materials 10<sup>th</sup> Grade at MAN 1 Magelang District" With the purpose of students will prefer to learn independently and can increase student's understanding of circular motion materials. In addition, knowing student's responses after using modules with a scientific process skills approach.

## MATERIALS AND METHODS

### Study area

Research starts from 2019 to June 2020. The research uses research-based methods of development in which processes carried out serve to develop and validate certain products (Sugiyono, 2016:407). The research was intended to develop a teaching module with a scientific process skills approach (KPS) on the uniform circular motion materials of

10<sup>th</sup> grade high school. The research is a R&D study with a model 4D explained by Tiagarajan, et al that divides into 4 phases there is Define, Design, Develop, and Disseminate. In this study, however, it is limited to a stage in the development of a limited testing phase. This is because of covid-19 unsafe environmental conditions.

### Procedures

The instruments used in this study are observation sheets, questionnaire, validation sheets, assessments. An instrument of study is an instrument that researchers use to collect data in order to get a good, systematic, and complete result that makes it easier for researchers to process the obtained data (Suharsimi, 2010:265). These are the steps made in the research, among which are:

#### 1. Define

At this stage researchers identify the problems or potential that occur as the performance of physical teaching activities in the 10<sup>th</sup> grade class MAN 1 Magelang District. The instrument used at this stage is the observation sheet used to screen as much information and as detailed as you can from teacher. In addition to the observation sheet, it is also use questionnaire to know deeper from students about the study of physics over time. Observations of teachers and questionnaire were analyzed using qualitative analyses.

#### 2. Design

At this stage researchers design the physics study module of uniform circular motion materials with a scientific process skill approach following the module's guidance from Depdiknas 2008. Design modules that start with opening, filling and closing. At this stage researchers design the contents of the module by interpreting indicators owned by the scientific process skill to give understanding to students. It aims to enhance the collective capacity of three cognitive, affective, and psychosomatic abilities.

#### 3. Develop

This stage of development is the development of the designed module and to know the quality of the module produced according to experts and students. The instruments used at this stage are 1) a validation sheet consisting of material validation and media validation, 2) an assessment sheet consisting of material assessment, a media expert assessment, and a physics teacher, and 3) a student's response sheet. Data obtained at this stage is analyzed using qualitative descriptions.

## RESULT AND DISCUSSION

The results of these studies and developments are the result of a physics module with peductive scientific process skills to increase cognitive, affective, and psychosomatic simultaneously. The content of the study refers to the curriculum 2013 revision basic competencies 3.6 which reads analyzing physical quantities of circular motion at a constant pace and application in daily life. And the basic competencies 4.6 that goes on to experiment and presentation the results of circular motion, physical meaning, and application in daily life.

The initial product was developed as a result of the creation of the first physics module based on analysis of needs made up of the analysis of student characteristics, the material analysis, library study, and the format of the physics module. From these initial products it is then validated, assessed quality, and tested so that it gets the end product of modules that are worthy of use in the learning process.

This physics module is composed of three main components that are opening, filling and closing. In the opening section the module consists of a front page, the preface, table of contents, the module's use instructions, the concept map, and the introduction. The content consists of four study activities that discuss uniform circular motion materials equipped with simple experiments and sumative tests that aim to understand students after learning all the material. Each learning activity contains the purpose of learning, material, examples of problems along with a solution, summary, and formative test. While at the close is the key to formative and sumative test answers, the glossary, and the list of libraries.

In each study activity there are indicators of the scientific process skill that aim to train and increase the capability/think processes that the student have. From the indicator stage presented, students are expected to be able to discover theories, concepts, and products (results) of

already studied material as of the learning that this student performs is more meaningful. The indicator of scientific process skill used are observations, classifications, communications, measurements, predictions, defined hypotheses, experimented on, and interpreted data.

After the initial product is finished, then the validation of the product uses the instrument that has been validated by the instrument expert. The product was validated by two materials experts and two media experts. From the validation these acquired some suggestions and input to correct the physics module that was generated. Then a revision of the product with the referral of suggestions and input given by the validator of materials and media.

The product that had been revised was then judged by physicists and physics teachers. This assessment aims to know the quality and worthiness of the physics module's first revision according to experts and teachers. After products are judged by experts in the media and materials, obtained productive values and Suggestions and input used to revise the second revision.

The aspect assessed by the material expert pertains to the quality of content, the aspect of language, and the completeness of the module. As for the data resulting from the product assessment presented in the form of table 1. this is the data of the physics matter assessment by the materials expert on table 1.

**Table 1.** Results Product Assessment By Material Expert

No	aspect	Indicator	Score Per Indicator	Score Per Aspect	Average Score	Category
1	Content quality	Material truth	34	190	3,73	Very good
		Material compatibility	34			
		Scientific Process Skill	33			
		Content interest	31			
		Systemic material	24			
		Accuracy of Illustrations	23			
		Experiment activities	11			
2	language	legibility	22	63	3.5	Very good
		Language precision	22			
		Use of terms ans symbols	19			
3	Module completeness	Self Intruction	10	50	3.33	Very good
		Self Contained	10			
		Stand Alone	10			
		Adaptive	10			
		Userfriendly	10			
Average					3.55	Very good

The aspect assessed by the media experts was a sufficient content of the module, the correct contents of the module and the interest of the module. As for the data resulting from the product assessment presented in the form of table 3.2. Then the valuation results of the media expert are shown on table 2.

**Table 2.** Module Assessment By Media Expert

No	Aspect	Indicator	The value of each indicator	The value of each aspect	Average value	category
1	Module content coverage	Suitability of the module content	12	70	3.33	Very good
		presentation	58			
2	Accuracy of module content	Organization	22	70	3.33	Very good
		Format	9			
		consistency	29			
		Font size and shape	10			
3	Attractiveness of the content	Validity	41	62	3.44	Very good
		Module design	21			
Average					3.36	Very good

The aspect that high school physics teacher judges relates to the material and media section. This is the physics teacher's assessment data displayed at table 3.

**Table 3.** Result Assessment By Physics Teacher

No	Aspect	Indicator	The value of each indicator	The value of each aspect	Average value	Category
1	Quality of content	Suitability of the material	22	114	3.56	Very good
		Science process skills	19			
		Attractiveness of the content	19			
		Material systematics	15			
		The accuracy of the illustration	12			
		Experimental activities	7			
2	Language	Legibility	12	40	3.33	Very good
		Language accuracy	14			
		Use of terms and symbols	14			
3.	Accuracy of module content	Organisasi	15	29	3.63	Very good
		Format	7			
		Font shape and size	7			
4	Design	Design	14	14	3.5	Very good
Average					3.52	Very good

After the physics module is in value by experts, the next step is a limited test. This limited test is for know the understanding the modules made by students. The results of limited test are on table 4.

**Table 4.** Result Assessment Of Limited Test

No	Aspect	The value of each as	Average	Category
1.	Tensile force	53	3.31	Good
2.	Language	104	3.25	Very good
3.	Ilustration	48	3.00	Good
Average			3.2	Very good

## Discussion

### Define

The defining stage is the first stage that researchers do to identify problems that occur during learning activities of physics in class and become the basis for designing the product of a physics module. At this stage is the characteristic analysis of the students, the materials analysis, and the curriculum applied in MAN 1 Magelang District.

- a. Characteristic analysis of students is done to know the ability, background, learning resources of students and so on. After an analysis of the teaching material found at the school pointed out that limited study material, some of the books used at the school are Depdiknas's packages and LKS publications. Only LKS is all the students can have, where as the package books are only used during teaching and reading in the library. Then another analysis showed that students only do an impractical activity only 4 times in a year of learning. This suggests that the process skills of learners are not optimal.
- b. After field surveys include observation activities, distribution of questionnaire, and interviews to students and teachers who will be used for the data retrieval about learning in the class. The results of the data obtained are: the learning used in the classroom tends to use the lecture method, motivation and interest of learning is very low, the learning by experiment is so infrequent that coaching participants on these materials is so short, students need easy and interesting study guides to study and be prepared with a variety of simple experiments.

### Design

The result of the defining stage used as a introduction to research, then the design phase involved the initial design of the module developed, the design of the module, and the design of the material presentation.

- a. Draft results of a physics module with a scientific process skill approach to enhance student's understanding. The module consists of three parts- the introduction, the content, and the cover. The resulting modules are systematic because they are rigged by debris to make it easier for students to become self-reliant.
- b. In this study uses several instruments that include observation sheets, student's questionnaire, validation sheets, assessment sheets, and test sheets.

### Develop

At this stage of development, it is validated by experts, assessments by experts, educators, and learners. Before validation and product assessments are done the instrument validation first on the instrument expert. After the validation of the instruments is finished the validation of the product by the material expert and the media expert. The validation results from a media expert and a material expert use as a reference to a revised product. So the resulting revision of the product I, and then the product is judged by materials

experts, media experts, and physics teachers. Based on the validation of the materials indicated on table 3.1, the results were averaged 3.55 in the category "very good". Suggestions and input were also obtained from material experts, including paying attention to the indicators, concluding and replacing some examples of questions that they could not meet directly.

Then, based on the results of the validation by media expert on table 3.2 obtained the overall 3.36 aspect under the category "very good." Some Suggestions given by materials include improving some of the step in the laboratory's mini laboratory, noting the order of the sentence, and noting the sentences that are still of double meaning.

According to assessments by teachers comes the average assessment of all 3.52 categories under the "very good" category. The Suggestions and input given by the physics teacher were to match the key to an formative and sumative test answer. Suggestions and input given by materials experts, media, and physics teachers are used as guidelines for revising modules. So revised module II which is next used for limited test by students.

Limited test were conducted by 9 students. Data results obtained of the student's responses to the modules shown at table 3.4. The data acquired from students consists of their responses after doing all the grooves in the module and in the activity of the lab. With the third revision in consideration of the suggestion and input results, the product is concluded as a result of the termination of extensive testing due to the prevalence of covid-19.

## CONCLUSION

From research that has been done comes a conclusion as follows:

The physics module that was developed using a scientific process skill approach to enhance the three skills students have simultaneously: cognitive, affective and psychomotoric. All indicators in the scientific process skill were presented in each learning activity such as observing, classifying, communicating, measuring, predicting, formulating hypotheses, conducting experiments, and interpreting data. The module is also used to increase self-reliance, student's perseverance in learning.

The modules are categorized very well by assessors. Assessments by materials expert state the quality of content worth, the discussed used and the completed module are categorized perfectly by an average of 3.55. Assessments by media experts state that worthiness in terms of the module's content coverage, context and preoccupation is categorized well with an average of 3.36. Teacher assessments state worthy material quality, the language used, the correct content of the module, and the module view is categorized perfectly well with a 3.53 average.

The module gets a good response from students after using and following the module's usage line in self-study. The student response performance of three aspects yields a category agreeing with an average of 3.2.

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