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Development of Electrical Measuring Instruments Practicum Modules Based on Science Process Skills for Physics Students

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Abstract
This research aims to develop practicum modules based on science process skills. Science process skills are an approach to learning that is designed so that students can find facts and build concepts and theories. In this science process skill, students are trained to be involved in scientific activities and become independent individuals. The development model in this study is the 4D model. The research subjects were 39 third-semester students who had taken the course on electrical measuring instruments. The instruments in this study were validation sheets (to determine product validity) and student and lecturer response questionnaire sheets (to measure product practicability). The results showed that the product, in the form of a practicum module based on Science Process Skills, was both valid and practical. The module validity was in the very valid category, with an average score of 83.14%. The practicality test for using modules for students was very practical (83.3%). The lecturer response questionnaire was in the very practical category, with a percentage of 81.25%. So, this practicum module is valid and practical and can be used to train students' Science Process Skills, especially in the material of electrical measuring instruments.

INTRODUCTION

Science Process Skills are very important for students to form knowledge to solve problems and obtain results. According to some experts, science process skills are a scientific way to guide researchers to think (Syafi'ah et al., 2022). Meanwhile, McKenzie stated that science process skills consist of critical and creative thinking skills combined with scientific methods to solve scientific problems that are being faced (McKenzie & Padilla, 1984).

Science Process Skills can train cognitive, affective, and psychomotor skills. Science process skills are divided into two categories: basic science process skills and integrated science process skills. Basic science process skills include observing, using space and time, inferring, communicating, classifying, measuring, and predicting. Integrated science process skills consist of controlling variables, operations, hypothesizing, interpreting data, carrying out experiments, creating models, and presenting information (Sari & Zulfadewina, 2020).

Learning science at the university level should emphasize providing direct learning experiences through the use and development of process skills and scientific attitudes so that all competencies can be developed. The American

Association for the Advancement of Science (AAAS) states that science process skills are very suitable for science learning and should lead to learning that makes students more active (Harianti et al., 2023; Kamelia et al., 2020; *Mission and History | American Association for the Advancement of Science (AAAS)*, n.d.)

The Physics Education study program at Universitas Islam Negeri Imam Bonjol Padang is a study program that is expected to produce prospective physics teachers who are competent in their field. Physics is a science that examines natural phenomena through a series of scientific activities. This scientific activity included making observations, formulating problems, conducting experiments, and drawing conclusions. Through this scientific attitude, learning physics produces products in the form of facts, concepts, principles, and theories (Liang & Lake, 2023).

Electrical measuring instruments are a course that must be taken by physics students at UIN Imam Bonjol Padang in semester 3. This course has competencies that students must achieve. To achieve these competencies, learning about electrical measuring instruments is carried out by learning theory in class and practicum in the laboratory. The approach that is suitable for practicum courses is the science process skills approach.

Unfortunately, the importance of science process skills has not been supported by encouraging results. Based on research by Novitasari (2017). the achievement of science process skills remains below average. Aspects mastered by students only observe, classify, and apply concepts in very low categories. They were interpreting, predicting, asking questions, planning experiments, and hypothesizing with low categories. Darmaji et al. stated that students 'science process skills in communication indicators and obtaining and processing data were in the poor category (Darmaji et al., 2018). The reason for the low ability of science process skills was that the lectures and practicums that were conducted did not optimally train students' science process skills.

Low students' science process skills have an impact on their ability to solve problems and obtain results, as well as low learning outcomes due to a lack of understanding of the material (Mindawati & Nana, 2020). Students' low science process skills would have an impact on the assessment benchmarks of students' cognitive, affective, and psychomotor abilities (Haka et al., 2020).

From the results of the researcher's interview with the lecturer for the course on the electricity-measuring instrument at the Physics Education study program at UIN Imam Bonjol Padang, it was found that the practicum module available for the course on the electricity-measuring instrument was not sufficient to train students' science process skills. Therefore, it is important to develop a practicum module based on scientific process skills in the course on electrical measuring instruments.

METHOD

This research is development research with a 4D model (Four-D). The 4D model consists of several steps, namely, 1. Define: This stage is carried out by analyzing student needs in practicum. 2. Design: This stage is carried out by designing practicum modules. 3. Develop; this stage involves validating the product and analyzing its usability. 4. Disseminate: This stage should be carried out through product distribution, but in this study, the distribution could not be carried out due to research limitations and will be carried out in the following semester (Thiagarajan, 1974).

The subjects of this research were 3rd-semester students of Education physics at FTK UIN Imam Bonjol Padang who took the course on electrical measuring instruments. This research was conducted for one semester. The types of data taken in this research are qualitative and quantitative. Qualitative data contains criticism and suggestions from validators through interviews and questionnaires based on the responses of lecturers and students who use the product. Quantitative data was obtained from product validation instruments where the validators consisted of three material, media, and language experts. Apart from product validation, quantitative data was also obtained from product practicality, which was filled in by 39 students.

Data from product validation results and their practicality are processed using the percentage of the total score divided by the maximum score. Furthermore, the values

obtained from the formula are interpreted according to Table 1.

Table 1. Validation and practicality assessment criteria

Percentage	Category
0%-20 %	Invalid/Impractical
21%-40 %	Less valid/Less practical
41%-60%	Quite Valid/Quite Practical
61%-80%	Valid/Practical
81%-100%	Very Valid/Very Practical

(Sutedja & Ahmaddien, 2020)

RESULT AND DISCUSSION

Based on a Four-D model that has been completed, the results are shown below.

Definition

Define has the purpose of analyzing the needs that arise when developing a practical module for an electrical measuring instrument based on a scientific process. Researchers may express concerns regarding the curriculum, subject matter, teachers, students, and tasks, while also outlining anticipated goals and expected outcomes stemming from the development of the practicum module.

a) Curriculum Analysis
Competency standards and learning indicators in the subject of electrical measuring instruments are prepared based on the KKNI curriculum. The learning achievements in this course are: 1) Students can master the facts, concepts, and principles of the basics of physics by Islamic norms and values needed to carry out secondary learning as well as for further studies. 2) Students can work in groups to apply concepts. 3) Students can compose and develop practica. 4) Students can communicate the results of the practicum in the form of a written report.

b) Conceptual/Material Analysis
The material developed in the practicum module for electrical measuring instruments based on process skills contains important and basic concepts to be known by Tadris Physics students, namely: getting to know electrical measuring instruments' working principles and how to use them.

c) Student Analysis
Students who take practical courses on electrical measuring instruments are 3rd-semester physics TADS students who are in the age range of 20–22 years. At this age, students can already think abstractly and complexly, which allows for the development of higher-order thinking skills. Therefore, through the development of practicum modules on electrical engineering tools based on science process skills, it is expected to facilitate students' development of thinking skills. Besides that, this module can also develop students' science process skills as preparation for becoming competent physics teachers.

d) Task Analysis
Based on the learning process in the subject of electrical measuring instruments, students are trained to carry out practicum activities as an application of various basic concepts in schools. Students' science process skills are trained when carrying out practicum activities. In this case, the indicators of basic science process skills trained are (1) observation, (2) classification, (3) interpretation, (4) prediction, (5) formulating hypotheses, (6) planning experiments, and (7) communicating.

Design

At this stage, a practicum module was designed for electrical measuring instruments based on science process skills by determining course descriptions, course objectives, subject matter, and indicators of science process skills. The cover for this module was made using the Corel application. Fill in the module using Microsoft Office 2019. The module design can be seen in Figure 1.

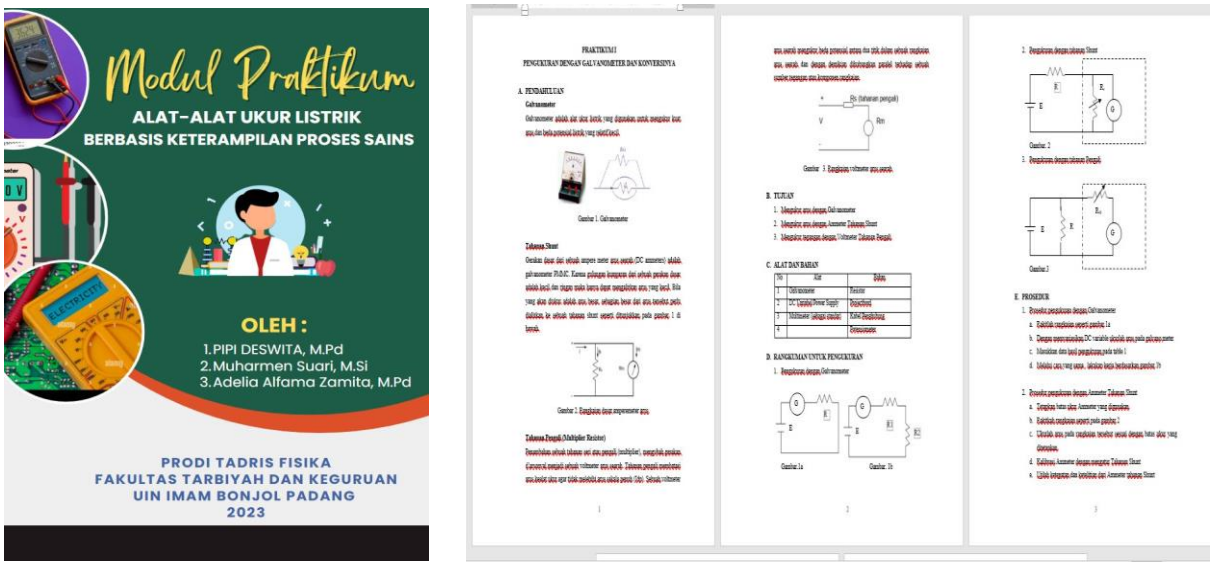

Figure 1. Practical module design for electrical measuring instruments based on science process skills

Development

After the practicum module has been designed, a product validation test is then carried out. Out by three validators. The results of product validation can be seen in Table 2.

Table 2. Product validation recap by the validator

No	Indicator	Validator Value			Score	Score max	% validation	Category
		1	2	3				
1	Objective	3	4	3	10	12	83%	very valid
2	Rational	10	9	10	29	35	82%	very valid
3	content	36	32	32	100	120	83%	very valid
4	suitability	18	17	18	53	60	88%	very valid
5	Construction	26	28	27	81	94	86%	very valid
6	Language	25	22	23	70	90	77%	Valid
7	Flexibility	4	3	3	10	12	83%	very valid
Total						**353**		
Maximum Score						**423**		
% Validation						**83.14%**		
Category						**Very valid**		

At this stage, improvements were also made to the practicum module based on suggestions from the validator in the form of writing procedures (formula numbering, image captions, tidying up tables); additional instructions for using the practicum module; replacement of the practicum module cover; clarification of indicators of science process skills; Practical steps are taken per point. After the validation was completed, the researcher continued to try out the product on 39 students from classes A and B. After the students had finished carrying out the practicum using the module, the researcher distributed student response questionnaires regarding the use of this module. Recapitulation of student responses to the questionnaire results in product use as shown in Table 3.

Table 3. Recap Analysis of Student Questionnaire Results

No	Question	Score	Score max	% practicality	Category
1	The practicum module has never been used before in practicum activities for electrical measuring instruments.	135	156	86,5%	Very practical
2	By using this practicum module, I enjoy practicum activities more.	140	156	89,7%	Very practical
3	The work steps presented in the module make it easier for me to practice	130	156	83,3%	Very Practical
4	Images and writings presented in the practicum module are easy to read	125	156	80,1%	Very practical
5	The appearance of the physical form of the practicum module as a whole, be it module design, color combination, image selection, or type of writing, is good.	126	156	80,7%	Very practical
6	It is easier to understand concepts and do practical work without the help of a laboratory assistant.	124	156	79%	Practical
7	I can work together with groups to complete practicum assignments.	130	156	83,3%	Very practical
8	After participating in practicum activities based on science process skills, I became motivated to learn and practice further physics learning.	130	156	83,3	Very practical
	Total			**1040**	
	Maximum Score			**1248**	
	% Practicality			**83,3 %**	
	Category			**Very practical**	

Based on Table 4, it can be seen that the practicum module is very practical (83.3%). The impression of students on the practicum module based on the science process approach is that students are happy with the existence of a science process skill-based practicum module so that it is easier to do a practicum, and with this module, it can hone the skills of students in science processes. Statements that scored below 80% were about how easy it was for them to carry out practicums without the help of a labor assistant (79%). This may be because a practicum without the help of a laboratory assistant is rather difficult to do. After all, there is a lot of equipment needed to carry out the practicum.

Furthermore, the results of the analysis of the lecturer's response questionnaire sheets to the use of practicum modules based on science process skills are shown in Table 5.

Table 5. Recap Analysis of Lecturer Questionnaire Results

No	Question	Score	Score mx	% practicality	Category
1	The practicum module is very useful for students and lecturers in carrying out practica.	7	8	87,5%	Very practical
2	The practicum work steps are by the learning outcomes.	6	8	75 %	practical
3	The practicum work steps presented are the indicators of science process skills.	6	8	75%	practical
4	Images and writings presented in the practicum module are easy to read.	7	8	87,5%	Very practical
5	The appearance of the physical form of the practicum module as a whole, be it module design, color combination, image selection, or type of writing, is good.	7	8	87,5%	Very practical
6	The practicum module adds to the knowledge and enthusiasm of students in carrying out practicum.	6	8	75%	practical
	Total			**39**	
	Maximum Score			**48**	
	% Practicality			**81,25 %**	
	Category			**Very practical**	

Based on Table 5, it can be seen that the practicum module is in the very practical category, with a percentage of 81.25%. In general, the suggestions given by experts for this module are to clarify the syntax and indicators of science process skills in the module so that the hope of improving students' science process skills can be realized. This means that both students and lecturers respond positively to the practicum modules that have been developed by researchers.

The results obtained are from research conducted by Fadilla (Fadillah & Angraini, 2018). Using the science process skills approach in carrying out practicums can guide students in understanding concepts. This is also in line with research conducted by Gultekin and Idris (Gültekin & Altun, 2022; Idris et al., 2022) that shows that science process skills students can carry out practicums with correct scientific work steps and can train students' independence in learning.

CONCLUSION

The development of practicum modules for electrical measuring instruments based on science process skills for Tadris physics students is carried out using the four-dimensional model stage, but only up to three stages, namely, define design and development. The resulting practicum module is in a very valid category with a percentage of 83.14%, a very practical category with a score of 83.3% (based on a student response questionnaire), and 81.25% in a very practical category (based on a lecturer response questionnaire).

Thus, it can be concluded that the practicum module based on science process skills can be used by students as a guide for carrying out practicums so that students' process skills can be honed properly. Suggestions for the

implementation of further research are to carry out the dissemination stage, namely, the dissemination of the final product to the entire population. It is recommended that this research tests its effectiveness.

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