

Generic Skills

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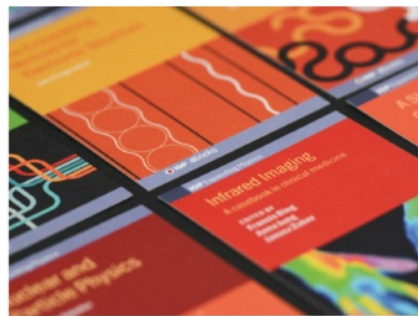
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Generic skills pattern of physical teacher's candidate through design of school physics practicum guidelines

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Abstract. The aim of the study is to describe the patterns of generic thinking skills of students through the design of physics practicum guidelines. The research method uses quasi-experimental using post-test only control group design. The research sample is a Physics Education study program student in 5th semester, taken by cluster random sampling technique. The experimental group carried out physics laboratory project learning with generic science skills while the control group studied physics laboratory projects. Data collection techniques are using observation and test sheets. Data analysis techniques using statistical tests with t test. The results of the study obtained observational data and test data, the data were tested for normality, reliability and statistical tests. The difference in generic science skill patterns was tested statistically, and then data were analyzed for each indicator of generic science skills. The product of this research is the school physics practicum guidelines. The results of the analysis of the generic science skills test showed that the generic science skills in the experimental class were better than the control class. Based on the generic science skill pattern, it is found that the physics teacher candidates are better on the aspects of direct and indirect observation.

1. Introduction

The process of learning physics requires understanding concepts, scientific performance and solving problems. This learning as physical knowledge of the properties of an object or event such as shape, weight, volume and objects interact with one another [1]. Physical knowledge plays an important role because it deals with problems in the physics learning process handled properly [2,3]. Teachers need skills to prepare learning programs so that students achieve learning completeness in cognitive, affective and psychomotor aspects. Students of physics teacher candidates must be able to build concepts [4].

In physics learning to build concepts, students are given the opportunity to use various learning methods and learning experiences [5,6]. A learning system includes various components that relate to one another, these components include goals, material, methods and evaluation. These components can be arranged to relate to one another in laboratory activities. Laboratory activities in physics learning are demanded by 21st century abilities that involve the ability of communication, cooperation and utilization of information technology in learning. Previous research describes that the success of 21st century learning has various skills indicator achievements [7,8].

A generic skill of science is one of the thinking skills and the ability to act relevant to mastery of student science concepts. According to [9] has the advantage of fostering basic abilities when undergoing a physics learning process that is useful as a provision to foster pedagogical competence and professional competence of prospective students of physics. Another advantage is based on indicators

of generic science skills that provide direct observation skills, indirect observations, awareness of scale, symbolic language, logical framework of the principles of natural law, inference or consistency of logic, cause and effect law, mathematical modeling, concept building.

The implementation of learning through practical activities based on generic skills is able to improve learning outcomes, laboratory skills, and generic science abilities of students. Generic science skills in learning help teachers improve students' learning methods, can accelerate learning and can regulate their own learning speed and which are arranged by the teacher according to the speed of learning. Several studies on physics learning models with laboratory activities have succeeded in developing generic capabilities of science [10].

Mastery of laboratory skills in designing and conducting practical activities by prospective physics teachers is very urgent [11,12]. In learning, especially in the laboratory, not all indicators of generic science ability can develop well [13](Susilawati et al., 2018). Thus, research needs to be done to be able to develop all generic science capabilities in supporting laboratory skills that are identical to practical activities [14].

Practical activities carried out in schools are expected to help improve understanding of students' physics concepts so that prospective teacher students must be able to develop inquiry laboratory activities [15,16]. One activity that must receive special attention is the skill in planning the design of practical activities, conducting practicums and interpreting the results of the practicum. In practical activities it automatically trains the science process skills needed to practice high-level thinking skills in the form of creative thinking, critical, and problem solving skills and includes generic science skills.

Based on preliminary observations, the implementation of lab work in schools still found many obstacles and limitations. Problems faced by teachers in schools are limited physics laboratory facilities and the difficulty of organizing practical activities. However, this requires an effort from the physics teacher and from the beginning is given provisions to prospective physics teachers in facilitating practical activities. Practical activities can also improve students' creative thinking skills. In connection with designing experiments, activities can support mastery of concepts that are related to students' ability to understand meaning scientifically in theory and contextual practice in everyday life. Based on the background of the problem, in this study the identification of generic science skills patterns in physics teacher student candidates was identified as an initial identification for the development of a physics laboratory lecture program.

The purpose of this study was to identify the patterns of generic thinking skills of students as initial perceptions in the development of physics laboratory lecture programs. These skills are advanced skills as performance skills of the prospective physics teachers in developing psychomotor aspects of the students. If the identification of generic science skills applied is expected to be the initial data and references in the development of physics laboratory lecture programs to provide meaningful provisions for students of physics teacher candidates to be able to design teaching aids, design laboratory activities, develop practical activities and other activities related to performance and attitude skills scientific student.

2. Methods

The research procedure consists of literature review, research planning, implementation of research and evaluation. Literature review is a reference for designing and compiling practical guidelines containing generic science skills based on references and scientific journals. The literature study is carried out by reviewing the literature, state of the art research related to the research that will be conducted. In addition, data sources and references that can support the research process.

Planning research carried out included compiling sheets and tests of generic science skills. The implementation of research that will be carried out is the preparation of school physics practice with generic science skills. Products in the form of school physics practitioners are validated by materials experts and practitioners. The expert appraiser provides recommendations and perfection for the practice guide with generic science skills. In addition, the expert appraiser will provide information on sheets and tests that will be used to identify patterns of generic science skills. Recommendations and suggestion

from expert appraiser and practitioners are followed up in the form of revisions to research instruments and research products. Revised research instruments focus on observation and test sheets. Research product revisions focus on school physics practicum guide lines.

The population of this research is the Physics Education Study Program Universitas PGRI Semarang in 2017/2018 academic year, consist of 53 students. The sampling technique used in this research is a random cluster technique. Data collection techniques used in this research includes observation and tests. Observations made are by observing the learning process. Tests can be used to test the results obtained after the action.

The qualitative data obtained in this research is validation data by a team of expert appraiser. Recommendations from expert appraiser are analyzed for improvement. Observation data in the process of compiling a physical practicum package were given a range from 1 to 4 according to the rubric of generic science skills that emerged. Data from the observations were analyzed through normality tests, homogeneity tests, two mean similarity tests using the t test [17].

The final stage of analysis uses the t-test technique to perform a comparative test between two conditions (problems) with a record of scale / type interval / ratio. These two conditions data can come from different samples (independent samples) or from the same sample (correlated samples). On this occasion a different sample (independent samples) was used.

3. Results and Discussion

This study revealed the pattern of generic science skills of prospective physics teachers through physics practicum guidelines.

Description of the Results of Content Validation

Based on the results of the expert Validation of the physical practicum guide content presented in Table 1.

Table 1. Description of Content Validation Physics Practicum Guidelines

No	Domain Validation	%	Recommendation
1	Practicum Topic	50	Topics are directed at the subject matter of school physics with more material
2	Practicum Objectives	50	Minimum goals at the level of applying or referring to high-level skills indicators
3	Basic Theory	65	The basic theory in general is relevant to the topic and purpose. Basic theories can be formulated in more depth and detail
4	Tools and materials	85	Tools and materials used are easy, inexpensive and meet the criteria.
5	Practicum Procedure	73	The practicum procedure is directed towards inquiry and problem solving oriented solving
6	Table of practicum results	50	Table of observations can be made many variations of lab work

The results of the validation of practicum guide content provide recommendations for improvements in topic selection, formulation of practicum objectives, formulation and development of basic theories, selection and use of tools and materials, formulation of research procedures and making variations in

tables of observations of physics practicum results. The results of the implementation of physics practicums based on generic science skills that appear can be presented in Table 2.

Table 2. Results of Observation on the Implementation of Physics Practicum

No	Observation Domain	Score	%	Explanation
1	Direct observation	3.8	95	Students observe the preparation of tools and materials, use tools and materials and design teaching aids.
2	Indirect observations	3.5	88	Students analyze observations indirectly based on the results of calculations and theoretical provisions
3	Awareness about the scale of magnitude	3.2	80	Measurements based on the scale standard, minimum standards and maximum standards
4	Symbolic language	3	75	Use symbolic language for each variable specified and the amount measured
5	Logical framework of obedient principles and natural law	2.8	70	Consider logic based on established facts, principles and laws
6	Logical inference	2.9	72	Summing up based on logical thinking
7	Law of cause and effect	1.1	27	Declares the cause and effect of a phenomenon
8	Mathematical modeling	1.5	37	Analyze data with various relevant mathematical equations
9	Build concepts	1.3	32	Conducting observations, data collection and data analysis to develop concepts

The results of observations of physics practicum guidelines based on generic science skills that appear can be presented in Table 3.

Table 3. Results of Observation of Physics Practicum Guidelines

No	Observation Domain	Score	%	Explanation
1	Direct observation	3.5	87	Presentation of practical procedures facilitates observations of practicum designs
2	Indirect observations	3.2	83	Abstract concepts obtained based on indirect data collection
3	Awareness about scale scale	3.3	84	Presentation of size, scale and standard of use of measuring instruments
4	Symbolic language	2.1	53	Basic theory and data analysis use symbol quantities and equations
5	Logical framework of	2.4	61	Basic theory based on the formulation of facts, principles and laws logic

	obedient principles and natural law			
6	Logic Inference	2.0	51	Presentation of the conclusion of the practicum
7	Law of cause and effect	0.7	18	Presentation of results of data retrieval, basic theory and discussion
8	Mathematical modeling	0.8	21	Using mathematical equations on the basis of theory and data analysis
9	Build concepts	0.5	14	Results of data collection, data analysis and conclusions

The results of the normality test, homogeneity test and t test are presented in Table 4.

Table 4. Test for normality, homogeneity test and t test

Aspect	Value	Category
Normality test	0.204 (experimental class) 0.408 (control class)	Normal Normal
Homogeneity test	0.000 (levenes test results)	Homogeneous
t Test	0.000 (<i>t-test</i>)	Significant

The generic science test results for physics teacher candidates can be seen in Figure 1.

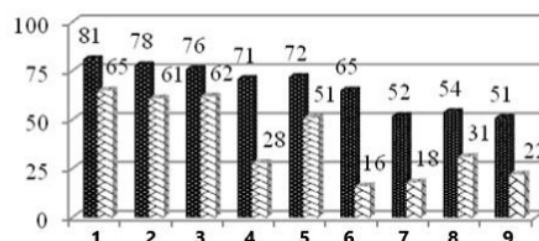


Figure 1. Generic Science Skill Test Results

Information:

1. Direct observation
2. Indirect observation
3. Awareness of quantity scale
4. Symbolic language
5. Logical framework of obedient principles and natural law
6. Logical inference
7. Law of cause and effect
8. Mathematical modeling
9. Build concepts

The Generic Skills Pattern of Prospective Science Physics Teachers can be seen in Figure 2.

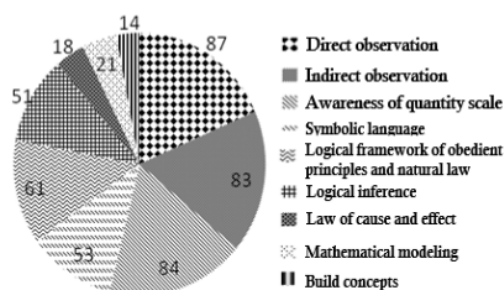


Figure 2. Generic Skills Pattern for Prospective Science Physics Teachers

The pattern of generic science skills that are dominant in the indicator of observation. Observation indicators provide skills in observing various symptoms, phenomena and good objects directly. Indirect observations in compiling the practicum and guidelines are skills possessed by prospective physics teachers. Direct or indirect observation is the most dominant generic science skill [18]. Trained observation skills when the prospective physics teacher takes practicum data and presents the procedure on the practicum guidelines. There are differences in the generic science skills of prospective physics teachers who compose a practicum guide compared to prospective physics teachers who do not compile a practical guide.

The results of the observation through the practicum guidelines showed that the practicum guide was more dominant in facilitating generic science skills in the direct observation indicator (87%), indirect observation (83%), awareness about scale scale (84%). The practicum guide has not been able to facilitate generic science skills on symbolic language indicators (53%), logic and natural law frameworks (61%), logical inference (51%), causal law (18%), mathematical modeling (21%) , and build concepts (14%). The test results showed differences in generic science skills of physics teacher candidates given simple project treatments to compile practical guidelines and making teaching aids rather than prospective teachers who were given direct practicum assignments. The pattern of generic science skills in prospective physics teachers is stated on the indicators of direct observation, indicators of indirect observation and awareness of the scale of the project completion process for making simple teaching aids and the preparation of a simple practicum guide.

The experimental group and the control group have similarities to the indicators of direct observation and indirect observation which have superior abilities compared to other generic skills indicators. In this study the ability to think of logic inference was analyzed through questions about conclusions as a result of taking practical data. other skills such as awareness of scale, symbolic language, logical framework of obedience and natural law, law of cause and effect, mathematical modeling, and constructing concepts trained during the process of making props, taking practical data and preparing practical guidelines.

4. Conclusion

This research produces products in the form of practicum guidebooks for 6 teaching aids including hydraulic excavators, vibration resonances, measuring energy and effort, Van de Graff generators, resonance tubes and liquid pressure. The results of the observation through practicum guidelines obtained that the practicum guide was more dominant in facilitating generic science skills on direct observation indicators (87%), indirect observations (83%), and awareness about quantity scale (84%). The practicum guide has not been able to facilitate generic science skills on symbolic language

indicators (53%), logic and natural law frameworks (61%), logical inference (51%), causal law (18%), mathematical modeling (21%), and build concepts (14%). The test results show the difference in generic science skills of physics teacher candidates given simple project treatments to compile practical guidelines and make teaching aids rather than prospective teachers who are given direct practicum assignments. The pattern of generic science skills in prospective physics teachers is expressed on the indicators of direct observation, indicators of indirect observation and awareness of the scale of the project completion process for making simple teaching aids and the preparation of a simple practicum guidelines.

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