

Strengthening Geoscience Conceptions and Research Skills through Field Work

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Abstract— The research aim was to describe geoscience project design to improve students' conception and research skill in geoscience. This research was conducted to undergraduate physics student at one of the state university of education in Bandung-Indonesia. The total subject were 34 students and divided into 6 groups. The pre-test and post-test were applied to all groups that assumed they have the same level of knowledge. The data were analyzed using independent sample test and Shapiro-Wilk sample test to know about distribution and normality of sample test. Paired t test was used to analyze significant impact of model to the learning result. Descriptive analysis conducted to assess students' research skill through field work. It concluded that the field work had a significant impact on students' conceptions and research skills in geoscience. These results can be demonstrated by the ability of the students in the preparation of proposal, in conducting research in the field, to compile a research report, and to make research product in the form of papers or posters. They are strongly recommended that the fieldwork is a potential strategy to improve students' research skills and the examined as one of the necessary skills in geoscience.

Keywords—geoscience; research skills; field work

I. INTRODUCTION

The basic problems of geoscience learning in higher education are students' mastery of concepts and research skills in geoscience. One of the backgrounds is the lack of a learning experience gained through the learning process. The student's geoscience concept is low and cannot be implemented widely. Limitation of learning resource and lack of interaction in learning process led to the geoscience misconception. It is necessary for authentic geoscience learning strategies in building and developing knowledge, skills and attitudes [1-5], problem-solving skills [6] as well as integrated with problems in the environment [7-9]. Several studies show that the misconception is strongly influenced by the concepts taught [10]. The skills of researching drilled in learning activities will provide many academic advantages in mastering concept and development of the field of professional work [11-14].

A fundamental objective of the geoscience education is ensure that all inhabitants has knowledge of the natural processes about physical environment and understand to human activities impact to the earth [15]. This is consistent with the concept of NGSS (Next Generation Science

Standards). This is consistent with the concept of NGSS (Next Generation Science Standards) that include substantial geoscience education focus to improve understanding of the community challenges facing the associated with the natural disasters, natural resources, economic and ecological systems [16].

Based on reports Basic Research Opportunities in Earth Sciences presented by the National Research Council (2001) [17], there are five challenges in the field of geosciences, namely: (i) the discovery, use and conservation of natural resources, (ii) the characterization and mitigation of natural disasters, (iii) managing the environment, (iv) geo technology support to infrastructure and commercial development, and (v) earth for global security and national defense. Geoscience education should be more emphasis on how to build the knowledge, attitudes, and skills of the communities in minimizing all changes that cause damage to the earth and loss for mankind. Emphasized that students associate with the context of Earth is part of the process of human development resource and produce a knowledgeable society [18]. There are useful to manage of the environment in a variety of ways with responsibility.

II. FIELD WORK DESIGN

Field work is an important part in the field of geoscience curriculum [19]. This activity will train students in all aspects [20] and performed in a wide variety of methods. The practice of field work provide many benefits for students, among others forming and developing students' conception of personal development, academic and professional [21] and also provides various pedagogical advantages [19].

Record, analyze and publish the results of field observations, measure and interpret an important part in the development of investigation in geosciences [22]. It is expected to develop some capability in geosciences, among several other (a) demonstrate knowledge and understanding of the basic principles, models, laws and terminology in the field of geosciences, (b) have the skills to access the scientific information that is reliable about earth, (c) have the responsibility of the diversity of nature and natural resources, (d) understand the earth planet as a system, (e) to appreciate the diversity of nature and natural heritage as a key in the development of local programs that are sustainable, (f)

understand the steps to predict and mitigate natural disasters and evaluate the measures most effective, (g) have the ability to apply knowledge of geoscience in the context of real and take the right decision, and (h) to describe and explain the phenomenon of geosciences basis, data and procedures, in the context of common and unusual [23].

Students are not only given knowledge but they were trained to apply the basic principles of geoscience in solving problems through field work. Based on these standards, some skills are trained among others: (1) define and analyze problems, (2) planning and developing models, (3) plan and carry out investigations, (4) analyze and interpret data, (5) use the thinking skills of mathematics and computation, (6) build explanation and designing solutions, (7) using an argument based on evidence, and (8) generating, evaluating and communicating information [24].

III. RESEARCH METHOD

This study focused on students' skills in carrying out research activities through field work that carried out in the Tangkuban Parahu Natural Park. It was conducted in one of the University of Education in Bandung West Java Indonesia. The subjects were students of physics who are taking Earth and Space Sciences courses. The number of subjects were 34 students, consist of 7 male and 27 female.

There are three stages in the study, consist of preparation stages, implementation, and reporting. The data collected in this study were student research skill based on the students' ability to design a geoscience project proposal according six of project themes (table 1), create reports on the field work and the manufacture of artifacts in the form of a poster or paper. All data was assessed based on the rubrics that have been developed researchers and analyzed descriptively and quantitatively. Score assessment based on criteria, 0.0-1.0 (bad); 1.1-2.0 (good enough); 2.1-3.0 (good); 3.1-4.0 (very good).

At the stage of preparation for carrying out the fieldwork, the students involved in the case and understand the potential issues associated with the volcanoes. Based on these activities, students were able to understand the case, potential issues, identifying the main theme, formulate questions and define the problem or project design. Results obtained from the preparation stage is a proposal field activities based on themes selected projects.

In the implementation stage, students carried out the field work according to the project proposals design, conducted an investigation about the environment and society around the volcano, recording and collecting data based on the observation. At this stage, the students made field notes as the basic of preparing the report of field activities and research products.

IV. RESEARCH RESULTS

The analysis of initial capabilities of students about the concept of geoscience conducted by independent testing. Distribution of sample test was analyzed using the Shapiro-Wilk normality test using SPSS 16. The analysis results can be

explained that the t value for each group > 0.05 (Table I). This means that the initial ability of students in each group was the same.

TABLE I. INDEPENDENT OF SAMPLE TEST FOR EACH GROUP

	Group	t-test for equality of means					
		I	II	III	IV	V	VI
Equal variances assumed	I		0.464	0.567	0.307	0.848	0.119
	II			0.868	0.728	0.632	0.439
	III				0.615	0.741	0.340
	IV					0.448	0.720
	V						0.223
	VI						

Sig 2 tailed > 0.05

Shapiro-Wilk normality test was performed to determine whether the study sample normal distribution. Based on the results of the normality test was known that the significance of each group > 0.05 (Table II). It means, that all samples groups of the study have a normal distribution

TABLE II. SHAPIRO-WILK SAMPLE TEST

	Group	Tests of Normality					
		Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Score	1	.283	6	.146	.846	6	.146
	2	.259	6	.200	.888	6	.307
	3	.220	6	.200	.886	6	.296
	4	.271	6	.192	.853	6	.167
	5	.236	5	.200	.955	5	.774
	6	.205	5	.200	.929	5	.586
a. Lilliefors Significance Correction							
* . This is a lower bound of the true significance.							

Before conducting field work, geoscience students attend a lecture with a focus on the study of volcanoes. Based on the pretest and posttest results (Table III). The t score = -10.907, degrees of freedom or df = 33. This value is significant because of t score < 0.05 . That is the lecturing activities undertaken a significant impact on the improvement of student learning outcomes.

TABLE III. PAIRED T TEST

		Paired Samples Test					t	df	Sig. (2-tailed)
		Paired Differences							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pretest - Posttest	-2.11094E1	11.28495	1.93535	-25.04692	17.17190	-10.907	33	.000

The increase of the students concept of geoscience in each group can be seen from gain score between pre-test and post-test (Fig 1).

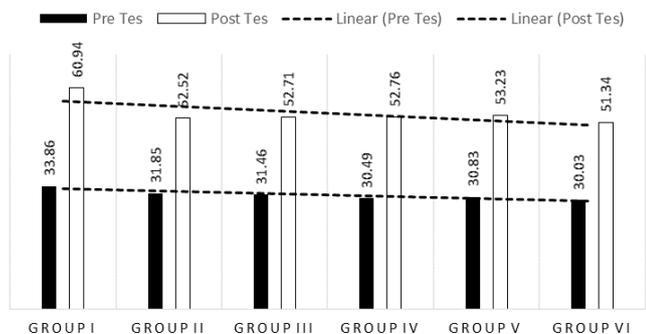


Fig. 1. Pre-post test result for each group

In carrying out the fieldwork, the assessment is based on four indicators. There are the dynamics of the group, the group collaboration, the ability to access and organizing data, and the suitability of activities planned. The aspects that have a minimum scores is suitability of activities planned and the highest score in carrying out the activities in the field is the collaboration within the groups.

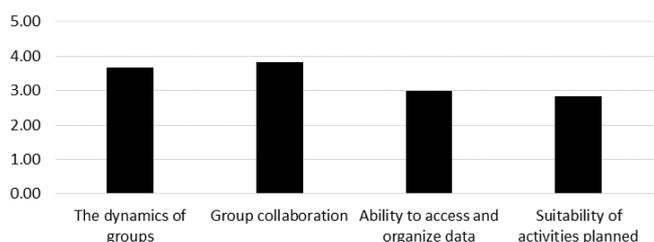


Fig 2. Results of the skills assessment in conducting field work

Willison & O'Reagan [25] showed some proficiencies in conducting research skills. There are explaining the necessary knowledge, finding and producing information, evaluating the information critically, organizing information, synthesis-analysis and applying new knowledge, and communicating knowledge. The skills are realized in the form of designing fieldwork proposals, implementing the field practice, preparing reports and research products.

In general, a physics student research skills in geoscience through field work activities is presented in Table III. The average scores of each group is varies. The highest score achieved by the group I (95.0), while the lowest score recorded in group IV (65.0). Some research skills are still low, consist of explained knowledge necessary and communicating knowledge.

Based on the results of the field work, many interesting findings can be communicated. Interesting students' findings from the field work activity is scientific explanation about the characteristics of Tangkuban Parahu's rock. The dominant of rock types in Tangkuban Parahu is igneous rocks, while there are many surrounding sedimentary rocks such as clay stone. A common igneous rock is basalt and andesite rock. The SiO₂ content is around 45% -56% and includes ultramafic igneous rock. The domination of rocks in some location are clay stones and diabase liparit. They has SiO₂ content of about 45% - 52% and included in the type of alkaline igneous rocks. Based

on the specific of rocks' characteristics, it can predicted that the type eruption of Tangkuban Parahu is effusive.

Another findings that are no less interesting is the endemic plants in the Tangkuban Parahu region. This plant is called Manarasa which can be used as a natural indicator of volcanic activity. It has long creeping roots, big, and strong. Roots hefty lead it became one of the trees that can survive in extreme environmental conditions and strong against storms and high winds. It has red stems but rod outer brownish-black because of the influence of weather and sulfur.

TABLE IV. STUDENTS' RESEARCH SKILLS

Research skills /Groups	I	II	III	IV	V	VI	Average
Explaining necessary knowledge	3	2	2	2	3	3	62.5
Finding and generating information	4	3	3	2	4	4	83.3
Critically assess information	4	4	4	3	4	4	95.8
Synthesis, analysis and apply new knowledge	4	3	4	4	3	3	87.5
Communicating knowledge	4	3	3	2	3	3	75.0
Score	95.0	75.0	80.0	65.0	85.0	85.0	

In general, the field work was considered successful in supporting geoscience learning especially in developing geoscience research skills. These results were based on student perceptions and some notes given on a perceptual questionnaire distributed after this program was conducted (Table IV).

TABLE V. STUDENT PERCEPTION ABOUT FIELD WORK

Aspect (predictor)	Students' perception (%)	
	Agree	Disagree
The program should shaping the scientific attitude of physics students	94.12	5.98
It is important to prepare as a member of society	100	0
It provide opportunities for cooperation and communication	100	0
It assist in understanding human's role to the environment	94.12	5.98
It contribute to the community in encounter the volcano disaster	100	0
It provide opportunities in the role of scholars both in the profession and as members of the community	94.12	5.98

The average student gives positive responds by revealing some of the programs' advantages. Based on the table, we know that the program was success to build students' scientific attitude (94.12%), constructing a positive value of students to the environment around the volcano (94.12%), and preparing students to help the community in the face of volcanic disasters (100%).

V. DISCUSSION

Integrated with the field work in course can significantly increase understanding concepts of physics student. Based on paired sample test (Table III), it can be seen that the value of $t > 0.05$. Fig 2 show us the average of pre-test was 29.78 and an average of post-test was 50.89. Gain score average was 21.11, while the N gain normalized score was 0.53. The increased of procurement of the concept looks after the students has attended lectures that are integrated with the field work activities. Although it is not maximum, there are seems to be an increase in the test results from the post-test. The field work can shape and developing concepts for academic progress [26-27].

In addition to the field work were able to improve the understanding of the concept of geosciences, integration of field work in learning activities make a significant contribution to the physics students' research skills in the field of geoscience. This statement was supported of the students' ability to preparing field work proposals, implementing the practice of field work, preparing reports and resulting product. Through the field work, students should learn how to work in groups, learning about the importance of observation, documenting and recording as part of the scientific method [28], and increasing content knowledge through research project [27]. Many experts agree that the field work is enjoyable learning strategies and very effective for providing a variety of learning experiences [29-30].

Even though all of them has limitations to transfer their classroom knowledge to the field environment. The average student has been able to identify the problem properly to pour it in the form of proposals. This aspects considered less are the completeness of the study design and the use of research relevance serves as a scientific basis to plan a geoscience projects.

Discrepancy between the plan and the conditions in the field are often the main factor causing difficulties in carrying out field work. The research design based on the problems in the field are more likely to be implemented because it is able to be implemented effectively [31]. Skill designed the research depends on knowledge of the design of field research. The use of relevant research related to the ability of information access about the latest research and the object being studied. Lack of support for research journals relevant and low skills is quite difficult to access information in the search for student's literature.

Collaboration within the group showed the highest score to carry out field work but the group dynamics is low. The ability to access and organize data and compliance with the action plan is still a record. Some of the problems when students carry out field work among others students less skilled in accessing information about the rocks, has no technique in exploring the geological information, and the measurement of environmental factors which affect the vegetation is less supported by corresponding tools. Students' ability to interpret the results are relatively better, but less able to offer a solution as a form of problem solving as planned in the proposal. Discipline time involved in submitting the report

into a separate issue that should get serious. Average group is not timely in collecting reports. The students should be trained to work in a predetermined time range [32].

Paper or poster as research products (artifacts) are average prepared very well by each group. The aspect that still needs to be improved was the quality of product. There were six of research products, but only two research products are considered worthy for publication, namely a paper on recognizing the nature of Tangkuban Parahu eruption based on the characteristics of rocks and a poster about the types and characteristics of the land on Tangkuban Parahu. They are relevant with all publication aspect requirement. Through field work, can be obtained information more clearly as it has been defined through a model or theoretical criteria [33].

VI. CONCLUSION

Based on the results of this study concluded that integrated with field work can improve student conception and research skills in geoscience learning. Through field work, students were gaining the real experience to volcanic problem-solving systematically. The environment and social issues in the volcanic surrounding became interesting topics in geoscience learning and should stimulate students to think critically and work to resolve it through research. The research results from field work also serve as a bridge to link the learning outcomes of geoscience in universities to the needs of the community and gives answer all issues about geoscience teaching is less considered.

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