Physics Student’s Research Skills Performance: A Field-Based Approach in Geoscience Learning

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Abstract. This research aims to describe performance of university physics students in the field of geoscience, focusing on assessment of students’ ability in field-practice implementation associated with geoscience learning to solve corresponding problems in the society living nearby the volcano. The present study involved a total of 32 students in the year 3 of their study, performing field work relevant to geoscience themes in Mount Kelud, well known as Tourism Park in East Java province, Indonesia. Based on the assignments distributed over the students during practising research skills, we concluded that students’ performance was overall good, indicating that they were well-trained. However, further improvement of the skills was required for at least two competencies, namely ability to assess critical information from the source and to both analyze and synthesize relatively new knowledge and hence different perspectives obtained on site. Following the research results, we hereby recommended that the field-based approach in geoscience learning is of significance in supporting improved performance and better research skills of university physics students.

1. Introduction

Good research skills are required for university physics students to develop their particular abilities in the field of geoscience. This is relevant to the characteristics of geoscience learning, which is concerned with both students’ involvement and interaction with the environment through scientific processes of problem solving that occur in the local community. It is a reform of science education by providing students with a wider range of opportunities to develop their research skills during science activities through field-based exploration and investigation [1]. Through such field work, geoscience involves science process skills, namely formulating hypothesis, identifying evidence, combining different evidences, and arguing science literacy of reasoning [2].

Effort in optimizing research skills of the students in the field of geoscience can be carried out through a field-based approach believed to be an appropriate method of attracting students in a geoscience course. This approach is of fundamental importance as it develops student conception about geoscience materials during field work to support the development of personal and academic competencies [3]. In geosciences, these competencies should be based and developed between the lecturers and the accompanying students to establish interdisciplinary and transdisciplinary courses [4] and to understand scientific phases as part
of efforts in performing better knowledge and expertise [5]. Through this field-based activity, students are encouraged to demonstrate their research skills to access reliable information about the Earth in general and to describe geoscience-related phenomena, including good procedure for data collection and analysis in varying geophysical contexts [6].

Thus, the primary objective of this research is to develop physics students’ research skills performance in the field of geoscience through a Field-Based Approach (FBA) applied during a field trip. The field scheduled activities resulted in outputs that could be utilized to solve corresponding geoscience problems in the local society. Research question to be answered in this research was how the students’ performance in the field of geoscience was developed during the course on this approach? This research is important because it is expected as a reliable tool for developing research skills among physics students in the year 3 in a geoscience course. The developed skill has lately been the main target in modern geoscience learning of either classroom settings or in particular field-based activities. During field work, the students were expected to be able to analyze geological facts and draw conclusions based on field data obtained [7].

2. Method
This research focuses on students’ skills in conducting research activities through field practice of various field activities performed in Mount Kelud Natural Park. A total of 32 students from physics education study program in the year 3 joined the research team, where all of these students took Earth and Space Science course in campus prior to doing this work. There were three stages performed during this study, namely preparation, implementation, and activity report. The data collected during field work reflected the ability of the students to design geoscience projects, the skill in research report making based on all the outputs obtained from the activities as well as the skill in posters creation and corresponding papers. All the data were assessed using invidual rubrics distributed over and filled by the students before being analyzed in a quantitative-descriptive method.

3. Results and Discussions
Students ability in designing geoscience projects was assessed using the submitted proposal of field-based activities. The proposal was thus arranged in accordance with geophysical issues related to Mount Kelud. The focus of the assessment was emphasized on five aspects, namely the ability of problem identification, research design creation, relevant approach application, appropriate method implementation, and research instrument development. The obtained assessment are depicted in Figure 1 below.

![Figure 1](image-url)
Based on Figure 1, the ability of students in designing a field activity practice proposal is quite good. The aspect in designing a prominent proposal is the ability to identify problems and conformity methods used in the field practice activities. The two components are at an excellent level of 3.67. The average issue identified is systematic and in accordance with themes provided. Meanwhile, the average design complexity is very good because it is complete, has clear stages and supports the problem solving process. The lowest-rated aspect is the ability to use relevant research. This component is at a sufficient level of 2.00. The average research plan is only supported by one relevant literature. The next relatively low component is the completeness of the design and the research instrument used to access all the data. Although the category is good, valued for 2.83, but it then remains challenging to be further improved. The research design developed by all the students has a clear stage but lack of support of problem solving in accordance with formulated problems in the proposal. While the instrument was made less complete and less specific it greatly affects the process of accessing field data.

![Figure 2](image-url)

**Figure 2.** The results of field work implementation for (a) skills in the project and (b) field notes.

Skills in research design are strongly influenced by the level of knowledge while the use of research results relevant to the current project may affect the ability to access information about the latest research.
Being lack of accessing relevant journals and low-level skills are the main cause to adequately complicate students in finding academic literatures used to reinforce the significance of the topic being discussed and the research novelty.

The practice of field activities is implementation of research design compiled by the students. There are 4 aspects reflecting the focus of assessment, namely group dynamics, collaborative group, data access, and suitable activities. Assessment of the activities was performed by 2 senior lecturers having the same perception on rubric assessment. The results for field-based activities assessment are then presented in Figure 2. Based on the assessment results, depicted in Figure 2a, it can be concluded that the groups are able on average to carry out field work in a proper manner. The students strive to obtain field data used to create research reports and to compile research outputs in accordance with the each group characteristics. In creating field notes, as seen in Figure 2b, the students are able to make good reports corresponding to each themes of their own project. However, the documentation of the field data is not yet completed, as required. Field notes are crucial in helping students to create good scientific reports after the field-based activities are completed.

![Figure 3](image-url)

**Figure 3.** Students’ research skills performance scales with: 0.00 – 1.00 categorized as bad; 1.01 – 2.00 categorized as enough; 2.01 – 3.00 categorized as good and 3.01 – 4.00 categorized as very good.

The skills of conducting research are assessed based on five aspects, as shown in Figure 3, consisting of (1) explaining knowledge required; (2) providing good information; (3) assessing critical information; (4) synthesizing-analyzing and applying new knowledge; and (5) communicating good knowledge [8]. Based on the assessment results of research skills, the highest aspect is providing (finding and producing) information and communicating knowledge (3.50). The lowest skills are the ability to synthesize, analyze and apply new knowledge (2.67) and critically assess information (2.83). This requires paying attention more in order to develop students’ research and publication skills in the course of geoscience. In carrying out activities in the field, collaboration in groups and suitability of activities with plans show the highest score, but the ability to access and organize data is still recorded, as depicted in Figure 2a. Some problems when students carry out activities in the field include: students are less skilled in accessing information from data sources, both from the environment and the community, do not have good techniques in
exploring geological information related to project themes and observations about rocks can not be done optimally because support equipment. Besides that, it is not possible to do environmental measurement that may affect vegetation, making unable to provide complete information related to the role played by vegetation as a volcanic activation records.

The ability to analyze and synthesize information can be seen from reports on the results of field activities. The ability of students to interpret the results is relatively good, but they are less able to offer solutions as a form of problem solving as planned in the fieldwork proposal. Discipline of time in completing reports becomes a separate issue that must get serious attention. Students must be trained to work within the required timeframe [9]. Based on the results of an analysis of students’ research skills, as shown in Figure 3, the two lowest rated aspects are critically assessing information and synthesizing, analyzing and applying new knowledge. This corroborates [10] writing, which explains the insignificant correlation between learning focused on data collection and analysis, quantitative analysis, use of scientific literature, and how to use learning outcomes during lectures to be applied in the field. Through learning that is based on direct interaction with the environment can minimize the gap between the practice of classroom activities and the ability to use knowledge and skills in the field.

An interesting statement made by [11], anything that cannot be tested or falsifiable both scientifically and mathematically now and in the future cannot be considered as science. This phenomenon is related to the emergence of the mysterious road phenomenon (mystery road) around Mount Kelud which has been believed to be influenced by supernatural power. The research results conducted by the students showed that the mysterious road nearby Mount Kelud is not caused by supernatural forces or the presence of gravitational anomaly, rather it is caused by changes in a road contour predicted due to the gradation of the ground which is triggered by seismic activities of Mount Kelud. These contour changes build optical illusions, so as if the road rises following the elevation of the slopes of Mount Kelud. The results of this study greatly help understanding for the local community around Mount Kelud related to the mysterious phenomenon.

From the results of the implementation of field practice activities can be formulated several important things, namely the suitability of the learning environment strongly support the success of the students in geoscience learning [12]. The students can use geoscience knowledge and skills to answer problems in the field, even with limitations. To optimize field practice activities, [13] conveys three important things that must be understood in field activities, namely total integration between physical and mind on nature and the environment (embodiment), building a representation of natural phenomena (creation and inscription), and linking between standard norms and practices, using tools, and understanding underlying assumption, limitation and uncertainty (initiation). In addition, the present study focusing on field-based approach for developing students’ research skills performance during the trip is likely to complete knowledge either through laboratory-based activities or those in classroom settings performed by other groups of students in the same department in previous years as addressed by [14]. The state of the art of good knowledge in geosciences is crucial to literally deliver for university physics students.

4. Conclusion
Field-based research is a kind of innovation in geoscience learning for making students more interested in the course. Through the field practice activities, the students are provided with the opportunity to come into contact with the environment in order to develop relevant scientific problem solving skills. Based on the research results, it can be concluded here that the students’ research skills performance are quite good. The important note that should be being primary concern is the ability to critically assess information and the other ability to analyze, synthesize, and apply new perspectives on geoscience. These two aspects are key factors in conducting field-based research. For this reason, it is then a must to make possible efforts, leaving the students well-trained through continual field work. Through continuous and sustainable field
practices, the students are ensured to have important skills in the field of geoscience, as required, and are become better to solve geophysical problems in varying contexts.

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