Bryological exploration: field-trip based learning to develop competencies of science teacher candidate

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Abstract. The purpose of this study was analyze the competencies of science teacher candidate after the bryological exploration. The intended competence of science teacher candidate was the ability to apply the concept and science ability to explore plant diversity that could be found around the environment. This field trip was conducted by exploring liverworts, hornworts, and mosses as well. This descriptive research was conducted during March until April 2017 at Universitas Negeri Surabaya (UNESA) and Sumber Brantas Arboretum in Malang, as the location of exploration. The subjects of this study were 76 candidate of teachers from science education department, which is divided into three classes. The competences observed on this study were describing, identifying, collecting specimens, furthermore. The research instruments were observation sheets, product assessment sheets, and response questionnaire. The data were analyzed descriptive-quantitatively, in percentage and then categorized. The results of this study indicated that: the describing skill was categorized as ‘good’; identifying skill and collecting bryophytes was categorized as ‘very good’; and communicating skills was categorized ‘good’. In addition, the teacher candidates gave a very good response to field-trip-based learning. It can be concluded that the bryological exploration can develop the competences of science teacher candidates of Science Education Department of UNESA.

1. Introduction

Education paradigm friction from the transferring knowledge to students to the real learning process was a phenomenon that happened during past century. In the higher education, the development was not prevalent and very dependent to the self-interest of teacher in education [1]. Education that has good quality won’t make sense if the learning doesn’t give the student the opportunity to develop the knowledge and the skill that fulfill the demand of the labor market that changed rapidly [2]. Students are the center of higher education, the their cognitive and affective learning experience have to be a guide for decision, according to the what and how they will do something.

Cognitive experience and the skill are very related to the word of competence. Competence is an ability to apply or use amount of knowledge, skill, and related ability to succeed doing ‘critical work function’ or exercise in applied working environment. Competence represents self characteristic of person that become a superior performance in the certain situation [3], and looked from the input and output section. Competence is also related by the way of person’s attributes, such as knowledge, skill, and behavior, showed in doing the certain work, and become the whole performance.

The competence of student, candidate of science teacher from Universitas Negeri Surabaya in subject Living Creatures Diversity are (1) Understanding the concept of diversity and variation in Protista, Fungi, Plantae, and Animalia; (2) Skilled in observing, describing, identifying the living creatures around the
environment that are needed as learning media. It can’t be denied that those competences can only be achieved by learning experience that is concrete and in the real situation. This field trip is an activity giving experience directly, real world experience, positive behavior toward science and interstudent socialization enhancement. Field trip is approved as important moment in learning; social experience that gives opportunity for the student to meet and explore something new in authentic condition. Field-trip-based learning is not a expansion or enhancement learning in the class, but as the precious supplement for learning in the class, and also the best way to prepare student in the future [4].

The type of the planned activity using field trip for students and candidate of science teacher is exploration. Exploration is an activity finding information or resource. The object in this exploration was bryophyte. Then, the name of the activity was bryological exploration.

2. Bryological exploration as field-trip-based learning

The main subject of bryological exploration was giving experience to students that couldn’t be obtained in the class. Bryological exploration is field-trip-based learning that provide the chance for the students to train applying their skill, concept understanding, and learning moss diversity in its natural habitat. Furthermore, this kind of learning give entertaining effect to students, aside give them learning experience.

Sumber Brantas Arboretum, Malang was chosen as field trip location because of the existence of 17 species of bryophyte that was considered as adequate to represent all of the bryophyte diversity; liverwort, hornwort, and moss. Arboretum location was far from the campus by 72 km in distance and 3 hours in traveling time. Then the field trip should be planned well. If the field trip wasn’t planed well in the start, it would have wasted time and money [5]. Field trip should be planned as cooperative activity that every student can participate below lecturer’s supervision [5] and should be designed as the specific education purpose [6].

There were three steps in this arboretum field trip: pre-trip step, field trip, and after-trip step (Table 1). Pre-trip step needed more times than the other two steps, since the students needed to do location survey and prepare permission and the students train exploring around the campus. Furthermore, the lecturer should prepare field trip activity sheet structurally. The second step was the field trip itself that involved student and lecturer’s role. This field trip was attended in one day, from morning until evening. During the field trip, lecturer was helped by lecturer assistant to guide students exploring the bryophyte. The third step was post-trip step that consisted of two components: discussion and concluding.

Table 1. Field trip activity in arboretum train students to apply their bryophyte diversity exploration skill

| Topic                          | Bryophyte diversity field trip in Arboretum Sumber Brantas. |
|-------------------------------|-------------------------------------------------------------|
| Activity                      | Trace the Sumber Brantas Arboretum and explore the bryophyte diversity in its natural habitat. Menyusuri/menelusuri Arboretum Sumber Brantas dan eksplorasi keanekaragaman lumut di habitat alaminya. |
| Subject                       | (1) To collect specimen from three taxa: liverwort, hornwort, moss; (2) To observe the characteristic of bryophyte using magnifier; (3) To capture bryophyte photograph using camera; (4) To describe the detailed characteristic of the bryophyte; (5) To identify the bryophyte using Bryophyte Diversity Atlas; (6) To make preserved bryophyte collection; (7) To have fun in arboretum. |
| Implementation step           | (1) Pre-trip step: student trained bryological exploration around UNESA campus, location survey, managed permission, prepared equipments and accommodation; (2) Field trip step: explored arboretum and the bryophyte diversity; (3) Post-trip step (follow-up): discussed the bryophyte concept, made preserved bryophyte collection, and made report. |

3. Research purposes

The study of bryological exploration purpose was analyzing the competence of science teacher candidate, including application of observation, description, identification, preserved specimen
production, and concept understanding skill; and analyzing students response toward field-trip-based learning activity.

4. Research method
This research is a descriptive research. The data of this research were collected by using observation sheet, assessment sheet, and a questionnaire. The research was conducted in April 2017 in the surrounding environment of the campus of Universitas Negeri Surabaya (Unesa), science laboratory of Unesa, and Arboretum of Sumber Brantas Malang. The subjects of research were the students of science education study program cohort 2015 who programed the subject of the diversity of living organisms. The total number of the research subjects was 65 students divided into 3 classes. The variables in this research were the science competence of teacher candidates which included the ability to apply observation skill, descriptive skill, identification skill and collection skill; and the ability to apply the concept of bryophyte diversity. At each stage of the filed trip, the students practiced science competence, but what was observed and assessed and collected as the research data were the field trip stage and the post field trip stage. The data of this research were in the form of (1) observation skill obtained from the instrument of student activity observation, (2) description skill, identification skill and collection skill were obtained from product assessment sheets, (3) concept mastery was obtained from question and answer sheets; (4) the student's responses toward the implementation of the field trip were obtained from a questionnaire. The data of the students’ competence and students’ responses were in the form of scores ranging from 1 to 4. The scores of each competence and each response were tabulated, and the average score was calculated. After that, the SD was determined. Furthermore, the data were analyzed descriptively based on the average score criteria as follows ≥ 3.6: very good; 2.8-3.59: good; 1.9-2.7: poor; 1.0-1.8: very poor.

5. Result and discussion
5.1. Competence of students as candidate of science teacher
Field trip is an activity that is planned well and give the chance to know, observe, and explore subject, phenomena, and process, and student interaction in natural condition [7]; field trip should be based on the exploration, discovery, and process skill, than shows only the fact [8]. Arboretum field trip gave an opportunity to the students to apply five skills in exploring moss diversity: observation, description, identification concept understanding, and production of preserved moss collection. Then, the field trip was not only providing fact for the students, but also information that could be analyzed by students. After observing, students analyzed the characteristic of the bryophyte in order to identify the species name. Outdoor work enabled students to develop their skills that could be useful in learning activity and also in the real life, such as information gathering and process skill, ability to work independently or in group; to develop experience and togetherness [7]. The outdoor concept was attributed by the interaction between people and outdoor environment where students could use all of their sense, get the experience directly, and interact directly in real life, and encourage the curiosity and imagination [9].

The assessment result showed that the four skills applied to the student in bryological exploration were classified as good (observation, description, identification, and concept understanding), while production of preserved moss collection was classified as very good. Although those five criteria got the good result, there was a thing to be considered. Description skill got higher standard deviation than the other skills (0.71). this meant that students couldn’t describe the characteristic of the bryophyte well. The production of preserved moss was done on after-trip step. The collected mosses that were preserved as wet herbarium should showed the characteristic of the bryophyte species such as gametophore, gemma cup, scale, and rhizoid on liverwort. So, the students must have the correct concepts of the bryophyte group and apply them when identifying and choosing bryophyte species collected completely.
Table 2. Assessment Result of Student Skill Applied in Bryophyte Diversity Exploration

| Skill                          | Score Average | SD  | Score Average criteria |
|-------------------------------|---------------|-----|------------------------|
| Observation                   | 3.53          | 0.53| Good                   |
| Description                   | 3.37          | 0.71| Good                   |
| Identification                | 3.17          | 0.65| Good                   |
| Concept understanding         | 3.53          | 0.58| Good                   |
| Production of preserved bryophyte collection | 3.64  | 0.51| Very good              |

The benefit of field-trip-based learning must offer so much opportunity of learning during the trip, take the benefit of unique character from the location, and give the experience that couldn’t be replicated in the class [8]; can arouse students’ interest, students’ learning activity, and help them to get the experience directly [9]. The bryophyte observation in their natural habitat was the students’s experience that couldn’t be obtained in the class such as observing moss colonization like the carpet or grew on the trunk. To explore the bryophyte, students should walk around the bush or trees or trace the river or even climb the trees to observe and take the bryophyte as collection. Students really learnt about the bryophyte diversity and characteristic variation in the real view. Only by direct contact by the environment, student could develop the awareness and get the knowledge aout outside life around them, and develop the skill they should have.

5.2. Response of student as candidate of science teacher

Based on the students’ responses on Table 3, it showed that the field trip was done well. Bryological exploration gave the important information to the student about bryophyte diversity by its character variation and types of the habitat. Students responded that the field trip was planned well from the preparation, the trip itself, exploration, and the follow-up. To avoid ineffective field trip, careful planning and field developing were important and the key element was preparation prior to field trip. Pre-trip preparation, deciding time that coresponded the curiculum to do field trip, equipment preparation, careful logistic planning, and after-trip discussin were effective way to overcome ineffective field trip problem [10].

Table 3. Response of student towards moss exploration implementation

| Statement                                                  | Score Average | SD  | Score Average Criteria |
|------------------------------------------------------------|---------------|-----|------------------------|
| Apply bryophyte diversity observation skill directly       | 3.72          | 0.45| Very good              |
| Apply bryophyte species identification skill               | 3.60          | 0.49| Very good              |
| Apply description of bryophyte character variation skill   | 3.55          | 0.50| Good                   |
| Obtain the hands-on                                       | 3.63          | 0.49| Very good              |
| Clarify the received concept by short talk or reading textbook| 3.31          | 0.58| Good                   |
| Bryophyte exploration trip is an enjoying field trip.      | 3.57          | 0.64| Good                   |
| Bryophyte exploration is not only learning activity, but also entertaining activity. | 3.58          | 0.58| Good                   |
| Enjoy nature beauty during the trip and in arboretum      | 3.72          | 0.52| Very good              |
| Open the insight of biodiversity by exploring the variation of bryophyte species and its natural habitat | 3.46          | 0.56| Good                   |
| Field trip is planned well involving preparing, traveling, exploring, and following-up after the activity. | 3.31          | 0.50| Good                   |
Students gave ‘very good’ responses on observation skill, hands-on experience during field-trip-based learning, and identification. The hands-on experience gotten by the students in bryological exploration was observing parts of the bryophyte using magnifier; collecting and taking specimen of the bryophyte from the habitat carefully, since the thalus was very delicate, especially on its sporophyte part; putting the specimen and bonding it by string to the mica plate for making wet herbarium. There were so many activities of students in bryological exploration, so the students got many experience of learning. Students got learning experience from the environment of active learning from field trip. Since it could change the class condition and the learning process, it could affect lecturer’s enthusiastic for several topics [10].

Very good assessment was also given in topic of nature beauty during the trip and in arboretum. They assumed that the field trip was fun, since they could enjoy the cool condition in arboretum while the temperature in the campus itself was commonly high. Sumber Brantas Arboretum is extinct plant conservation area located on the slope of Anjasmoro Mountain. The Anjasmoro Mountain itself is 1,500 from sea level in height, has beautiful view and cool air by 10-20°C in temperature. Students and lecturer reflected their experience after the trip, so it could make comfortable learning environment. Field trip could entertain students, helps making learning experience more sociologically memorable, and increase students’ motivation for the learned topic [10]. Exploration in arboretum was different with learning in the class. Different innovation and impression during outside the class became unforgettable moment and kept in the mind for long time [11].

Field trip offered opportunity for the student to learn in the real world and bond the gap between theory and practise [10]; should be planned in order to make student relating between the focus of field trip and the concept they gotten in the class easily [12]. Students’ responses showed that bryological exploration was good to clarify concept given from lecture or reading textbook. They also said that by doing trip in the natural habitat of bryophyte could open their knowledge about bryophyte biodiversity. In campus, they could only learn about the moss from the preserved specimen in the bottle. However, they said that they knew if the liverwort grew attaching the soil surface and accumulated each other; Marchantia and Riccia (liverwort species) made different colonies that could be used as characteristic. Outdoor learning concept have been applied in bryological exploration. Outdoor learning was related by interaction between people and outdoor environment where students could use all of the sense, get the experience directly from real world, encourage curiosity and imagination [9]. Then, experience using can cause students getting more knowledges about certain subject [7].

Among the good responses, students said that they were not satisfied by the field trip. They wanted to do field trip more than a day by reason: (1) exercise working time would become longer then they could do their work; (2) could play in nature, since arboretum was the first location they visited.

6. Conclusion
Field-trip-based learning by bryological exploration activity can develop competence of science teacher candidate. They got the experience directly to apply observation skill, description skill, identification and concept understanding, and also bryophyte collection making concept. From the four skill trained, description was a skill that not all of student got it.

Students’ response toward field trip was good, since the first step of the field trip was done well. So, they thought that field trip gave them some benefits. Students got many experience of learning to relate the concept they gotten in the class and the real world. Moreover, students felt satisfied because the field trip location was amusing by beautiful different view.

Acknowledgement

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