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Field trips based on a focused strategy to stimulate the improvement of students' problem-solving skills on ecosystem materials

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ABSTRACT

Improving problem-solving skills has been promoted as a helpful strategy in student learning in the 21st century. Field trips are a learning method that can encourage students to interact directly with natural objects in nature. The learning method is expected to improve students' problem-solving skills. In this case, this research was conducted to find the effect of field trips on improving students' problem-solving skills based on a focused strategy. This research is quasi-experimental research using pre-test and post-test designs. The participants in this study were students from two tenth grades of SMAN in Pameungpeuk, Garut, during the 2019/2020 school year. The data obtained were analyzed using the average comparison test, namely the t-test (for parametric data) and the Mann-Whitney test (for non-parametric data) with a value of 0.05. Based on the analysis, the problem-solving skills of students in the two classes increased in the medium category, and there was a significant difference in the problem-solving skills of students in the two classes with a significant value of 0.044. Thus, it can be concluded that a focused strategy-based field trip affects problem-solving skills and can stimulate the improvement of students' problem-solving skills on ecosystem materials. Therefore, a field trip with a focused strategy can potentially be an alternative method for teachers in high school to improve students' problem-solving skills on ecosystem materials.

Introduction

Field trips as a field-based or outdoor learning method effectively teach biology to students (Ayotte-Beaudet et al., 2017; Fägerstam & Blom, 2013; Rahman & Spafford, 2009). Several experts revealed that this learning is commonly used in Biology, for example, in the branches of Botany, Ecology, Environmental Biology, and Zoology in universities, because field-based learning such as field trips is focused on helping students get basic training, understanding, and knowledge about the diversity of life such as how one species. Organisms interact with their environment and how humans as a species will affect the abundance and distribution of other species of organisms (Fleischner et al., 2017; Thomas & Fellowes, 2016).

As stated by researchers, Biology in Senior High School (SMA) is a subject matter closely related to the environment, which studies how a species of organism interacts with its environment; in this case, it is an ecosystem. Students must be given hands-on experiences in nature that a good understanding of the relationship between organisms and their environment, which can indirectly foster students' interest in Biology (Puhek et al., 2012), Students' environmental awareness develops, which leads to how students learn to protect nature (Borsos et al., 2018). Even if learning in this field trip is combined with some questions that lead to problem-solving, this will indirectly encourage students to learn and develop their investigative skills (Puhek et al., 2011). Learning with this field trip can offer new learning experiences that can develop interactions between teachers and students, leading to meaningful learning (Amosa et al., 2015).

Researchers report that in some schools, hands-on experience and nature activities have almost disappeared (Boric & Skugor, 2014); it is feared to impact cognitive levels (Puhek et al., 2011). The condition is contrary to the Basic Competence (KD) of the 2013 Curriculum in Indonesia (Kementerian Pendidikan dan Kebudayaan, 2016). At the cognitive level, ecosystem materials require students to have higher-order thinking skills such as problem-solving (Ariyana et al., 2018; Kurniawati et al., 2015).

Higher-order thinking skills are essential because these abilities are beneficial for students in the 21st century (Whiley et al., 2017), so that students can compete in today's global society (National Education Association, 2012). Environmental challenges such as conservation and water quality, climate change, and loss of biodiversity are increasingly pressing (Szczytko et al., 2018). In addition, environmental challenges that are increasing on a local to global scale at this time are lead contamination of water in urban areas to global climate change (Kinslow et al., 2018). Therefore, to overcome this, it is necessary to have a young generation who understands ecology, cares about the environment, has the skills to analyze complex problems, and is motivated to act (Hollweg et al., 2011).

Educators try to overcome environmental challenges by conducting outdoor learning by placing students directly in a learning environment. There are various terms for outdoor learning experiences, such as situated-learning, informal education, outdoor learning, Field-trip or Fieldwork or Field-study, Field-based learning (FBL), and Learning in natural environments (LINE) (Kinslow et al., 2018). Therefore, the ability to solve significant problems is explicitly taught to students whose learning has the main principle of being student-centered, which is collaborative, contextual, and connected to the community or community (Zubaidah, 2016). Field trips are specifically recognized to provide outdoor learning experiences with educational value that can develop the abilities of students who are critical thinkers and can work as part of a team (group) to solve problems (Larsen et al., 2016).

Several studies have revealed that problem-solving exercises conducted by students who take field courses can make students perceive the problem more deeply and provide brilliant solutions than students who take classroom learning (Easton & Gilburn, 2012). A study conducted in Sweden revealed that learning in nature involving fieldwork has a tremendous developmental impact in terms of student collaboration and problem-solving skills (Manni et al., 2013). Students' knowledge of local environmental habitats increased significantly (Jose et al., 2017). Therefore, participating in field trip learning has an impact on increasing the value of biology achievement but also increases students' environmental awareness, affective (inter-personal and positive behavior) students, and pro-environmental attitudes that lead to environmentally sound and responsible citizens. Responsibility can lead to decision-making to deal with environmental problems in the 21st century (Hill, 2013; Patrick, 2017).

One of the challenges and opportunities lost in organizing field trips to the natural environment is the low ability of teachers to take their students out of school (Tal et al., 2014). This problem can be overcome by conducting field trips through various strategies, as revealed by Falk et al. (1998), namely a

Focused strategy, Moderately focused strategy, and Unfocused strategy. The three strategies above are used by visitors in field trip activities that can affect the learning outcomes due to their experience.

After all, teachers as education practitioners play an important role in influencing strength and clarity during field trips. Teacher involvement during field trips ranges from actively working with students (such as monitoring student activities) to letting students fend for themselves in digging up information from field trip locations. This involvement shows that the positive value of the field trip is very dependent on the learning strategy (instructional) of the teacher who organizes it. However, the new knowledge students get when participating in field trip activities is also played by their choices, controls, interests, and prior knowledge. Peers or other study group members can even play it. Other people in the study group can also play, even acquiring new knowledge during field trip activities (Kisiel, 2006). Therefore, by using two of the three strategies that have been revealed by Falk et al. (1998), the researcher intends to analyze the implementation of field trip learning on students' solving abilities in ecosystem material.

Considering the types of skills studied, ecosystem material was chosen as one of the appropriate Biology subject topics to observe the effect of field trip learning on problem-solving skills because ecosystem material is a topic that has a strong relationship with nature. After all, it discusses interactions between living things and their environment and the balance of ecosystems or nature (Adisendjaja et al., 2019; Zaragoza & Fraser, 2017). The ultimate goal of learning about ecosystems is to generate knowledge and develop students' awareness and concern about the ecosystem as a whole and its related problems to shape students' pro-environmental and conservation behavior (Bogner, 2010). This choice also refers to the recommendation of the 2013 Curriculum Implementation Training Module that the appropriate learning resource following Basic Competencies (KD) is the environment or nature because KD 3.10 and 4.10 are about ecosystem materials and interactions that occur in ecosystems. Biology subjects in class X have contextual, collaborative characteristics and motivate students to think critically and solve daily life problems. Learning activities can be developed by analyzing the components that make up the coastal ecosystem and the interactions that occur in it through direct observation in a nearby school environment. coastal areas (Kementerian Pendidikan dan Kebudayaan, 2016).

Method

Researchers used a quasi-experimental method (Creswell, 2013). The objects in this study consisted of two groups: the first group as the experimental class and the second group as the comparison class (not control). Participants in each class were 18 students in the experimental class and ten students in the comparison class. The difference in the number of participants between the experimental class and the comparison class is the number of participants (students) who fully attend the field trip learning from the initial stages, namely pre-field trips, during-field trips to the final stages of post-field trips.

The sampling technique used is that the class is considered a cluster or sampling unit (Asra & Prasetyo, 2015; Fraenkel et al., 2012), so it resembles the sampling technique using random cluster sampling. The experimental class experienced a field trip based on a focused strategy as a learning method. The participants' field activities were guided by a field worksheet containing activities to solve problems and divided into several activities to make them more focused. Meanwhile, the comparison class experienced a moderately focused strategy-based field trip. Field worksheets also guide field activities, but the activities carried out by participants in solving problems are not partial but integral as a whole so that the activities carried out by participants become moderately focused. In addition, this study also adopted a pre- and post-test research design (Creswell, 2013) in which a test instrument was used to measure students' problem-solving skills on ecosystem materials.

Table 1. Aspect of problem-solving skills tested on students

Aspects of problem-solving skills	Sub problem-solving skills	Troubleshooting test indicator
Representing the problem	Selecting relevant and irrelevant information	Identifying the problem
	State or reformulate the problem	Formulate the problem
Planning a solution	Looking for problem-solving strategies	Making possible answers (solutions) related to the problem
Implementing the solution	Proving the truth	Determine the possible answer (solutions) to solve the problem
Evaluating solutions	Examine the results, looking at the implications of the solution	Predict the impact or effect of the best answer (solution) is applied to solve the problem

Source: Adapted and adopted from the Problem-Solving Pathway Model (Eibensteiner, 2012)

The ecosystem material tested in the test is the relationship between the concepts contained in the ecosystem, including ecosystem components, interactions between components, biogeochemical cycles, and ecosystem imbalances. The test instrument used to measure students' problem-solving skills is in the form of essay questions. The tests that were compiled and developed were adapted to aspects of the Problem-Solving Pathway Model (Eibensteiner, 2012) and adapted the form of questions to questions from Paidi (2010), which can be seen in Table 1.

The test given is a set consisting of five interrelated questions to solve problems according to the context of the problem. The test used has been tested for items through the help of ANATES software with the results of item reliability of 0.86 with Very High criteria (Arikunto, 2016) and item validity of 0.76 with High criteria (Arikunto, 2016). The test instrument decision-making criteria used from the test results and item analysis refer to the item quality criteria from Zainul and Nasution (2001) and the decision-making criteria about the results of the study by Sudiatmika et al. (2010). The pre-test and post-test results were calculated to get an increased index or n-gain using the following formula and interpretation from Hake (1998). Proofing of the hypothesis is done after the data is tested for prerequisites through the normality and homogeneity tests; in this study, the hypothesis testing uses an independent sample t-test.

Results and Discussion

The value of Problem-solving skills in the experimental class and the comparison class is presented in Figure 1. The KPM value is obtained from the measurement results using an essay test instrument which consists of five questions. The test consists of five aspects of Problem-solving skills according to the Problem-Solving Pathways Model, including representing problems (Representation of problems), planning solutions (Planning of solutions), implementing solutions (Execution of solutions), and evaluating solutions (Evaluation of solutions) (Eibensteiner, 2012).

Figure 1 shows an apparent increase in the value of problem-solving skills from the results of the pretest to the post-test, both students in the experimental class who followed the focused strategy-based field trip learning and in the comparison class who participated in the moderately focused strategy-based field trip learning. However, the average value of the pretest problem-solving skills between the experimental class and the comparison class seems to have a different average value, so it can be interpreted that students in the experimental class and comparison class have different initial problem-solving abilities.

Even so, the research findings show that the post-test average value of the problem-solving skills of the experimental class is greater than that of the comparison class. Therefore, it can be concluded that the application of field trip learning in the experimental class has a considerable impact in stimulating the improvement of students' problem-solving skills in ecosystem materials than in the comparison class. The magnitude of the increase in students' problem-solving skills obtained by the experimental and control class is presented in Figure 2.

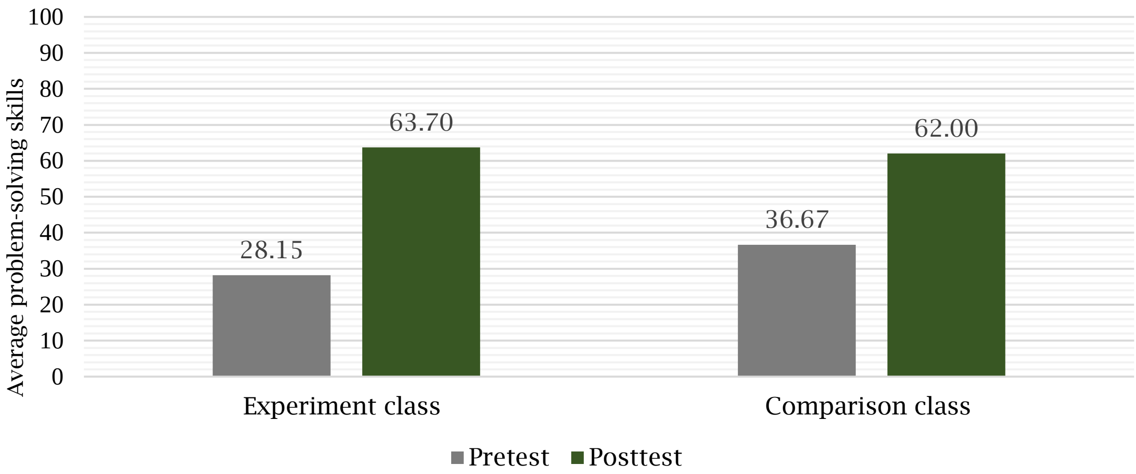

Figure 1. Comparison of average pretest and posttest of problem-solving skills

Figure 2 shows that the increase in problem-solving skills in the experimental class is more significant than the increase in problem-solving skills obtained by the comparison class. However, based on the categorization (Hake, 1998), the improvement obtained by both classes is in the "moderate" category. This result means that the treatment given to the experimental class has almost the same impact on the comparison class in improving problem-solving skills. Furthermore, to show that the experimental class can improve problem-solving skills more significantly than the comparison class, improvement analysis is carried out on each sub-aspect of problem-solving skills presented in Figure 3.

Figure 3 shows that each sub-aspect of problem-solving in the experimental class generally improves more than in the comparison class. Problem-solving skills in the comparison class in problem-solving sub-aspects 1.1 and 1.2 are superior to the experimental class. This result shows that each student in the experimental and comparison classes has different initial abilities in seeing a problem. Students' thinking processes differ in responding to a problem (Yanti & Syazali, 2016). This condition is also supported by the average value of the pretest of problem-solving skills, and the average value of the problem-solving aspect of the representation of the problem also shows that students in the comparison class (mean pretest = 28.15) have initial abilities in problem-solving that are different from their abilities. students in the experimental class (mean pretest = 36.67). However, students in the experimental class only had difficulties selecting relevant and irrelevant information or, in other words, difficulties in identifying the problem of ecosystem imbalance (sub-aspect 1.1) and also in stating or reformulating the problem of formulating the problem of ecosystem imbalance (sub-aspect 1.2). This sub-aspect can happen because the problem-solving test questions used in this study are in the form of discourses that require students to apply their conceptual understanding to think critically in finding solutions to solve problems (Febrilia et al., 2019). Not only that, but thinking skills in solving problems are also higher-order thinking skills that are rarely used, requiring habituation in the learning process (Amprasto et al., 2020).

The research findings in both classes clearly show that field trip learning is combined with a focused or semi-focused strategy. In this study, both were able to contribute to the improvement of students' problem-solving skills. Asra et al. (2018) reveal that combining field trip learning with inquiry activities can increase students' problem-solving skills. It was further explained that in field trip learning, students were allowed to interact directly in the field to identify problems, solve problems, evaluate alternative problem solving, and select and execute alternative problem-solving.

Figure 2. Comparison of n-gain index of problem-solving skills

The research results by Adisendjaja et al. (2019) also revealed similar findings: students' problem-solving skills after participating in field trip learning on ecosystem materials showed a significant improvement. This result is because during field trips, students "have a detailed description of the problem" because they encounter the object or phenomenon firsthand and know how to solve it. Students are more than observing existing objects or phenomena; they also research them. In fact, through direct observation of phenomena, students' reasoning skills are indirectly involved. It can also be assumed that direct observation of the problem in nature during a field trip allows one to see a more concise description of the problem.

In other research, Boric and Skugor (2014) revealed that students' level of knowledge in specific topics, both in classes that held field trip learning and those that did not, remained the same, but the problem-solving skills of students who took field trip lessons increased significantly. It was further explained that outdoor learning, such as field trips, allowed students to connect lesson content with everyday life, and it offered its challenges to be explored and investigated further. Not only that, learning science, especially biology, should emphasize exploration rather than just demonstrating and describing it so that in that way, new knowledge is constructed as a consequence of the students' observations and thoughts. Even in the field, when students see objects and phenomena in nature, they will relate theory and practice more efficiently and remember them better than when students only hear them in the classroom (Puhek et al., 2012). Furthermore, Boric and Skugor (2014) state that observing natural phenomena and exploring nature will allow students to deal with the content they are interested in, thus enabling the acquisition of knowledge to be easy, fast, and long-lasting than just observing from books that cannot be observed, and touched by the concrete object by students. In addition, students will develop various abilities that they can apply in the problem-solving process because by exploring and learning outside of routine learning situations, they will find many facts about the topic they are studying.

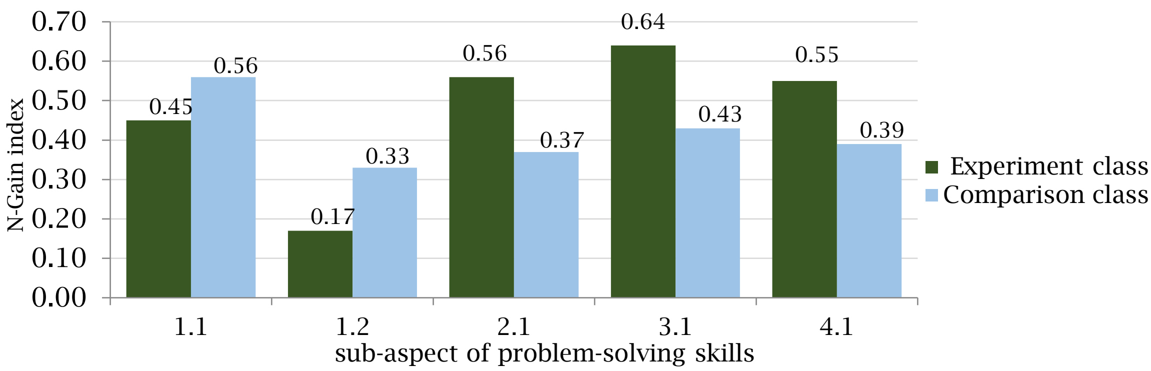

Figure 3. Comparison of n-gain Index of each sub-aspect of problem-solving skills (1.1 Selecting relevant and irrelevant information; 1.2 State or reformulate the problem; 2.1 Looking for problem-solving strategies; 3.1 Proving the truth; 4.1 Checking the results by looking at the implications of solution)

Table 2. Independent sample t-test of problem-solving skills

Group data	Mean	t-count	df	Significance	Decision
Gain experiment class	35.55	2.114	25.427	0.044	significant difference
Gain comparison class	25.30				

Morag et al. (2013) research revealed that when students take a field trip program, they indirectly apply theoretical knowledge in the field by discussing, interacting, and developing environmental awareness to be involved in problem-solving. Field trips can allow for discussions that lead students to articulate the ideas discussed in the problem-solving process. Further study results by Ampuero et al. (2013) revealed that field trip learning combined with empathy strategies has significant benefits in solving environmental problems because students think critically in solving existing problems. Thus, field trip learning is combined with various strategies; the study results reveal that field trip learning impact students' cognitive skills, both critical thinking and problem-solving.

The results of the case study by Dourado and Leite (2013) also found similar findings, stating that field trips can improve problem-solving skills; this is because field trip learning allows for actual activities in providing more detailed observations to students that facilitate students to conclude that better. Amprasto (2016) found that field trips can improve problem-solving skills. It was further explained that to improve problem-solving skills, and students must get used to doing activities outside the classroom. In this way, students will enjoy learning, interact with other people, and become closer to nature; as a result, students will get more information from the environment.

As mentioned above, the mean value of the comparison class pretest is greater than that of the experimental class, so it means that students' initial ability to solve problems is different. Therefore, to reveal the significant difference in problem-solving ability between the experimental class and the comparison class, data on the difference between the posttest and pretest scores or what we often know as gain data (not n-gain) is used, the results of which are presented in Table 2.

The results show 2.114 (t-count) > 1.708 (t-table) with a significance of 0.044 < 0.05, this means that H0 is rejected so that it can be interpreted that the problem-solving skill gains data between the experimental class and the comparison class is not the same. The result shows that the students' ability to solve problems both in the experimental and comparison classes is significantly different.

During the field trip, students observe the environment directly to get an accurate picture; this can help increase students' understanding of the problem and analyze causal relationships. Likewise, the research results of Asra et al. (2018) revealed the same thing that field trip learning was able to improve students' problem-solving skills in the "high" category. This result is because, in field trip learning, students are trained to identify problems, formulate them, find alternative solutions and apply them.

Similar to the field trip learning in this study, when students took part in the pre-field trip learning stage, students were introduced to a problem related to ecosystem imbalances through video observations. During the pre-field trip, each group of students is required to solve the problem of ecosystem imbalance from the video shown. In the implementation of problem-solving activities during the pre-field trip, stage students are guided by a worksheet that contains the stages of problem-solving that must be carried out by students starting from identifying problems, formulating problems, looking for alternative problem solving, and determining the best solution to solve problems. Predict the possible impact or effect if the best solution is chosen to solve the problem. Not only that, at the learning stage in the field, students are also required to be able to find the problem of ecosystem imbalance directly in the environment and find alternative solutions to solve the problems found.

Conclusion

The thinking skills of students who take a field trip learning with a focused strategy in the experimental class have differences in problem-solving skills compared to the thinking skills of students in the comparison class who take a moderately focused strategy-based field trip learning. Field trip learning can be an alternative method for high school teachers to improve student problem-solving skills on ecosystem materials. The field trip was learning in both the experimental and comparison classes; both methods can stimulate the improvement of students' solving skills on ecosystem materials.

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