Designing a field trip: The role of multiple intelligence and scientific reasoning

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Abstract. Field trip is one learning method that provides direct experience for students to be able to interact with the surrounding environment. In Biology class, field trip is one of the keys when students want to observe natural phenomena. This study aim to identify student multiple intelligences and scientific reasoning profile as a reference in designing a field trip for high school students on ecosystem topics. The subjects in this study were 55 students from two classes of 10th grade in even semester with purposive sampling. Data collection using Teen MIDAS (15-19 years) to identify student multiple intelligence and TOLT instruments for student scientific reasoning profile. The results of this study indicate that there are 3 types of intelligence that are most prominent, namely naturalistic, interpersonal and logical-mathematical as for future reference to dividing groups based on these three intelligences. In addition, student scientific reasoning which was found to be at 66% formal operation, 22% transitional and 12% concrete operation stage indicated that the design of the field trip that had to be prepared to have a level of analysis with one or two variables. There are still many students who have not been able to solve combinatorial reasoning. Thus it can be concluded that the best field trip design for this group of student is a design with worksheet that featured naturalistic, interpersonal and logical-mathematical with no more than two variables involved.

1. Introduction
The use of various methods by the teacher can present the experience of interacting directly with the place or object of the material being learned. One learning method that can be used by teachers to present these experiences is a field trip. The advantage of this method is that it can improve student learning outcomes and student readiness to be more effective. Another advantages of a field trip besides providing direct experience for students, this method can explore motivation as well as stimulate student interest in science and give meaning to learning and the relationships within it. This method also enhances observation skills and also influences students' social development [1,2].

As an out class learning activity, Field trips must be planned as well as possible considering the safety and efficiency factors. In a planning stage, the teacher have to consider: 1) determining the purpose of the field trip; 2) identifying the location description must be clear, in accordance with the learning objectives and student activities; 3) doing survey; 4) getting permission from the school principal and other related parties; 5) checking the destination field trip can and are available when visited; 6) providing information to parents or guardians of students related to the implementation of the
field trip as well as obtain a visit permit, an agenda in the field and details of the funds needed; 7) preparing accommodation properly at the time of the activity; 8) providing documentation both in photos and videos; 9) organizing attention to safety standards, evacuation routes and appropriate clothing; 10) preparing accommodation, first aid and other unexpected things are given more attention so that the implementation of field trips can run smoothly. Students should also be directed to arrange questions that might be asked during the field trip [3].

In the field trip, the teacher and students can interact more relaxed in a natural setting not found in the classroom. Obviously this is inseparable from the achievement of cognitive, instructional goals in the realm of skills and affective as well as in aspects of multiple intelligence development [5,6,7]. Multiple intelligences introduced by Gardner include not only linguistic and logical-mathematical but also include kinaesthetic, musical, visual-spatial, interpersonal, intrapersonal and naturalist aspects tailored to the characteristics of learned concepts [8]. In general, Gardner introduced there are 8 types of multiple intelligences. A person's ability to use parts or whole body to communicate and solve problems, mean the kinaesthetic intelligence dominate and allows for the connection between mind and body that is necessary to succeed inactivity. Naturalist intelligence feature the ability to recognize, differentiate, express, categorize and more sensitive to what is found in nature and the environment. Then Linguistic intelligence points a person's ability in oral and written mastery and the ability to use language theory to achieve a particular goal. Musical intelligence shows one's ability to be sensitive to the rhythm or sound, environment, and music that surrounds it. Interpersonal intelligence shows a person's ability to be sensitive to the feelings of others, including the ability to socialize with the environment around him. Intrapersonal intelligence person excel and more sensitive to his/her own feelings and is able to recognize the various strengths and weaknesses that exist in one-self. Logical-mathematical intelligence is demonstrated by ability in both deductive or inductive reasoning, as well as the ability to understand and make excuses about relationships based on patterns of numbers. A person with Linguistic intelligence has ability in oral and written mastery and the ability to use language theory to achieve a particular goal. Visual-spatial intelligence demonstrates one's ability to understand more deeply the relationship between objects and space. The ability to imagine a real form and then solve the problem [9].

From the description above, Biology as a subject in senior high school is potential to take consideration of student multiple intelligence and scientific reasoning when conducting a field trip. Multiple intelligence will useful to identify each student intelligence before devide group work to maximize every student potential to their base. A good field trip also considered student ability to reasoning object of observation as a scientific phenomenon. Therefore the purpose of this study is to identify the distribution of student multiple intelligence and scientific reasoning as a reference in the preparation phase of a biology field trip.

2. Method

The method used is descriptive method. In this study, student multiple intelligence was measured by the Multiple Intelligences Development Scale (MIDAS) assessment instrument for adolescents (15-19 years). Teen-MIDAS is a multiple intelligence standard instrument developed by Branton Shearer and has been adapted by Kurniawan [10] with better understanding for Indonesian students. The test consists of 119 multiple choice item recommended by Howard Gardner with additional understanding when interpreting the results. Gardner gave note for few intelligences such interpersonal, kinaesthetic and others should be judged with considering assessment of homeroom teacher and other teacher who known these student well.

Furthermore, student scientific reasoning measured by the Test of Logical Thinking (TOLT) [11,12] to identify students reasoning profile. This test consist of 10 two tier questions with 5 stages of scientific reasoning, that are proportional reasoning, variable control reasoning, probability reasoning, correlational reasoning and combinatorial reasoning. The data collected are student multiple intelligence and scientific reasoning profile and analysed descriptively to find preference to design an ecosystem
field trip. This research were conducted in the even semester of the academic year 2019/2020, the subjects of this study were two classes of the 10th grade students with purposive sampling.

3. Result and Discussion

3.1. Student multiple intelligence profile
Multiple Intelligence in this study is referred to Howard Gardner, it is a set of abilities, skills or intelligence that can grow with age and social changes. Unfortunately, Teen-MIDAS in this study does not show clear findings toward student multiple intelligence profile.

![Figure 1. Student multiple intelligence profile](image)

Figure 1 shows that types of multiple intelligence from 55 students, the data are not strong enough to determine a student to one dominant intelligence. There are 6 levels, VH (Very High), H (High), M (Moderate), L (Low), and VL (Very Low). However, from the figure above shows that generally there are three intelligences that are quite prominent, namely naturalist intelligence (1 student), interpersonal intelligence (1 student) and logical-mathematical intelligence (2). In particular these intelligences have few number of students who reach VH criteria and less student at VL than other intelligence.

3.2. Student scientific reasoning
Table 1 shows the results data of student scientific reasoning measured by TOLT that 66% at concrete operation, 22% transitional and 12% formal operation. This finding is not too quite different from previous studies on this grade [14,15]. Furthermore, from the TOLT results it can be identified that this group of students excels at proportional reasoning and correlational reasoning.

![Table 1. Student scientific reasoning](image)

| SR level         | Frequency |
|------------------|-----------|
| Concrete Operation | 33 (66%)  |
| Transitional     | 11 (22%)  |
| Formal Operation | 6 (12%)   |
The findings above show that multiple intelligence and scientific reasoning can be used as a reference in the preparation phase of field studies. From the multiple intelligences aspect, a field trip will give better experience if the teacher know all of student type of intelligence. Field trip designs are often found that giving priority to quantitative aspects without regard to the field trip process. This only benefits students who are dominant in logical-mathematical and linguistic intelligence compared to students with musical, naturalistic, kinaesthetic intelligence and others. Fortunately, in Biology class a field trip with Ecosystem topic teacher can design a field trip to natural object such as riverside, lake, beach or other ecosystem while considering multiple intelligence aspects for collecting data process and scientific learning when student works on their worksheet. Naturalist student has good understanding of natural phenomena around them to find objects of observation, visual-spatial students who excel in the landscape to help naturalist and linguistic students read map of an area as navigator. Meanwhile, students with good interpersonal skills will be good group leaders, he/she along with kinaesthetic will be very helpful in coordinate the team and field work. Finally, logical-mathematical students can do math for the data they collected and intrapersonal will appear in the discussion session as a good speaker.

Realized or not field trip is a very complex learning method that requires the role of the teacher and all students so that it can be implemented well. Recognizing student intelligence of students is not enough, the field trip material should have to design with considering student scientific reasoning stage. Even the group divisions already consider some intelligence, but if the worksheet involves complex reasoning skills assignments but are not followed by students’ ability to reasoning will not be effective. Students will consider the field trip as a burden so that it will deviate far from the initial purpose of the field trip. In this research for student reasoning characteristic above field trip assignment better only have two variables observed.

4. Conclusion
Multiple intelligence and student scientific reasoning data can be used for preparation phase while conducting a field trip. Since a field trip basis is outdoor learning, it need teacher and student to work together so it can run successfully. Recognizing every student’s intelligence to form a group team and adjusting the level of difficulty of the task in accordance with the abilities of students becomes very important in designing field trips. Without those two aspects, field trips will be difficult and burdensome for students. Based on the data in this research a field trip for ecosystem topic is ideal because one of prominent intelligence is naturalist and the task for each group can involve one or two variables.

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