Implementation of formative assessment through oral feedback to develop 21st century critical thinking skills of student on plantae learning

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Abstract. The challenges of 21st century globalization require students to have various skills needed in compete at the global level. One of the 21st century skills students need to have is critical thinking skills, but student’s critical thinking skills in Indonesia are still relatively low. To develop this skill, learning is needed along with appropriate assessment. The application of formative assessment in learning is one of the efforts in developing the skill. Through formative assessment, teacher can make appropriate learning strategies to facilitate student learning needs. However, the practice of assessment for learning rarely facilitates student learning needs. Thus, this study was needed for investigating the effect of formative assessment in develop critical thinking skill of students. The quasy experiment method is used in this study with the pretest posttest control group design. The experimental group was given the application of formative assessment through oral feedback during learning, while the control group was given the conventional assessment. The result showed that formative assessment through oral feedback can develop critical thinking skill of students, indicated by the experimental group has higher critical thinking skill improvement than control groups in Spermatophyta and Bryophyta chapter.

1. Introduction

The pressure of globalization and internalization requires resilient graduates who can compete at the global level. To face this challenge, the education system must refer to the mastery of content and skills simultaneously [1]. Three categories of skills that students must have to live in the 21st century are learning and innovation skills, life and career skills, information, media, and technology literacy. In the category of learning and innovation skills, there are four skills which are important for preparing students in the future. They are critical thinking, creative and innovation, communication, and collaboration [2].

The 21st century skills really need to be trained for students to deal with global environmental problems and save the plant diversity. The abundant plant diversity in Indonesia contains great potential that can be utilized for the welfare of nation, if they managed properly and sustainably [3]. However, most of Indonesian people are unaware with the high plant diversity in Indonesia [4]. About 240 plant species are declared rare and 36 tree species in Indonesia are threatened with extinction. In addition, even though Indonesia is noted as a country with the highest diversity of plants, only small number of plant species have known information on their genetic resources [5]. To save plant biodiversity from extinction and explore greater information on genetic resources in plant species, each
individual need to have good critical thinking skill, so they can think effectively, provide appropriate judgement and decisions to solve various problem about plant diversity.

In developing critical thinking skills of students, ideal learning must be combined with ideal assessment. The assessment must contain the task and feedback that can improve critical thinking skills of students during learning. Formative assessment can be the strategy which is used to develop critical thinking skill of students. Formative assessment is used during the learning process to provide feedback for students and teachers, so they can act based on the feedback which is obtained to improve the learning and teaching process [6]. Formative assessment for the 21st century aims to make student learning and understanding visible, so that teachers can adapt learning strategies to facilitate student needs. Thus, good formative assessment helps educators to determine understanding, misconceptions, thinking processes, and students’ knowledge [2]. The center of formative assessment is the concept of feedback. The impact of formative assessment arises from the strength of the feedback given to students about their learning and to the teacher about how they teach [6].

In the teaching and learning process practice, most of assessment for biology learning in schools is less encouraging in achieving critical thinking skills of students. Frequently carried out assessments at schools only assess learning outcomes, while formative assessment which is used during the learning process is still limited to practice [7]. If the assessment carried out in learning is only summative assessment, according to its function the assessment will only determine the position of students’ abilities and measure the achievement of learning objectives. As a result of that practice, only little feedback will be obtained to improve the implementation of learning, and consequently students' critical thinking skills are not developed.

Several studies showed that students' critical thinking skills in Indonesia are still relatively low [8, 9]. The low level of critical thinking skills of Indonesian students is also shown by the results of the Program for International Student Assessment (PISA). In PISA 2015, Indonesia is ranked 62 out of 70 countries participating in the PISA test [10]. PISA questions require critical thinking, problem solving, and written communication skills, as well as measuring student literacy, mathematics and science literacy achievements. If students' literacy skills in Indonesia are low, it can be implied that their critical thinking skills are also low [11]. The level of students’ critical thinking is also relatively low at plant diversity subject. This have been showed by the results of research which states that students’ ability to evaluate information about medicinal plants is still lack, meaning that there are still many students who do not know how to assess, classify and compare types of medicinal plants [12].

Low critical thinking skills in plant diversity subject can also occur because students have a low level of plant literacy. The decline in plant literacy can cause the scientific literacy crisis, so the way students and teachers learn the science of plants become the main focus to improve [13]. The absence of plant literacy in students can be caused by several factors, including the lack of students’ interest in knowing plants and the low frequency of introduction about plant diversity to students. In the absence of plant literacy, students’ critical thinking skills towards plants and basic knowledge of plants are also at a low level [14]. Thus, learning practices are needed to help students learn about plant diversity, plant morphophysiology characteristics, and focus on environmental conservation. The learning which is prepared certainly must have appropriate assessments to accompany learning strategies that are used so the learning can develop skills that students need to have for overcome problems about plants [15].

The learning practice that are implemented need to be accompanied by formative assessment. Through formative assessments during learning, feedback will be generated and help teacher to make decisions about learning that must be done at the next learning to help students achieve learning goals and develop competencies that students have. Some studies related to formative assessment show that formative assessment can help improve the learning process and student learning outcomes [16,17], however the research about formative assessment to improve students’ critical thinking skills in plant learning is still very limited. Thus, this research is important to identify the improvement of students' critical thinking skills that are given formative assessment through oral feedback.
2. Methods
Quasy experiment method with the control group pretest posttest design was used in this study. The population in the study included all first grade students at one of Senior High School in Sukabumi Regency. Samples taken were two classes, each as an experimental group and control group. Each class consists of 30 students. The sampling technique was cluster random sampling. The experimental group was given formative assessment treatment through oral feedback, while the control group was given the assessment which was usually carried out at school, but both of group were given the same student worksheet in each subchapter.

The formative assessment used in this study is student worksheets with a rubric to develop students’ critical thinking skills. Student worksheets have a role in developing students’ critical thinking skills in grouping various plant specimens by create fenogram based on morphological characters. The worksheets also contain various questions to guide students’ learning. The questions adjusted to indicators of critical thinking skills according to Partnership for 21st Century Skills. Indicators of critical thinking skills developed include effective reasoning, systems thinking, and making judgments and decisions.

Worksheet that has been done by students will be used by the teacher to find out the students’ understanding based on guidance questions that have not been answered well by students or the grouping of plants that are not appropriate. Based on the result, teacher changes the way of learning at the next learning to make better students’ understanding. The teacher also provide oral feedback to students to show their mistakes in a more focused manner and guide students to correct the mistakes in grouping plants or answer guidance questions, so students can develop their critical thinking skills.

Data obtained by critical thinking test and students questionnaires. Critical thinking test is developed based on indicators of critical thinking skills according to the Partnership for 21st Century Skills and used as pretest and posttest in each subchapter. The questions developed were 12 essay questions for Spermatophyta subchapter and 8 essay questions for Bryophyta subchapter. Student questionnaires is used in the end of plant instruction to identify students’ response about formative assessment during learning. Data analysis was carried out through T-test, N-gain analysis, and student response questionnaire analysis.

3. Result and Discussion
Data about students’ critical thinking skills for each group is known by the analysis of pretest and posttest score. Statistical analysis was carried out in SPSS version 21 to see whether there was a significant difference critical thinking skills between the experimental and control group. According to the independent t-test results, there was significant difference on students’ critical thinking skills at Bryophyta posttest.

Table 1. Comparison of experimental and control group students’ scores on pretests and posttests

| Subchapter | Group | Mean | Sig (α = 95%) |
|------------|-------|------|--------------|
| Spermatophyta | Pretest | 7.73 | 2.87 | 0.004 |
| Posttest | 74.93 | 68.47 | - |
| Bryophyta | Pretest | 18.33 | 29.40 | 0.015 |
| Posttest | 84.11 | 82.60 | - |

According to Table 1, pretest score of experimental group was higher and significantly different with control group at each subchapter. Based on that result, mean comparative test was not carried out for posttest score. The analysis was continued to N-gain analysis in order to identify differences of students’ critical thinking skills improvement at each subchapter.

Figure 1 shows a graph about N-gain mean of students for each group at Spermatophyta and Bryophyta subchapter. According to Figure 1, critical thinking skills improvement of experimental and control group for each subchapter was in high category, however experimental group achieved better
critical thinking skills improvement than control group for each subchapter. High category of critical thinking skills improvement in both of group can occur because of the same worksheet which was used in both of group, only different feedback on learning and the change of teaching way in the next meeting which become the difference between experimental and control group.

Figure 2 presents the graph about students’ percentage in both of group which is include to high, medium, or low category improvement. Based on Figure 2, most of students in experimental and control group have critical thinking skills improvement at high category. However, experimental group have more students that improve their critical thinking skills at high category than control group for each subchapter. There are no students at experimental group that include to low category critical thinking skills improvement.

![Graph of N-Gain](image)

**Figure 1.** Comparison of N-gain value for critical thinking skills

![Graph of Percentage Distribution](image)

**Figure 2.** Percentage distribution of N-gain student’s critical thinking skills (S = Spermatophyta subchapter, B = Bryophyta subchapter)

The improvement of postest score and students’ N-gain was supported by students’ worksheet that provided at each subchapter. As seen in Table 2, experimental group students achieved higher score than control group at each subchapter. It is showed that oral feedback which was provided during the learning process could guide students to improve their mistakes in the worksheet they have worked on, so worksheet score of experimental group was better than control group.

**Table 2.** Comparison of worksheet score between experimental and control group

| Subchapter   | Mean   |
|--------------|--------|
|              | Experimental Group | Control Group |
| Spermatophyta| 83.75   | 71.81       |
| Bryophyta    | 81.42   | 77.78       |
Based on the result of experimental group posttest score, N-gain, and worksheet score which are higher than control group, it can be stated that formative assessment through oral feedback can develop students’ critical thinking skills. This is consistent with findings from other studies which state that experimental group students which were given formative assessment practice have significantly higher levels of academic achievement than control group students [6].

The higher posttest score, N-gain, and worksheet score of experimental group can be caused by the given of oral feedback and changes in teaching strategy as the part of formative assessment in every subchapter. The oral feedback will give the clear, detailed, and personal explanation to students about the task they have worked [18]. The feedback which was given also could become the appreciation for students’ to encourage their involvement and self regulation in learning process [19].

In experimental group, changes in teaching strategy based on formative assessment results can help students understand the subject better, make students aware of their mistakes in studying plants, and form students’ critical thinking skills. Based on the results of the questionnaire, 73.3% of student more easily change the way of learning by following change of teaching strategy rather than change the way of learning independently.In addition, 50% of student stated that teaching improvement was more important than improving student learning methods. This is in line with the results of better student worksheets after a change in the way teachers teach.

Based on the results of students’ worksheet in Spermatophyta subchapter, most students in the experimental group still find it difficult to find the similarity from the Spermatophyta plant they observed. Thus, at the next meeting, the teacher changes the learning strategy by emphasizing each student to review the similarities of the Spermatophyta specimens that they observe and exemplify the similarity that some specimens have.

In Bryophyta subchapter, based on the results of students’ worksheet, some students have problem in determine the character of the moss that used in making the phenogram. This is consistent with findings from other studies which state that in plant diversity subject, especially for classification of plant, student need to have analytical thinking skill because involve he various character about plant that can be used or not to classify various plants [20]. Thus, the teacher changes the learning strategy by asking students to exchange information with different groups so that students can correct each other to determine the right character on the specimen observed by their friends.

In addition to changing teaching strategy by teacher, students are also given group oral feedback. The teacher will control each group and give oral feedback to guide students to correct errors in determine morphologic character of plants, group each specimens to the right class, or answer guidance questions. Example of oral feedback given by the teacher to students such as "The selection of morphologic characters for making the phenogram is good, but try to observe again whether the melinjo seeds are protected by fruit flesh?" "The worksheet you are working on is almost perfect, but let’s observe again and determine the similarity from all Spermatophyta plants that you observe ". Let’s observe again the characters from *Polytrichum* sp and *Sphagnum* sp, are you sure that they are belong to different class? ", "You have grouped all of Bryophyta specimen to the appropriate class, please add the specific characteristics of each class."

The oral feedback given will make students know clearly where their mistakes are and think more critically about correcting them, so their critical thinking skills will improved. All students agreed that the oral feedback given could help them to improve the task and learning process, motivate them to learn, and help to understand plant subject. In addition, 83.3% of students preferred feedback in the form of comments rather than numbers, and 76.7% of students were more comfortable making improvements based on oral feedback given by teacher. This is in line with findings from other studies which state that provision of oral feedback is needed by students because the content of oral feedback in formative assessment is the effective and efficient model of feedback which can support the performance improvement of students in learning [21, 17]. Oral feedback also facilitates students to interact directly with the teacher, thus avoiding students’ misconception in learning. This is in line with the research which states that oral feedback is important to do because it helps students to immediately realize their mistakes and get clarification from the teacher without delay [16].
4. Conclusion
In general it can be stated that implementation of formative assessment through oral feedback can improve students' critical thinking skills. This is showed by better improvement of critical thinking skills of the experimental group than control group for each subchapter, and significant difference between the critical thinking skills of experimental group and control group at Spermatophyta chapter. Most students respond positively toward the worksheets, feedback, and changes in teaching methods provided by teacher in the implementation of formative assessments in learning.

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