Analysis of ability to use microscope and its relation with visual and verbal representation in representing microscopic objects in anatomy of plant lecture

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Abstract. Visual representation is a person's ability to represent objects visually while verbal representation is a person's ability to represent objects in writing or oral. This study aims to identify the ability to use a microscope and its relation to the visual and verbal representation of students in representing microscopic objects in anatomy of plant lecture. The type of research used in this research is descriptive research. Research subjects are Biology Education students who register the subject of plant anatomy. The instruments used are general visual and verbal ability's tests, microscope usage rubrics, visual and verbal assessment rubrics, and questionnaires. At the beginning of the lecture 51% of students have the ability to use microscopes in the category of poor. After 5 lecture meetings, the students' ability to use microscope increased to 60% in the category of good. The ability to use microscope is correlated with students' ability to represent objects visually (visual representation) (r = 0.373; p < 0.05) and verbally (verbal representation) (r = 0.669; p < 0.01). The result shows that the ability to use a microscope is not the only factor that contributes to the student's ability to represent microscopic objects both visually and verbally. Several contributing factors are discussed in this paper.

1. Introduction
Biology is a study of living organisms such as animals, plants and humans, including their interaction with all the factors that affecting their life [1]. The scope of biology is not only included macro object that can be seen with the naked eyes, but also objects that can be observed through microscope [2]. Branch of biology that study microscopic objects is anatomy. Anatomy is the branch of biology that concerned with the internal structure of humans, animals, and other living organisms, especially as revealed by dissection and the separation of parts and looked at through microscope [3].

The problem that often encountered in studied plant anatomy was the limitations of students to distinguish the tissue between a group of plant cells from a preparation which already available with plant cell groups from other preparations through experiment activity [4]. In addition, in represented microscopic objects visually or verbally, students are still faced difficulties and often use the literature not based on the observations that have been done [5].
Thus far, the experiment activities are evaluated less efficient and effective because obviously experiment activities are only considered as a complement in learning. For achieve a success in studying plant anatomy, good imagination is needed so that students can describe the structure, position, and function of plant cells and the relationship between one cell and the other cell [4]. In this activity, students apply a ability that is called representation. Representation is the ability to describe an idea, concept, or an object.

Many researches indicated that representation could be helpful for students in understanding the concept more rapidly than through texts only [6]. There are many diverse form of visual representations in the biology are drawings, maps, diagrams, flowcharts, graphs, tables, and videos [7]. Visual representation plays an important role in the delivery of the concept of science [7,8].

The fact of low representation ability in the students, is correspond with the research that has been proven by Suprapto [4] which states that the ability of students in capturing messages from reading and reveal text messages as the language (verbal) shows less satisfactory results. For microscopic objects, students need a representation that corresponds to the characteristics of plant anatomical material, is through microscopic representation.

Microscopic representation is part of visual representation, only a form of the representation derived by the aid of a microscope. Microscopic representation is an ability to describe an idea, concept, or an object derived from a microscopic observation result [8]. The low microscopic representation ability of students leads to the low mastery concept of plant anatomy. At the time of representing the microscopic object visually or verbally, the student encounter difficulties and often uses the literature not based on the observations that have done. For develop better understanding of a microscopic observation activity, the student is required to portray the results of their microscopic representation upon observation through the image (visual representation) and complete the description of the microscopic representation verbally.

Some references [9] state that combination of visual representation and verbal representation ability influence on the students’ understanding. Furthermore, create visual representation is an effective method to remember the information’s. This statements are reinforced by other results of a study that make visual representations can help the learning process [10].

Based on the results of previous researches, has been much explained about the ability of visual and verbal representation in a learning activity to the cognitive system and student understanding, but not known what factors that affect students have low ability to observe through microscopic yet. Therefore, through this study the researchers intend to investigate the ability of students to use a microscope and its relation with their visual-verbal ability in representing microscopic objects on the plant anatomical lectures and any factors that affect the ability of student on visual and verbal representation.

2. Research method

The descriptive research was used in this research, that purpose to identify the students’ ability in using the microscope and its relationship with the visual and verbal representation in representing the microscopic object on plant anatomy lecture. The participants were 45 students of Biology Education particularly who have contracted plant anatomy course of 2017-2018 academic year.

The research was carried out on topic of ground tissue (parenchyma). PAL (Peer Assisted Learning) strategy was applied in this lecture [11]. The research took place in the Laboratory of Plant Anatomy Structure on FPMIPA UPI Bandung. The rubric of using microscope was used to measure the students’ ability to operate microscope, while the instrument that used to measure the ability of visual and verbal representation were visual and verbal representation rubric. Questionnaire was also used as additional instrument.

The procedures of this research were evaluated students’ ability in using microscope at beginning and after 5 meetings of the course, while the assessment of visual and verbal representation ability were evaluated while studying. In order to determine whether there is relationship between microscope usage ability and visual and verbal representation was conducted correlation statistic tests. The indicators to evaluate students’ ability on microscope usage were ability to use the microscope that appropriate with
the procedure and obtain a clear object image. Visual representation ability were assessed based on some aspects, included suitability with actual object, detail, size, caption and accurate image. For the verbal representation, using some indicators, were suitability of image information and concept, completeness of image information, clarity of image and write scientific name down. Categorical of visual and verbal presentation that referring to [12] is presented in table 1.

### Table 1. Category of visual and verbal representation’s ability.

| Score interval | Category       |
|----------------|---------------|
| 80-100         | Excellent     |
| 60-79          | Good          |
| 40-59          | Adequate      |
| 20-39          | Inadequate    |
| 0-19           | Very Inadequate|

3. Result and discussion
The findings of this study can be scrutinised through the pictures: student’s ability in operating microscope (figure 1); visual’s ability (figure 2), and verbal’s ability (figure 3). Figure 1 shows that there are 60% students who have ability in operating microscope appropriately (good). This ability also has positive correlation with the visual representation’s ability, because it showed a significance value 0.373 (P=0.05).

![The Ability of Microscope Usage](image)

**Figure 1.** Percentage of students’ microscope usage ability.

In addition, the assessment result about student’s ability in operating microscope based on the rubric yielded the average score 3, which means that overall the steps in operating microscope has been consistent with the instructed procedures - there was a missed part-, yet the object could be seen clearly. This is also promoted by the questionnaire’s result particularly for the statement “student has been able to operating microscope based on the instructed procedures”, the accumulation’s result showed 75.6% (almost all participants), while for the statement “student has recognised all the microscope’s parts” presented 86.7%. According to the data, almost all the students have been able to identify the parts of microscope and has no effort to operate it which in other words the students could operate the microscope based on the instructed procedures. However, almost all the student had difficulties in making the object focus clearly. Based on the result of the assessment’s rubric showed the average score of students was 2 – observed object is not clear even though the lighting is good.
Figure 2 shows that there are 73% students who were categorised very good and good in visual representation’s ability, while only 53% of students who were very good and good in verbal representation’s ability. The visual representation’s ability gained the positive correlation with the verbal’s that is showed on the correlation test with the significance value 0.669 (P=0.01). The correlation result can be scrutinised on the table 2.

Table 2. Correlation results test.

| Variable | r    | Sig  |
|----------|------|------|
| Students’ microscope usage ability with students’ visual representation’s ability | 0.373 | 0.012 |
| Students’ visual representation’s ability with students’ verbal representation’s ability | 0.669 | 0.000 |

On the one side, the assessment result of visual representation’s ability presented a very good result with 31% and 38% good covers some aspects such as conformity with the object (authenticity of the picture), picture detail, picture proportion, picture description and picture accuracy. On the other hand, the assessment result for the verbal representation’s ability showed 22% very good and 31% good with the assessment criteria: explaining the conformity of the real object’s description with the concept that has been learned (conformity picture with the concept); explaining a complete description of the real object (completeness picture’s description); explaining a clear description of the real object and did not show the ambiguity (picture’s clarity) and the writing style is on accordance with binomial nomenclature (the writing scientific name).

These findings interpreted that students have a good visual representation’s ability in the parenchymal tissue’s course. This is aligned with the result of the questionnaire that there is 66.7% (more than half) students had no difficulties in representing microscopic object – parenchymal tissue—because this tissue a basic tissue which has an appeal characteristic so that was not tricky to be
represented. Similarly, students in verbal representation’s ability for the parenchymal course also showed that they had no difficulties because the parenchymal tissue have parts that could be easily recognised and to be described. This is also supported by the result in the questionnaire that there is 60% students (almost all students) have no difficulty in representing verbally because it can recognize the parts in parenchymal tissue. According to Suprapto [4] in his replication that students will easily represent microscopic object if they recognise the parts of it competently. In addition, the basic tissue (parenchymal) is a simple basic tissue which the forms and the characteristic could be easily observed. Therefore, students were easier to imagine representing the structure, the position, or the form in plant anatomy particularly in parenchymal tissue. This is supported by the dual coding theory that conveyed through imagination, student would not have an effort to representing an object. Likewise, Guillot [13] construed that visual representation’s ability can help students to cope with the difficulties in learning anatomy course.

The other finding also showed that there is a correlation between student’s ability in operating microscope with the visual and verbal representation. The 0.37 correlation value presented that ability in operating microscope is not the only factor which contribute on the student’s ability in representing microscopic object either visually or verbally in the anatomy plant course. According to the questionnaire result, there is 48% or almost a half of total amount of the students showed that students keen on drawing. As a result, this factor can also arouse visual representation ability. Student who like drawing will be easier to represent object. This discourse is also supported by the result that showed all students who like drawing have a good result in visual representation ability [14]. Moreover, based on the result of the survey almost all students (75.6%) stated that they had no difficulties in explaining the result of the visual representation.

On the other side, another result showed that a good visual representation could facilitate student to represent an object verbally. This is possibly happened because of the information can be easily remembered and manipulated effortlessly if it is coded into two systems (visual and verbal) [15]. This is also approved by the previous research that students will use their memory in according to what they had seen to help them representing an object visually or verbally [16]. In addition, based on the dual coding theory also discloses that there is relationship among representational systems – e.g. visual and verbal. Alternatively, the verbal and visual systems which pointed to deliver a message can facilitate learning process. The survey’s result also showed that student could easily remember the picture which is then represented with a writing (verbal representation). According to Paivio [17], students will be easier to remember a picture from the mental representation. This implies that student who has a high representation ability will effortlessly represent a picture verbally because it can be easily remembered. In the same way, Referensi [14] also conveyed that the consistency in verbal and visual representation is important to help student in learning process. The implication is in a learning process, it should be involving the visual and verbal representation ability that student will accustom with it or practice it. In a lecture, particularly plant anatomy, the information about concepts could be learned by the text or picture. As mentioned before, the dual coding theory conveyed that verbal and visual tools in a learning is very essential to present the concept in learning [18].

4. Conclusion
In conclusion, there is a relation between student’s ability in operating microscope with their verbal and visual representation in representing microscopic object in plant anatomy module. To representing the microscopic object visually or verbally, it is needed a ability in operating microscope. However, the ability in operating microscope is not the only one factor that contribute on the students’ ability in representing microscopic object either visually or verbally. The other factors such as students’ hobby in drawing also could contribute on the visual representation’s ability. The implication of this study is to comprehend the concept in plant anatomy well, in the beginning of module section, the students should be trained to operate the microscope properly (based on the procedure) so that they can represent the object accurately.
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