Identifying Students’ Scientific Communication Skills on Vertebrata Organs

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Abstract: The purpose of this study is to identify students’ science communication skills of vertebrate organs. Using the EICIR (Experiencing, Interaction, Communication, Internalization and Reflection) approach. This study uses descriptive qualitative research method and the learning activities are designed based on a learning approach called in Indonesia as MIKIR. This approach consists of five learning stages: experience, interaction, communication, internalization and reflection. One hundred and twenty student teachers from Elementary Teacher Education study program, FKIP, University of Riau, participate in this study. The findings indicate that students’ written science communication skill is lower than their verbal science communication skills. In addition, the MIKIR approach could trigger and develop students’ science communication skills.

1. Introduction
Science is a concept of learning nature, and it has a broad relationship related to human life. Science learning has an important role in the educational process and the development of technology [1]. Science learning guides students to be able to understand, discover and explain concepts and principles in science through a process of discovery and not the domination of memorization. Science learning generally requires more understanding of learning concepts and links these concepts to the phenomena of environment. In most courses in learning science, such as in the Basic Science Concept II course in a public university in Riau, which is very closely related to daily life, students are required to master the science concepts so that they can solve problems in the field of natural sciences and can relate them to the phenomena in the natural environment.

Mastery of concepts becomes more meaningful if students discover their own concepts. An activity that supports students mastering the concept is through the process of direct observation or experimental activities. Therefore, the present study is interested in investigating students’ scientific communication skills in scientific writing, information representation and knowledge presentation. Some studies show that laboratory activities can develop students’ communication skills [2, 3, 4]. In her recent study found an inquiry based-practicum can develop students’ communication skills [5]. Hence, many universities prepare students to have some competencies in accordance with the demands of the workplace. Communication skills, including listening, writing, speaking and interpersonal, are to be existent in teachers to facilitate students’ understanding of teaching materials on the course, as well as to have the ability to take their responsibilities effectively [6]. Experimental or experimental activities are inseparable from science communication skills. Science communication skills are
positively correlated with students' level of thinking. Practicing science communication skills to students enables students to express their scientific ideas. Science communication skills enable students to obtain as much information as they can from observations, and it makes easier for them to solve various problems in learning material. Crucial to the success of these classroom interventions is a need for open communication skills [7]. Experimental activities in the learning process are in line with the development of scientific attitudes in students. Various empirical studies aimed at improving students' communication skills through learning have been largely undertaken using various strategies and learning models such as scientific communication program [8], blended learning [9], open inquiry, virtual interactions [10], role-play, inter professional approach, and science communication competence. Research to investigate communication skills related to other aspects such as content knowledge and life skills has been done [11].

One of the subject matters of Basic Science Concepts II course is vertebrate organ systems, and the learning process will be accelerated if the course is given through a practicum. This subject is particularly important because its application is often found in daily life, for example, recognizing and knowing the benefits of the organs of fish, frogs, cats and other animals.

Learning activities in class are considered to be important to apply a learning approach, so that the learning process that takes place can be directed and systematic. Learning must provide more space for students to be active in the learning process in the classroom, and it supports students to have scientific communication skills and scientific attitudes. Therefore, we apply a learning approach called MIKIR in Indonesian term. MIKIR consists of five stages namely Experiencing, Interaction, Communication, Internalization and Reflection. Within this approach students are invited to directly experience the learning process by interaction and active communication in the learning process. In addition, students are expected to internalize their character values in daily life. This approach is intended to invite students to be more active and directly involved in the learning process so that they can develop their learning potential well. This MIKIR approach is expected to trigger students' science communication skills and to develop their scientific attitudes that affect students’ mastery of concepts in vertebrate organ systems.

2. Research Methods
This study uses the descriptive qualitative research method because this study aims to identify and analyze students' scientific communication skills in learning vertebrate organ systems using the MIKIR approach. One hundred and twenty students from Elementary Teacher Education study program from Faculty of Education and Teacher Training, University of Riau, participated in this study. Data were collected through classroom observation and interviews. The observation method is used to collect some information about students’ understanding of science communication skills. We use the indicators presented on table 1 to identify students’ science communication.

| Table 1. Science Communication Skills |
|---------------------------------------|
| Science Communication Skills | Science Communication Skills | Assessment Type |
| Scientific Writing | Do a practicum report | Non test |
| Information Representation | Make representations in the form of schemes, graphs, mathematical and verbal | Test |
| Knowledge presentation | Make Presentation materials and oral presentation | Non test |

Data obtained through observation sheets is processed as a percentage to determine students' verbal and written communication skills. The data is calculated using the formula stated by [12].
\[ NP = \frac{R}{5M} \times 100\% \]

Information:
NP = Percent value sought or expected
R = raw score obtained by a group of students
SM = Ideal maximum score of the test in question
100 = Fixed number

The guidelines for assessment are as follows:
86 - 100% = excellent
76 - 85% = good
60 - 75% = moderate
55 - 59% = fair
<55% = poor

Data obtained through interviews were analyzed descriptively. This data is needed to determine student responses to the use of the MIKIR approach that has been used.

3. Discussion
Learning activities of vertebrate organ system in the Basic Science Concepts II course are organized based on the MIKIR approach. The students worked in small groups (6-7 students in each group). The learning activities followed the five stages of the MIKIR approach. In the learning process, the students are asked to convey ideas or thoughts both orally and in writing. They are also asked to convey directly the work or report the results of group discussions. Students who participate in learning are expected to be able to instill the value of character which is the result of the learning process that has been experienced by students. At the end, the students are asked to repeat the learning experience they have gained so that future learning can be even better.

Learning is given in the form of assignments such as students’ presentations. Based on the observations of learning activities using the MIKIR approach in learning vertebrate organ systems using observation sheets to assess students' scientific communication skills in aspects of scientific writing, information representation and data knowledge presentation, we get the result as presented in table 2.

| Aspects of Science Communication Skills | Group |
|----------------------------------------|-------|
|                                        | I     | II    | III   | IV    | V     | VI    | VII   | VIII  | IX    | X     | XI    | XII   |
| Scientific Writing                     | 2     | 4     | 3     | 4     | 3     | 4     | 3     | 2     | 3     | 4     | 3     | 3     |
| Information Representation             | 2     | 4     | 4     | 4     | 2     | 4     | 3     | 2     | 3     | 3     | 3     | 4     |
| Knowledge presentation                 | 3     | 4     | 4     | 4     | 4     | 3     | 2     | 4     | 3     | 4     | 3     | 3     |

Table 2 shows difference levels of students’ science communication. Students from four groups have very good communication skills, while two groups are categorized as fair because their average scores around 2. For instance, group 8 obtains 2 points to the all aspects of science communication skills, and this belongs to fair category.

Students’ scientific communication skills in the aspect of scientific writing are fair because students have not been able to write the Latin names of body parts of vertebrates, discuss information obtained, determine and evaluate relevant information, make reports, and present the results. The aspect of information representation when reporting a report in class is sufficient. Students have been able to explain the body parts of vertebrate animals even though there are some students who have not been able to explain properly.
Aspects of the presentation of knowledge that are visible, students are able to find and choose various sources of reference and inform it to their friends. Student communication skills in lectures are the result of observing discussion activities in experiments. This activity is an integral and fundamental of what is done, discovered and what is thought of the results of the experiment. Science communication skills in lectures are demonstrated by the ability to read graphs, explain the results of experiments and submit reports systematically and clearly.

A summary of students’ science communication skills is presented in figure 1. It seems clear that the students have better science communication on information representations, and they really perform low on scientific writing. This result could indicate that the students’ science communication skills are moderate. Using appropriate skills, media, activities, and dialogue to produce one or more of the following personal responses to science (the AEIOU vowel analogy): Awareness, Enjoyment, Interest, Opinion-forming, and Understanding could improve students’ science communication, [13].

![Figure 1. Students’ Science Communication Skills](image)

Learning in groups can bring up certain aspects of communication that can change students’ attitudes as well as facilitate the learning process. According the concepts of communication and attitude change will always be inherent in learning, especially in group learning. The learning process using the MIKIR approach triggers students to have some experiences in science, interact with other students, communicate their ideas, internalize their knowledge and reflect what they have learned. Students are invited to be directly involved observing and asking questions, students will exchange ideas and respond to the opinions of other students. Science communication that is owned by students will vary based on their abilities. The results showed that science skills experienced changes in students. Science communication in asking questions raised by students when the lecture process always uses open questions so that it opens and stimulates discussion between groups. The open question will solve the problem of the material being studied.

4. Conclusion
Based on the results of research and discussion of students’ science communication on vertebrate organs using the MIKIR approach, it can be concluded that students’ abilities to present their knowledge is quite good. Students’ written communication skills reflecting through their reports is still lower than the other skills. Only 37% of students could have sufficient written communication skills. While, students verbal communication skills measuring through their science representations and knowledge presentation acheive score 70% and 56% respectively.

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