The identification of preservice biology teacher’s misconceptions on the concept of mangrove ecology using the certainty of response index (CRI)

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Abstract. The integration of mangrove ecological concepts and contexts in biology learning is expected to support maritime-based education. The concept of mangrove ecology is important to understand by preservice biology teachers, especially in coastal areas. The real knowledge and experience of preservice biology teachers in coastal areas related to mangroves is predicted to be different from the concept of mangrove ecology that has been studied by experts. This causes misconceptions that can affect the integration of the concept of mangroves ecology in biology learning. To analyze the misconceptions of preservice biology teachers, the Certainty of Response Index (CRI) method was used. The instrument used was a multiple choice test equipped with a confidence level in answering it. Identification of misconceptions using CRI was carried out to determine the level of understanding and misconceptions of preservice biology teachers, then also to identify what sub-concepts these misconceptions occurred. The research was conducted on 12 preservice biology teacher who took mangrove ecology courses in the 2018/2019 school year. The results of the average distribution preservice biology teacher understanding levels are 45% understanding of the concept, 7% guessing, 8% not understanding the concept, and 40% misconception. The sub-concept with the most misconceptions was the mangrove research method as much as 47.92%, while the least occurred in the sub-concept of mangrove resilience 33.33%. Given the high level of misconceptions, it is necessary to increase the understanding of the concept of preservice biology teacher related to the concept of mangrove ecology. The use of the CRI method can be used to distinguish groups between students who experience misconceptions and students who lack of knowledge but are unable to explain the reasoning process and the specific causes of misconceptions that occur in students. In order for misconceptions to be identified more specifically and accurately, a combination of other techniques is needed in addition to the use of tests to carry out further misconception analysis.

1. Introduction
The ideals of the Indonesian state is to become a world maritime axis. The ideal is very possible to be achieved considering that Indonesia is an archipelago country. Various fields support the ideals of the country, one of which is education. Several research results and thoughts related to maritime basis have been published internationally indexed by Scopus. The education sector has a big share in achieving the ideals of the country. The Indonesian government has been and is currently pioneering maritime-based education. Maritime-based education needs to be supported by various parties,
especially educators in both formal and informal education. In the realm of informal education, institutions engaged in the marine environment can educate the public. Meanwhile, educators in schools can support maritime-based education by integrating marine or maritime concepts and contexts in learning [4].

As a maritime country, Indonesia has the potential to be integrated with learning, for example being used as a learning resource. The potentials that support the maritime curriculum are the potentials of natural resources in the form of islands and seas. Indonesia has the second longest coastline in the world after Canada [5], the number of islands is around 14,572, and very wide waters reach 6,292,156.82 km$^2$. Furthermore, Indonesia has human, political, and cultural resources and the potential established from a strategic geopolitical environment [6]. Efforts to utilize local potential (wisdom) as a source or medium of learning, encourage more meaningful and contextual learning. One of the natural resources that can be used as a learning resource is mangroves.

Mangrove is one of the main characteristics of a maritime country. Regardless of the definition of mangrove as a forest or a designation for certain groups of vegetation that live on the coast [7], mangroves are now getting more and more attention by many experts. Not only ecologists, there are more and more experts in economics, law, pharmacy, trade, tourism, and also education who connect their fields of knowledge with mangroves. Indonesia has the most extensive mangrove forests compared to other countries in Asia [8].

Mangrove ecology is a concept that is closely related to maritime or marine life. As a Biology Education Study Program that has a maritime-based vision, the Raja Ali Haji Maritime University Biology Education Study Program has elective courses of mangrove ecology. The study in the mangrove ecology course contains the definition of mangroves, a general explanation of the distribution of mangroves, historical background and evolution of mangroves, mangrove biology which includes anatomy, physiology, reproduction and distribution, mangrove species, flora and fauna associations in mangrove ecosystems, mangrove ecology includes zoning of mangrove ecosystems, food webs and energy flows in mangrove ecosystems, mangrove responses to various environmental stresses and the role of humans in empowering mangrove ecosystems, as well as research related to mangrove ecology. Mangrove ecology learning is carried out by examining not only mangrove-related content but also related to the context of coastal areas. This contextual means inviting students to conduct fieldwork lectures in the form of planting mangrove seedlings.

It is hoped that the content contained in the Mangrove Ecology Course can be used as a material to integrate learning biology with marine. Learning science is closer to marine literacy than other learning (social, language, mathematics), that is, the closest is Biology, then Geography, Physics then Chemistry [9]. In order for mangrove ecology to be well integrated in biology learning, educators must well master the concept of mangrove ecology. These efforts could be made earlier for preservice biology teacher. Preservice biology teacher are expected to have the correct concept regarding mangrove ecology. In other words, they have little or no misconceptions

This article discusses the identification of preservice biology teacher’s misconceptions on the concept of mangrove ecology. The findings are expected to be a consideration in developing mangrove ecology lectures and can become a reference for further research related to marine-based learning, especially mangrove ecology.

2. Method
This study is a descriptive study with survey method that identify and explain the misconceptions of mangrove ecology experienced by preservice biology teachers (students). The subjects in the this study were 12 students who took ecology mangrove course in 2018/2019 academic year at Biology Education Department of Teacher Training and Education Faculty Maritim Raja Ali Haji University.

The data were obtained using a misconception test instrument in the form of multiple choice questions consisting of 20 items equipped with a choice of confidence level (using CRI) in answering
the questions. The test were tested at the end of the semester exams in ecology mangrove course. The CRI (Certainty of Response Index) method is frequently used in social sciences, especially survey research \cite{10}. The CRI technique was characterized by a scale of confidence in answering questions \cite{11}, that have four scales as shown in Table 1. The results obtained were then analyzed using the method namely certainty response index (CRI).

| CRI | Criteria          |
|-----|------------------|
| 1   | Almost guess     |
| 2   | Not sure         |
| 3   | Sure             |
| 4   | Almost certain   |

Table 1. Category and criteria for answer confidence using the CRI method scale 4

The question instruments were developed based on several indicators covering several sub-concepts on the ecological concept of mangroves, namely characteristics of mangroves, ecosystem of mangroves, resilience of mangroves, and mangrove research methods. Each question item consists of 5 answer choices. After the respondent gives an answer to one of the available answers (a, b, c, d, and e), then the respondent writes down his level of confidence.

Data processing was carried out by grouping students' understanding into four categories, namely: Knowledge of correct concepts, Lack of knowledge (lucky guess), Lack of knowledge, and misconceptions \cite{10}. The grouping is shown in Table 2. Identification is carried out by categorizing students' understanding and analyzing which sub-concepts are part of the mangrove ecology concept that has misconceptions.

Table 2. Decision matrix for a given question. Based on combinations of correct or wrong answer and of low or high CRI

| Low CRI (<2,5) | High CRI (>2,5) |
|---------------|-----------------|
| Correct answer | Correct answer and low CRI (CL) |
| Wrong answer  | Wrong answer and low CRI (WL) |
|               | Lack of knowledge |
|               | Knowledge of correct concepts |
|               | Correct answer and high CRI (CH) |
|               | Wrong answer and high CRI (WH) |
|               | Misconceptions |

3. Result dan Discussion

3.1. Understanding the concept of preservice biology teacher on the concept of mangrove ecology

The results of the data analysis based on the diagnostic test with CRI showed that of the 12 students who were the objects of the study, 45% understood the concept, 40% had misconceptions, while the rest who did not understand the concept and those who guessed were 8% and 7%, respectively.
Figure 1 shows that in general, the number of students who experience misconceptions and those who understand the concept is almost the same, which is a difference of 5%. Likewise, the number of students who do not understand the concept and who guess, is only a difference of 1%. Students who experience misconceptions are less than students who understand concepts, but more than students who do not understand concepts and who only guess.

The percentage of students who understand the concept is higher than others due to several factors, including learning experiences that have been followed, experiences in daily life, student participation in activities related to mangroves. The diagnostic test is carried out during the final semester exam (UAS), it is predicted that students will learn first based on the grid given by the lecturer before the exam is carried out. The grid is made in accordance with the concepts discussed in the study using the presentation discussion method. In addition to the learning experience that was followed, most of the students since childhood lived in coastal areas were also predicted to affect the percentage of students who understood the concept. All students pass through the mangrove ecosystem when leaving for college, because the campus is in a coastal area. Students also almost every semester participate in mangrove planting held by the Biology Education Department.

The high percentage of students who experience misconceptions is caused by wrong reasoning about the concept of mangrove ecology. Based on interviews with several students, it was found that students admitted to not participating in presentation discussion activities because they felt less confident. So that students receive incomplete information. Mangrove ecology lectures are carried out using the presentation discussion method, so students who are actively seeking information and actively discussing will construct their knowledge well. Meanwhile, students who are passive receive incomplete information.

Students’ understanding and experiences in other subjects that are closely related to the mangrove ecosystem also have a big influence. Subjects that are closely related to mangrove ecology include: ecology; plant anatomy, morphology and physiology; and animal physiology, as well as marine biology. If students misunderstand the concepts in these subjects, it will be difficult to understand the concept of mangrove ecology. False initial conceptions can trigger misconceptions (Mustika, 2014). Students expect that there are
learning resources in the form of textbooks developed by lecturers, so that students get more valid information than the sources from the internet that are searched by students.

Students who do not understand the concept and guess very little (15%). This indicates that very few students are unsure of the answer, either the wrong answer or the right answer. Most of the students choose a high CRI which is sure.

3.2. Preservice biology teachers’ understanding of the mangrove ecology sub-concept

Students’ understanding of the 4 (four) sub-concepts tested can be seen in Figure 2.

![Image of Figure 2](image)

**Figure 2.** The level of understanding of UMRAH biology students for each sub-concept based on the results of diagnostic tests on the concept of mangrove ecology.

Figure 2 shows that misconceptions occurred in 4 sub-concepts tested through diagnostic tests with the CRI method. The first highest misconception was in the 4th sub-concept, namely the mangrove research method sub-concept of 47.92%, the second highest misconception was in the first sub-concept, namely the mangrove characteristic sub-concept of 41.67%, the third highest misconception was the 2nd sub-concept, namely the sub-concept. the mangrove ecosystem was 38.89%, the lowest misconception was in the 3rd sub-concept, namely the 33.33% mangrove resilience sub-concept.

The high student misconceptions on the sub-concept of the mangrove research method can be caused by students’ lack of understanding of the ecological concepts that have been studied in the previous semester, especially in the sub-concepts of ecology-related research. The sub-concept of this mangrove research method is the same as the research method on ecological concepts, it’s just that the vegetation or special animals that live in the mangrove ecosystem. Students carry out mangrove research practices on the same day as mangrove planting activities, to be precise after planting mangroves. So that students do not serious research methods because students feel tired. Lack of time to do mangrove research because the mangrove ecology course weighs only 2 credits. Lecturers are worried about burdening
students if they are asked to do mangrove research at another time. Based on the findings of this study, it is hoped that the learning strategy in conducting mangrove research can be rearranged, so that students do not experience high misconceptions.

The high level of misconceptions in the first sub-concept was caused by inaccurate reasoning by students regarding the material characteristics of mangroves. This inaccurate reasoning was caused by the incomplete information received by students during the discussion presentation. The lack of textbooks that are used as references in presentations and discussions is one of the reasons why students do not receive complete and valid information. Students rely more on popular articles from websites or blogspots. Scientific articles are also rarely reviewed because students are not used to it. Popular articles are preferred because they are considered more practical and show the desired information than scientific articles. In fact, the validity of information in popular articles is not reliable. Efforts to reorienting Learning Science (Biology) based on ocean literacy to support maritime education can be done by integrating marine concepts (mangrove ecology) into educational practice, research, curriculum, textbooks, and assessment [9].

Misconceptions experienced by students can be caused by the students themselves (Suparno, 2005) or their learning experiences at school (Tekkaya, 2002). Students are less able to apply or prove the concepts received in class in real life everyday, so the concept seems to be memorized. The material or concept will be easier to understand if applied to everyday life. For example, when going to the beach, students seldom deliberately observe directly the characteristics of mangrove vegetation, such as the various forms of roots, leaves, and fruits of mangrove vegetation. Although almost the majority of students live in island areas, while studying in high school, students are rarely taught about mangrove ecology. There are no specific subjects that study mangrove ecology, although only local content. At least, learning should be integrated with mangrove ecology.

The percentage between students who understand the concept and those who experience misconceptions is almost the same, which is only a difference of 5%. However, in the sub-concept of mangrove characteristics, the percentage of students with misconceptions was higher than students who understood the concept. Most of the misconceptions in the sub-concept of mangrove characteristics were the questions that examined the differences between mangroves species and mangroves community. Students consider mangroves to be the same as mangroves, even though mangroves are a species of mangrove, which has the scientific name Rhizophora sp. While mangrove is the term for an ecosystem in which there are various kinds of species, for example Bruguiera sp, Avicennia sp, Sonneratia sp, and so on.

The question that contributes highly to the sub-concept of the mangrove ecosystem is "Predict what will happen if the shrimp-eating fish population decreases!". Most students believe the answer is wrong. Questions with command words / operational words were predicted to test high-level cognitive processes (HOTS). Based on HOTS identification research, it was found that the HOTS of Indonesian students tended to be low 3.3. Factors Causing Misconceptions

The results of the student interviews showed that there were several factors that caused the misconception, including inaccurate student reasoning due to incompleteness and invalidity of the information received. In addition, students stated that mangrove ecology material was interesting because it was contextual to their lives. However, students do not have any more demands that encourage students to learn in a real way directly in the field in a period of time. This is because the mangrove course is an elective course that weighs 2 credits, so that
lecturers do not give more burdens. The understanding that underlies the ecology of mangroves can also be a cause of misconceptions among students, one of which is understanding about ecology.

4. Conclusion
Based on the results of tests carried out and analyzed using CRI, it was found that students who experienced misconceptions were as large as students who understood the concept. Misconceptions occur in the three sub-concepts, namely characteristics, ecosystems, resilience and research methods. The most misconceptions were found in the research method sub-concept and the least in the resistance sub-concept. The use of the CRI method can be used to distinguish groups between students who experience misconceptions and students who lack good knowledge but are unable to explain the reasoning process and the specific causes of misconceptions that occur in students. In order for misconceptions to be identified more specifically and accurately, a combination of other techniques is needed in addition to the use of tests to carry out further misconception analysis.

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