



## Misconceptions of Prospective Biology Teachers on Fructus Material Using the Certainty of Response Index Technique

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### ABSTRACT

*This study is aimed to identify misconceptions about fructus that occur in biology teacher candidates. To achieve this goal, this study used a descriptive research method with a survey method to describe a condition of misconceptions of prospective biology teacher students based on the CRI technique. This research was carried out at the skip of lancang kuning university in the 2020/2021 academic year. The population in the study were biology education students who contracted the plant morphology course with the research sample selected by saturated sampling or total sampling, amounting to 35 people. The data collection technique is by giving a fructus concept ability test in the form of multiple choice equipped with a cri scale with a total of 15 question numbers. Data analysis techniques were used using the cri (certainty of response index) technique and the levels of conception and constructive misconceptions were presented descriptively. The findings of the study were obtained from 525 conceptions that there were three categories of conceptions that occurred among prospective biology teacher students about fructus, namely understanding the concept of fructus 27.75% and not understanding the concept of fructus 37.35% and misconceptions 34.90%. Biology teacher candidate students were found to have misconceptions with moderate levels of misconceptions. The concept of misconception occurs in students about fructus, namely the concept of true fruit groups and pseudo fruit groups in fruits. It is hoped that the findings of misconceptions in prospective teachers can become the basis for parties to develop appropriate models or media to reduce the level of misconceptions.*

**Keywords:** *misconceptions, fructus, CRI*

### INTRODUCTION

It has been agreed that high-quality education is the main goal to be achieved by every educator. This is because one of the main goals of learning is to help students understand scientific concepts that are useful in their lives in society. In accordance with the educational objectives in Government Regulation no. 19 of 2005 concerning National Education Standards, Article 26 (4) states that graduate competency standards at the higher education level aim to prepare students to become members of society who have a noble character, have the knowledge, skills, independence, and attitude to find, develop and apply knowledge, technology, and art that benefit humanity. Furthermore, in article 28, paragraph (1) it is stated that educators must have academic qualifications and competence as learning agents, be physically and mentally healthy, and have the ability to realize national education goals (Team PustakaYustisia, 2007).

According to Basri (2013), the teaching and learning process needs to be planned so that the implementation of learning goes well and can achieve the expected results and free from misconceptions. Steps that need to be considered in developing a learning implementation plan include; identifying and classifying subject competencies, developing standard materials, and determining learning methods. So the first step that needs to be prepared by the teacher is

identifying student competencies, one of which is identifying students' initial understanding of conceptions and misconceptions.

The importance of a correct understanding of biological concepts in biology learning. If the mastery of the correct concepts has been mastered and understood by students correctly, students can develop their understanding of higher concepts and make connections between other biological concepts. According to Kara and Yesilyurt (2008), students must understand biology concepts correctly so that they can be integrated into the natural world of technology and everyday life. If students already have a strong understanding of concepts, this can help students more easily understand more complicated concepts because biology concepts are interrelated between one concept (Ardiyanti and Utami, 2017). If students have misconceptions about certain concepts, they can influence their learning outcomes because according to Tekkaya (2002), misconceptions can hinder students' understanding of biology concepts.

According to Dikmenli et al (2009), an understanding of students who experience misconceptions will still exist or settle in them if there is no correction from either the teacher or from other sources. Therefore, misconceptions can be a barrier for students to understand other concepts that are interrelated with each other and can interfere with the formation of further scientific concepts (Ramadhani, 2016). So for prospective teachers, it is necessary to prepare a lesson plan that can identify misconceptions that occur in students. Although sometimes misconceptions arise due to students' misunderstandings that arise because students explain concepts using their own language, causing misconceptions (Kustiyah, 2007). Therefore, the first step that needs to be considered is the identification of conceptual abilities and misconceptions. Misconceptions are concepts that people believe in even though the concept is wrong, either in the form of wrong ideas or judgments or in the form of wrong opinions (Suparno, 2013).

Misconceptions can occur at every level of education (Kose, 2009) starting from the most basic level, namely elementary, junior high, high school and can even occur at the tertiary level. In line with this, based on the level of education, research on students' misconceptions can be carried out starting from the elementary, junior high, high school, tertiary level, elementary and high school level teachers (Suparno, 2013). In 2020, Nerfiyani et al (2020) reported that elementary school students had misconceptions about the concept of light. In addition, there are misconceptions about photosynthesis and plant respiration as reported by Mustaqim (2014) in high school students. In addition, Afidah (2015) found misconceptions at the student level about the concept of evolutionary mechanisms with the main cause being that students follow their intuition in answering test questions. The results of research from Rustaman (2019) identified misconceptions that occurred among junior high school, high school students and science teachers and prospective Biology teachers about biological concepts.

Until now, a lot of research has been done related to the occurrence of misconceptions about biological concepts. One of them is Herawati's research (2012) regarding misconceptions about the nervous system in humans and Khotimah's research (2014) regarding misconceptions about Archaeobacteria and Eubacteria material. Research conducted by Nehm & Reilly (2007) found misconceptions about the concept of natural selection among students at the University of New York (CUNY), New York. The results of Morton's research (2008) found misconceptions about physiology and metabolism experienced by college students. Research on evolution by Alter and Nelson (2002) examines the teaching of evolution in colleges. Rustaman's research (2019) regarding misconceptions about the concept of radiation evolution of humans and primates which also occurs among students tends to be corrected because a category of misconceptions is found that is static. Research on biological misconceptions that have not revealed their misconceptions at the student teacher level is about fructus or fruit in the Morphology branch. In addition, it is important to examine misconceptions about the concept of Fructus or fruit in this study because it is very close to everyday life.

Various models and techniques have been carried out by researchers in an effort to measure and identify the occurrence of misconceptions in students. Many techniques have been successfully developed to overcome and reduce the level of misconceptions. According to Hasan et al. (1999) one of the Certainty of Response Index (CRI) techniques can be used to distinguish students who understand concepts, do not understand concepts, and misconceptions from the confidence index of answers to certain concepts. Many studies using CRI techniques have succeeded in identifying misconceptions. Because the CRI technique can be used easily and simply for every level of education.

As well known that Biology education students at FKIP Lancang Kuning University are Biology teacher candidates and as Biology teacher candidates students must be able to dig up information and apply correct basic concepts about Biology when facing problems or issues about Biology. Therefore, it is necessary to conduct research using the CRI diagnostic technique in diagnosing misconceptions that occur in biology education students as prospective biology teachers on the broader concept of plant morphology. The certainty of response index technique is one of the diagnostic techniques in the form of a belief response to answers from a test that is carried out (Hasan et al., 1999). The certainty of response index (CRI) is a concept confidence index understood by students in acquiring knowledge of plant morphology concepts. It is hoped that from the results of the research, it will be possible to develop scientific standard material and determine a suitable learning model to minimize the level of misconceptions of prospective biology teacher students. So that prospective biology teacher students have competence in biology material content that can be mastered properly and without any misconceptions.

## **METHODOLOGY**

This research is a descriptive study which is aimed to measure and describe the misconceptions experienced by students about the concept of Fructus (fruit) in biology education students as biology teacher candidates. This research was carried out in the even semester of the 2020/2021 academic year with Biology students at the FKIP Lancang Kuning University, Pekanbaru. The population of this study was all Biology education students who contracted the Plant Morphology course in the 2020/2021 academic year at the Biology Education Study Program, FKIP, Lancang Kuning University. The total population is 35 students of the Biology Education Study Program. The sampling technique used was the total sampling technique or saturated sample in which all members of the population were sampled in the study, meaning that all students who contracted plant morphology courses became the sample in this study, namely as many as 35 students of the biology education study program.

The research instrument uses test questions combined with a belief response in answering concept questions. Conception ability used multiple choice test questions with as many as 15 question numbers. The multiple-choice questions used for research were first validated by the validator. Then the instruments used were validated again through the Anates software. Along with collecting concept data, students are also equipped with a response questionnaire for confidence in answers using the Likert scale technique, namely the Certainty of Response Index (CRI). In this research instrument, students are given an overview of the level of student confidence in the answers they choose. The CRI used is based on a scale of six (0,1,2,3,4,5). Scale 0 means the answer is guessed in total; 1 means the answer is not sure; 2 means almost certain; 3 means Confidence; 4 means sure right; 5 is sure to be true.

Data collection techniques by providing test questions and response questionnaires to internal answers were carried out by limited direct tests with students. Test results and questionnaires were collected for analysis. The data that has been collected is then analyzed using the CRI technique. Analysis of research data used the Certainty of Response Index (CRI) criteria developed by Hasan, Bagoyoko & Kelley (1999). Analysis of test answer data and CRI scale

responses was carried out to identify the conceptions that occur in prospective biology teacher students. The conception is in the form of students who understand the concept, do not understand the concept, and experience misconceptions based on a combination of right or wrong answers with high or low confidence index (CRI) student answers. The criteria for student answers can be seen in Table 1.

**Table 1. CRI Response Criteria**

| Response criteria | CRI low (< 2,5)                                                        | CRI high (>2,5)                                                   |
|-------------------|------------------------------------------------------------------------|-------------------------------------------------------------------|
| Correct answer    | Correct answer but low CRI means don't know the concept (right guess). | Correct answers and high CRI means mastering the concept well.    |
| Incorrect answer  | Wrong answer but low CRI means also don't know the concept             | The answer is correct but high CRI means there is a misconception |

(Hasan., Bagoyoko & Kelley, 1999)

Based on Table 1, it can be identified that there are several criteria for student answers, namely if the concept answers are correct and the CRI confidence level is low (0, 1, or 2) then students are categorized as not knowing the concept, if the answer is correct with a high CRI scale level (3, 4 or 5) students in the category of knowing the concept, if the student's answer is wrong with a low level of confidence in the answer scale (0.1 or 2) it is categorized as a student who does not know the concept, but if the answer is wrong with a high level of confidence in the answer (3.4 or 5 ) then the conception of students with the category of misconceptions. The identification of the conceptions obtained from the CRI analysis is then calculated in percentages. Then an analysis of student conceptions was carried out by adding up the percentage of students who understood the concept (PH), did not understand the concept (IP), and had misconceptions (MK) for each question number. Student conceptions for each number of questions in each test are categorized based on CRI criteria as shown in Table 1. The results of the percentage of conceptions found can be interpreted as the level of student misconceptions.

Furthermore, the results of data analysis of groups of students who experience these misconceptions will be interpreted at the level of misconceptions with three categories namely; the low level at 0%-30%; Moderate level in the range of 30% -60% misconception percentage; and a high level in the range of 60% -100% misconception percentage. So that it can be concluded that the category of misconceptions that occur in prospective biology teacher students about the concept of Fructus.

## RESULT AND DISCUSSION

The Certainty of Response Index (CRI) technique can reveal respondents' beliefs from their conceptual abilities by giving responses to a confidence scale from the answers to the questions given to respondents. Based on the results of the CRI test data analysis, it was found that all students had misconceptions about Fructus (fruit). In addition, it was also found that there were varying percentages of conception in each Fructus concept. In the next stage, the data is then processed to obtain: 1) data on the percentage of students' conceptual understanding as a whole; and 2) data on the percentage of misconceptions on each indicator of the Fructus Concept. So that the results of the analysis showed that the diagnostic test obtained data on student conceptions of 525 conception events. The conception event came from 35 students who responded to the 15 questions on the Fructus concept being tested, in the sense that 35

students were multiplied by 15 the number of questions being tested. Following are the results of research data analysis in the form of conceptions and misconceptions.

### Conception of Prospective Biology Teacher Students

Student conception data is calculated using the Certainty of Response Index (CRI) technique. This technique can reveal the respondent's belief in the ability of the concept he understands by responding to a confidence scale from the answers to the questions given. The results of student answers are calculated based on Table 1. Based on the results of the data analysis, the results of the concept test obtained that 525 conceptions of the Fructus Concept occurred in student teacher candidates. The conception event that comes from the multiplication between the number of prospective teacher students is 35 people with the number of concepts tested being 15 concept question numbers. Conception events were found that there were three categories of conceptions that had occurred in students, namely understanding concepts, not understanding concepts, and misconceptions. The results of the analysis carried out obtained data that there were varying percentages of conception on the concept of plant morphology of the Fructus material, each concept represented by each question number, namely 15 question numbers. In general, the percentage of the conception of the results of this study can be seen from the following figure 1:

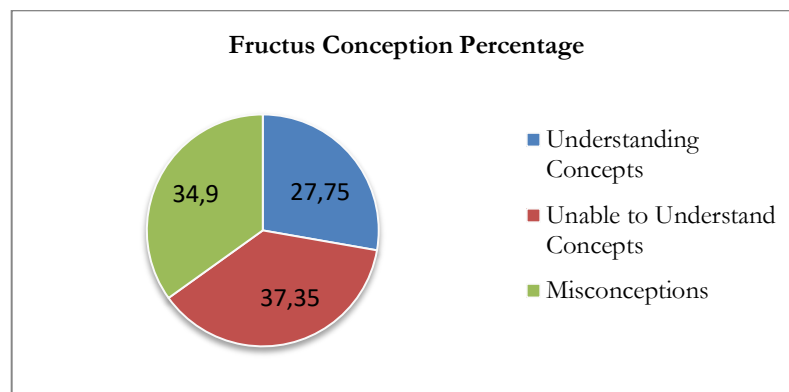


Figure 1. Percentage of Student Conception

Based on Figure 1, it can be explained that three types of conceptions occur in students, namely students who understand the concept of Fruit or Fructus, students who do not understand the concept, and students who experience misconceptions in the research sample. In the group of students understanding the concept of Fructus there was 27.75%, the group of students who did not understand the concept of Fructus was 37.35% and the group of students who had misconceptions about Fructus was 34.9%. Based on the level of misconceptions, the group of students whose misconceptions occur are grouped into Moderate criteria. The next data analysis process is the conception data for each indicator, the conception data for each indicator is obtained which is developed with 15 test items. The conception of each item represents concepts about Fructus. To more clearly the distribution of conceptions that occur in the results of this study can be seen in Figure 2.

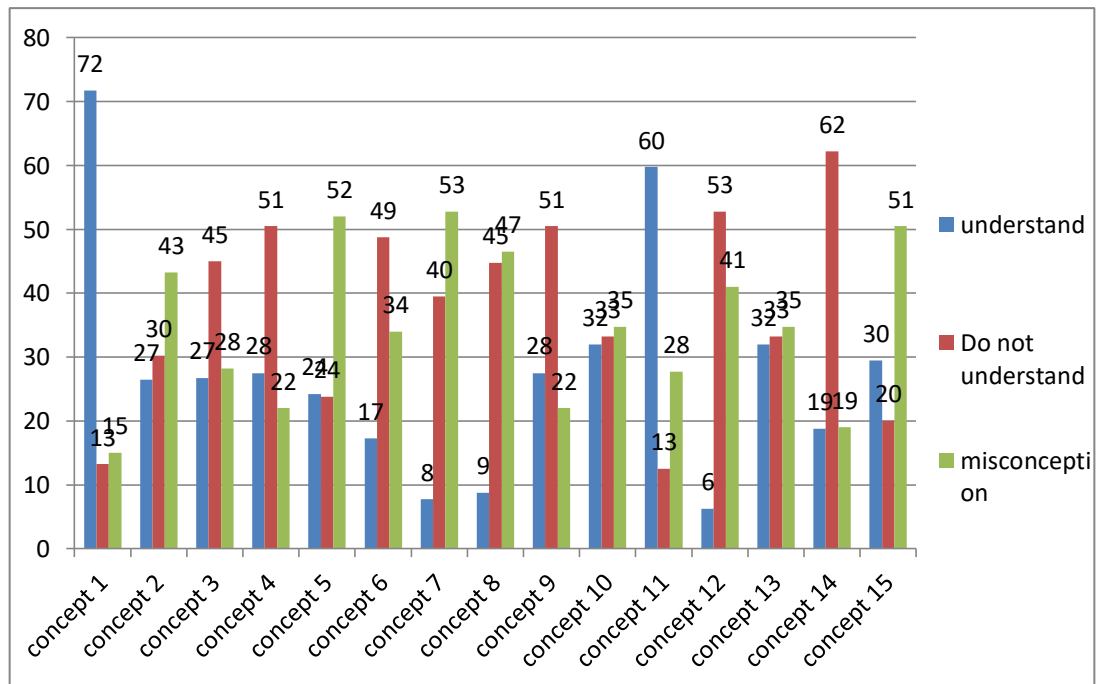


Figure 2. Conception Percentage for Each Question Number

Based on Figure 2 above, it can be seen that the percentage of conceptions is spread in various ways for each item given. In the Concept Understanding (PH) category, it was found that the group of students who understood the concept (PH) was highest in concept 1 by 72% of respondents, the highest percentage occurred in concept 1 concerning the concept of true fruit and pseudo fruit by 72% and the lowest understanding occurred in concept 12 about the meaning of parthenocarpy in fruit by 6%. In the results of the analysis of the data on the conception of the group of students who did not understand the concept (TP), it was found that the highest number of students who did not understand the concept (PH) was in concept 14 regarding the single true fruit in the example of the mango plant, amounting to 62% while the lowest did not understand the item items. 11 about 13% of the flower stalks turn into corn fruit hairs. In the results of the analysis of misconception data, it was found that the data on the distribution of concepts with the highest incidence of misconceptions occurred in concept 7 regarding the concept of single true fruit and double true fruit, with a misconception of 53% and the lowest level of misconception occurred in item 1 about the example of pseudo fruit and True fruit by 15%.

### Misconception Data of prospective biology teacher students

The results of the analysis of misconceptions using the CRI technique show that misconceptions have occurred in Fructus concepts in biology teacher candidates at the Faculty of Teacher Training and Education, Lancang Kuning University. Misconceptions occur in each item given with various levels of misconception. Each item represents concepts about Fructus which are translated into 15 question numbers. The distribution of misconception data on each concept representing the number of questions is shown in Figure 3.

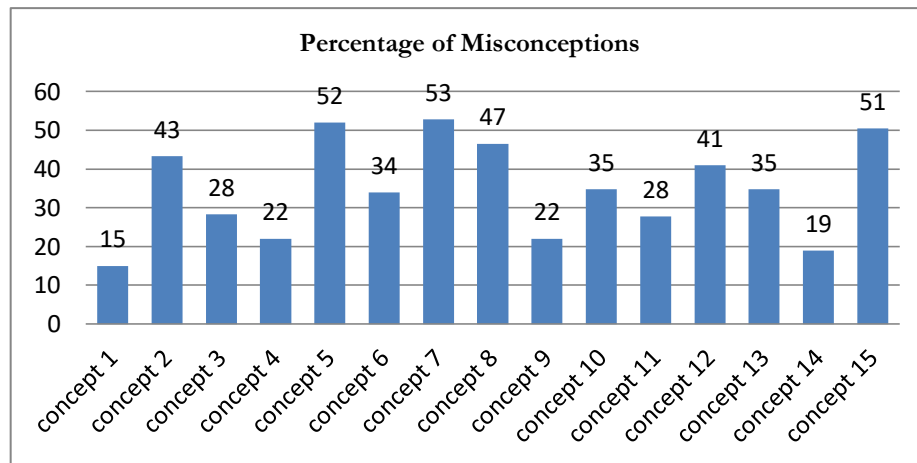


Figure 3. Percentage of Misconceptions for each item

Based on the results of research data analysis using the CRI technique, it was found that there were misconceptions in each item on the fructus concepts. In Figure 3 it can be seen that the categories of misconceptions are spread from 15% to the highest percentage of 53%, meaning that the level of misconceptions is in the Low and Medium level range. The level of misconceptions that occur in students with low-level categories is found in concept 1, concept 3, concept 4, concept 9, concept 11 and concept 14. Meanwhile, students with the level of category misconception are found in concept 2, concept 5, concept 6, concept 7, concept 8, concept 10, concept 12, concept 13, and concept 15. Meanwhile, for high-level misconceptions, there was no incidence of misconceptions in Biology teacher candidate students.

The concepts that occur are misconceptions among low-level students spread over several different numbers of students. In concept 1, prospective biology teacher students believe the wrong concept about true fruit and false fruit, there is a 15% misconception. Most of the students already know about the concept of true fruit, which is a fruit that is solely formed from the ovary, the remains of other flower parts sometimes have fallen and the fruit is not wrapped. Concept 3 is about examples of pseudo fruit (*Fructus spurius*) which are represented by examples of ciplukan plants (*Physalis minima*). Students experience misconceptions about the concept of ciplukan fruit as a true fruit. The percentage of students who experience misconceptions is 28% with a low level. According to the concept of fructus in the ciplukan plant is a pseudo fruit where the concept of ciplukan fruit is the concept of fruit originating from the flower part in the form of flower petals.

Concept 4 about fruit from the example of the cashew plant (*Anacardium occidentale*), students believe that edible fruit is actually a fruit. Concept 9 regarding pineapple fruit (*Ananas sp*) which belongs to the compound buni fruit plant group, meaning that the fruit comes from each compound flower that forms a buni, this concept was failed to be understood by 22% of students. Concept 10 regarding the concept of multiple buni fruit where the fruit comes from flowers that have ovaries that develop and form buni, this concept occurs as a misconception among students by 35%. Concept 11 regarding the concept of the part of the flower that is still left behind and develops into part of the fruit, namely the hair on the corn plant (*Zea mays*) is part of the stalk of the stigma that is still left behind, students experience a misconception about this concept by 28%. Concept 14 regarding the concept of a true single fruit found in mango (*Mangifera indica*) failed to be understood by 19% of students. The edible part of the mango fruit is a single true fruit concept which develops from the floral part.

The level of the misconception that occurs among students in the Medium category with a varying number of students is represented by several concepts in certain question numbers. The results of data analysis found that in concept 2 there was a misconception of 43% of students.

Concept 2 is about the concept of pseudo-fruit development. Students believe in different concepts about pseudo-fruit development. The scientific concept is pseudo fruit, namely fruit that comes from the development of fruit parts that grow from flower parts that become fruit. Concept 5 is an example of a pseudo-fruit concept represented by a strawberry. Strawberries are a fruit which is a pseudo-fruit concept derived from the development of the base of the flower which becomes an edible fruit. This concept has been misconstrued by students by 52%. Concept 6 is an example of the concept of fruit being eaten represented by the example of durian fruit (*Durio zibethinus*). This concept includes concepts with 34% incidence of misconceptions among students. In the concept of durian fruit, the part of the fruit that is eaten on the Durian fruit plant is part of the true fruit group with many fruit leaves and several spaces and many seeds.

Concept 7 regarding single true fruit and double true fruit, the level of the misconception that occurs is 53% of the number of prospective teacher students. Concept 8 regarding the concept of plants with double true fruit which is represented by the example of a plant, namely the cempaka plant (*Magnolia champaca*). There has been a misconception of 47% of students, students mistakenly believe the concept that the fruit on the cempaka plant is classified as a single true fruit. Students experience the misconception that cempaka is an example of a plant with a single true fruit concept. Concept 12 regarding the concept of flowers that do not go through pollination and fertilization was also misconstrued by 41% of students. Concept 13 regarding the concept of fruit from the jackfruit plant was misunderstood by students by 35%. Concept 15 regarding the single true fruit group found in papaya fruit (*Carica papaya*), students believe that papaya fruit comes from several ovaries with one chamber and many seeds.

Thus it was found that the concepts that occurred were misconceptions by prospective biology teacher students at the Lancang Kuning University FKIP with the percentage of misconceptions occupying a number position that was classified as Moderate at 34.29%. The concept that has the most misconceptions that occur in students is the concept of the part of the flower that develops into an edible fruit in Cashew or Monkey guava is the flower stalk, the results of the analysis found that students believe that the edible part comes from the growth of the ovary. So the concept of fructus / fruit is still often misconstrued by the public, even though the fruit that is formed from the ovary on the flower and other parts of the flower falls and the fruit can be called a true fruit. If the fruit is formed from other parts of the growing flower, it is called a pseudo fruit or closed fruit. Examples of true fruit are apples, berries, and cucumbers. Examples of all fruits are cashew fruit or cashew fruit.

Based on the results of data analysis of conceptions and misconceptions that have been found using the CRI technique, the concepts of fruit or fructus development are concepts that have the potential to experience misconceptions. This means that the concept of fructus (fruit) is quite difficult for students to understand so students have misconceptions. According to Alter and Nelson (2002), there are five basic assumptions that can lead to misconceptions among students; from everyday experience; misconceptions built by students themselves; being taught and learning misconceptions, unscientific facts taught by parents or others informally; vernacular (regional language) misconceptions, misconceptions caused by differences in the use of scientific words and everyday words. Misconceptions in belief and the basis of myths. Based on the tendency of the concept of questions used in this study, namely examples of fruit that can be found in students' immediate environment, misconceptions arise because of the factors that were found. In line with that Suparno (2013) states that sources of misconceptions can occur from student and teacher factors, as well as textbooks, as well as incorrect contexts. According to Handoko and Sipahutar (2016) that misconceptions can arise from students' preconceptions because the initial concepts possessed by students before entering the teaching and learning process that they already have are sourced from experience and thoughts and limited understanding of the natural surroundings. So that simple examples that are understood from the



surrounding environment can become misconceptions in the actual concept. This is evidenced by the research findings, namely the concept of fruit in cashew nuts which experience misconceptions among students. Students believe that the part of the fruit that is eaten as a fruit in cashew nuts is the real fruit, it turns out that it is different from people's understanding of scientific concepts so that this is the cause of misconceptions.

Therefore it can be concluded that the misconceptions found in each of the fruit concepts occur in student-teacher candidates with varying levels of misconception distribution. It is feared that this will be transmitted to students later so that they can deviate from true knowledge. Ideally, a teacher does not have misconceptions about the concepts being taught to his students so that students can correctly accept certain scientific concepts in accordance with scientific concepts.

## CONCLUSION

Based on the results of this study, it was found that there had been a misconception among Biology teacher candidates regarding the Fructus concept at FKIP Lancang Kuning University. The results of the misconception diagnostic test using the Certainty of Response Index (CRI) revealed information that the level of misconceptions of prospective biology teacher students was at the moderate level category with a percentage of 34.9%. The level of misconceptions that occur in students is in the range of 15% -53% which is spread over each distribution of misconceptions. Misconceptions occur between the concepts of true fruit and pseudo fruit as well as true fruit class and pseudo fruit class in examples of fruits that are close to everyday life. Therefore it is suggested that further research be carried out to overcome misconceptions in prospective teachers through the application of models, methods or learning media that can minimize/reduce the occurrence of misconceptions in prospective Biology teachers.

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