Identification of Misconceptions and Causes of Student Misconceptions on Genetics Concept with CRI Method

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Amelia Gusmalini, Sri Wulandari, Zulfarina

Biology Education – Postgraduate Programme, Universitas Riau
Jl. HR. Soebrantas, Km. 12.5, Pekanbaru, 28293, Indonesia

ameliagusmalini@gmail.com

Abstract. This study aimed to identify students' misconceptions and causes of students' misconceptions on genetics concepts with Certainty Response Index (CRI). This research was conducted at Sains Tahfizh Islamic Center Senior High School in Siak with a sample is students' of grade XII science program. Students' misconceptions were identified by using 20 items multiple choices accompanied by CRI sheets with four scales of beliefs, which are very sure, sure, not sure, and very unsure. The causes of students' misconception were identified using a students' response questionnaire with three indicators of misconceptions causes, namely context, students', and teachers. The data of students' questionnaire were analyzed using a Likert-4 scale. The result showed 42.1% of students' experienced misconceptions, 37.8% of students' know the concepts, and 22.4% of students' did not know the concepts. The cause of misconceptions in this research is in term of the genetic concept itself. This is evidenced by the result of students' responses questionnaire analysis which showed an average of 79.6% students' agreed that the scope of the context of genetics concepts is very broad and has difficult terms, so that it triggers students misconceptions.

1. Introduction

Educational problems that often arise in biology learning are misconceptions of learning concepts. One of the biology topics that became research among educators was the difficulties and misconceptions of students' on genetics concept, even though genetics are important to learn in school [1]. Genetics is considered difficult because it is abstract and has many foreign terms, this causes the concepts that understood are often not in accordance with those adhered to by experts [2]. This fault called misconception which is an obstacle to understanding and mastering the concept, so that it impacts on the level of students' understanding and achievement in learning [3]. Misconceptions or concepts errors indicate that is not appropriate concepts or different from scientific understanding by experts in a field, or an error and incorrect relationship between concepts [4].

Misconception on genetics concept are found on the concept of the meaning and scope of genetics, genetic material (genes, DNA, and chromosomes), gene-DNA-chromosome relationships, protein synthesis processes, heredity principles, inheritance mechanisms, sex determination, relationship meiotic and meiosis division with inheritance, and mutations [5, 6]. This misconception can occur due to several factor, in general these factors are students, teachers, books, context, and teaching methods [7]. Based on observations of the average learning outcomes genetics concepts of students' at the Sains Tahfizh Islamic Center Senior High School amounting to 62.8 with minimum completeness criteria (KKM) 80. This showed that the level of students' understanding on genetics concepts is quite low. Meanwhile, based on the biology teacher's interview at the high school, the possibility of misconception will occur as much as 30% of the number of students' by looking at the students'

category in the class. That is, 50% of students' find difficult, 35% of students' can understand teachers explanation, and 15% of students' feel there is no meaningful difficulties.

So far, the efforts to identify misconceptions on genetics concepts in students' at the Sains Tahfizh Islamic Center Siak Senior High School have not been carried out. Therefore, there needs to be a pattern to distinguish students' who understand the concept, do not understand the concept, and misconception. One way to facilitate the identification of misconception in this study is use the Certainty Response Index (CRI) method, developed by Hasan and Kelley in 1999. CRI uses a scale that is given along with each answer to the question, the level of confidence in answering the question is reflected in the CRI scale that is given. A low CRI indicates students' lack of confidence in answering the question it can be assumed that the answers are guesses. Conversely, high CRI shows high concept confidence in students. With this method, students who experience misconceptions and who do not understand the concept can be distinguished simply by comparing whether or not the answer with high or low the confidence scale of the answer given for each questions. Based on the description above, this study aims to identify students' misconception and the causes of students' misconception on genetics concept.

2. Methodology

This research is a descriptive study using quantitative descriptive methods. The subjects in this study were students' grade XII science program at Sains Tahfizh Islamic Center Siak Senior High School. The instrument used in this study is multiple choice tests with CRI and questionnaires causing students' misconceptions. The multiple choice questions were 20 questions accompanied by a level of confidence in choosing answers validated by material, construction, and language professors. Questionnaire on the causes of misconception is arranged in the category of positive statements with three indicators of causes of misconception. The first indicator is the cause of misconceptions in terms of context, the second indicator is the cause of misconceptions from students and the third indicator is the cause of misconceptions from teachers.

The results of the misconceptions identification is expressed in terms of percentage by referring to the criteria for the test answers by the CRI method in Table 1. Furthermore, the identification data are categorized into three groups of level concept understanding, namely understanding concepts, misconceptions, and not understanding concepts. While the questionnaire causing students' misconceptions was analyzed using a Likert scale with four character rating ranges, namely: strongly disagree score 1; disagree score 2; agree score 3; and strongly agree score 4.

Table 1. Tests answer criteria with CRI method.

Answer criteria (Score)	Low CRI (≤ 2,5)	High CRI (≥ 2,5)
Correct Answer (1)	Correct answer but low CRI means do not know the concepts	Correct answer and high CRI means know the concepts
Wrong Answer (0)	Wrong answer and low CRI means do not know the concepts	Wrong answer and high CRI means have a misconceptions

3. Result and Discussion

The results of students' answers on multiple choice tests using CRI method are presented in Figure 1. The figure shows the percentage of students' level understanding categories on genetics concept. The categories of students' level understanding consisted of understanding concepts, misconceptions, and not understanding concepts.

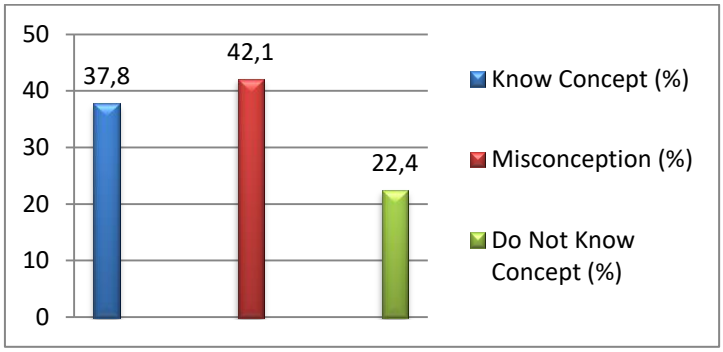

Figure 1. Average percentage of students' level concept understanding on genetics concept.

Based on Figure 1 above, the percentage of students' level concept understanding on genetics concept at the highest is 42.1% with the category is misconceptions, then 37.8% students' know the concept, and 22.4% do not know the concept. Data on the level of students' concept understanding in each genetic sub concept can be seen in Table 2.

Table 2. The average percentage of students' level understanding in each genetic sub concept.

No.	Sub concept	Items	Level understanding		
			Know concept (%)	Misconception (%)	Do not know concept (%)
1.	Meaning and scope of genetics	1, 6	52,5	27,5	20
2.	Genetic material and chromosomes	3, 4, 14, 15	35	48,7	16,3
3.	Gene-DNA-chromosome relationships	18, 20	25	55	20
4.	Cell division	9, 10, 11	25	48,3	23,3
5.	Protein synthesis	2, 5, 7, 8	22,5	55	45
6.	Mendel law	13	50	25	25
7.	Inheritance	17, 19	30	52,5	17,5
8.	Mutation	12, 16	62,5	25	12,5
Rata-rata (%)			37,8	42,1	22,4

Based on the data listed in Table 2, it can be seen that the level of students' concept understanding with category know concept, highest in the mutation sub concept with an average percentage of 62.5%, while the lowest category of know concept is in the protein synthesis sub concept with an average percentage of 22.5%. Then, on 55% students' experience misconceptions highest in the gene, DNA and chromosomes relationship sub concept as well as the protein synthesis sub concept. The lowest percentage of misconceptions is in Mendel's law sub concepts and mutation, with an average percentage is 25%. The next category of concept understanding is do not know the concept. Based on these data, it is clear that most students already know the concept or have misconceptions. This is indicated by the low average percentage of students' not know the concept of each sub concept. The highest percentage in the category did not know the concept that is equal to 45% in the protein synthesis sub concept, while the lowest average percentage is 16.3% in the genetic material and chromosomes sub concepts.

Students' understanding of the relationship between genes, DNA and chromosomes is quite varied, most students experience misconceptions. Based on the analysis of the answers, most students' assume that genes and chromosomes are determinants of the nature of living things found in DNA. This is

contrary to the opinion of experts regarding the relationship of genes, DNA and chromosomes, a gene is a segment of DNA that is stretched to form a chromosome [8]. Next, sub concept with the category highest misconception and do not know concept is the sub concept protein synthesis. Most students' assume that replication is a process of multiplying DNA into DNA, this is contrary to the opinion of experts, replication occurs in organism with DNA genetic material and organism with RNA genetic material, such as virus [9].

Data on the causes of students' misconception in this study were obtained from the distribution students' questionnaire responses to the common causes of misconception consisting of three indicators namely context, students, and teachers. Figure 2 shows a graph of the percentage of students' responses to the causes of misconception. The first indicator is the cause of misconception in terms of context has the highest percentage compared to other indicators, with a percentage value of 79.6%. The high percentage on this indicator shows that the cause of the students' misconception is sourced by the contents of the genetic concept itself. Most students' have difficulty understanding the terms used in genetic concepts. In addition, a broad and abstract range of genetic concepts also makes it difficult for students' to understand concepts well, because genetics involves several biological organizations so that students' cannot connect each concepts well, in addition students' also find it difficult to understand the terms contained in genetic concepts [10].

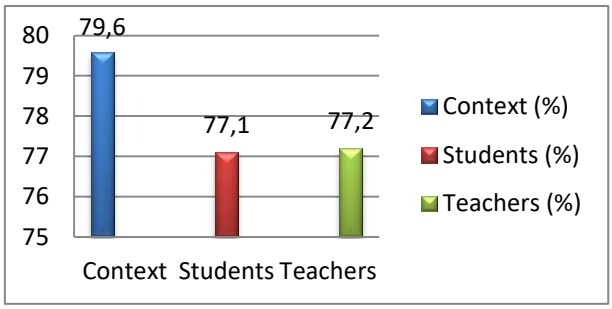

Figure 2. Percentage of students' questionnaire responses to the causes of misconception**.**

4. Conclusion

Identification of students' misconceptions on genetic concepts shows that 42.1% of students' have misconceptions, 37.8% of students' know concept, and 22.4% of students' do not know the concept. The highest students' misconception is on the sub concepts of gene, DNA, and chromosome relationships and the sub concepts of protein synthesis. The causes of students' misconception in this study is in terms of the context of genetic concepts with an average percentage of students' responses is 79.6%.

References

[1] Mustika A A, Yusminah H, and Andi F A 2014 Identifikasi miskonsepsi mahasiswa biologi Universitas Negeri Makassar pada konsep genetika dengan metode CRI *Jurnal Sainsmat* **3(2)** 122-129

[2] Nusantari E 2011 Analisis & penyebab miskonsepsi pada materi genetika buku SMA Kelas XII *Jurnal Bioedukasi* **4(2)** 72-85

[3] Tekkaya C 2002 Misconception as barrier to understand biology *Journal of Education* **3(23)** 259-266

[4] Nusantari E 2012 perbedaan pemahaman awal tentang konsep genetika pada siswa, mahasiswa, guru-dosen & implikasinya terhadap pemahaman genetika *Jurnal Ilmu Pendidikan* **18(2)** 244-252

[5] Sarhim F P and Fauziyah H 2015 Identifikasi miskonsepsi siswa pada materi genetika di kelas XII IPA SMA Negeri 13 Medan Tahun Pelajaran 2014/2015 *Jurnal Pelita Pendidikan* **3(4)** 162-170

[6] Suhermiati I 2015 Analisis miskonsepsi siswa pada materi pokok sintesis protein ditinjau dari hasil belajar biologi siswa *Jurnal Ilmiah Pendidikan Biologi* **4(3)** 985-990
[7] Suparno P 2013 *Miskonsepsi & Perubahan Konsep Pendidikan Fisika* Grasindo, Jakarta
[8] Nusantari E 2014 Genetics misconceptions on high school textbook, the impact and importance on presenting the order of concept through reorganization of genetics *Journal of Education and Practice* **5(36)** 20-28
[9] Corebima A D 2013 *Genetika Mendel,* Airlangga University Press, Surabaya
[10] Duncan R G and Reiser 2007 Reasoning across ontologically distinct levels: students' understanding of molecular genetics *Journal of Research in Science Teaching* **7(44)** 938-959