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Misconception Identification by Open-Ended Test on Innovative Biology Learning Materials Based on Life-Based Learning and 21st Century Learning Characteristics

Firda Ama Zulfia[1], Ahmad Kamal Sudrajat[1], Herawati Susilo[1*], Fandi Tri Fajar Cahyo[1], Fitria Romadona[1], Hamri Permana[1], Rifka Fachrunnisa[1]

[1] *Department of Biology, Faculty of Mathematics and Science, Universitas Negeri Malang, East Java, Indonesia*
[*] *Corresponding author. Email: herawati.susilo.fmipa@um.ac.id*

ABSTRACT
Open-ended test is one of the diagnostic tests that can be used to measure misconceptions in students. The use of open-ended tests will give students the freedom to write their reasons for choosing answers to multiple-choice options. The purpose of this study is to identify misconceptions of 21st century biology learning material for prospective biology teacher students in Malang State University. The development model used is the ADDIE development model. The sample used was 26 students of prospective biology teacher at Universitas Negeri Malang in the 7th semester. The results of the open-ended test analysis for innovative biology learning materials, life-based learning, and 21st-century learning characteristics experienced misconceptions of 23%, 19%, and 18%. The misconceptions experienced by these students are still relatively low because the percentage of misconceptions is still in the range of 0-30%. Based on the results of the analysis it can be seen that there are still students who have a different understanding from the general concept of experts. Students are expected to be able to increase their understanding of concepts by creating learning tools that have been assigned in the form of concept maps/mind maps/resumes.
Keywords: *misconception, open-ended test, students*

1. INTRODUCTION

The development of science and technology makes lecturers have increasingly complex demands, so lecturers need to prepare themselves as best as possible so that they can become professional lecturers in accordance with the demands of the era (Greenstein, 2012). 21st century learning asks lecturers to design learning more fun for students by realizing that each student has different abilities and weaknesses (Blair, 2012). Lecturers who only use one teaching method during learning can make students experience misconceptions because students feel bored and do not use their brain's ability to construct material (Nurulwati, Veloo & Ali, 2014; Siswaningsih, Firman, Zackiyah & Khoirunnisa, 2017). Though learning activities are the main source for students to get concepts (Sidauruk, 2005).

One of the causes of students' inability to understand concepts is when students experience misconceptions (Rositasari, Saridewi & Agung, 2014). Misconception is a different concept from the general concept of experts (Garnett, Garnett & Treagust, 1990). Misconceptions are found in elementary and middle school students compared to college students. This is because students have more opportunities to study the material and have more experience (Nurulwati et al, 2014).

Misconceptions on students are influenced by various factors and occur without realizing it so it is necessary to identify misconceptions to find out whether students experience misconceptions or not (Alawiyah, Ngadimin & Hamid, 2017). Factors that cause misconceptions are concepts learned, material learned, lecturers, source books, and yourself. Based on the results of calculations from the questionnaire, the highest cause of misunderstanding among students is due to self (Bayuni, Sopandi & Sujana, A. 2018).

There are various measuring tools that can be used to identify misconceptions such as the use of cartoon concepts that ask students to describe the material they know (Ekici, Ekici & Aydin, 2007), open-ended test with reasons that are freely written down by students (Siswaningsih et al, 2017), two-tier tests with two levels of tests (Kanli, 2014; Rositasari et al, 2014), three-tier tests with three levels of tests equipped with confidence levels (Pesman & Eryilmaz, 2010; Kirbulut & Geban, 2014), and tests four tier with four levels of tests that are equipped with two kinds of confidence scale (Akmali, 2018). Misconceptions that occur in students due to student difficulties in understanding concepts can be identified

using diagnostic tests (Shalihah, Mulhayayiah & Alatas, 2016).

Open-ended test is a diagnostic test that functions to measure learning difficulties and understanding students' concepts (Gurel, Eryilmaz & McDermott, 2015). This study uses an open-ended test because there are empty spaces to be filled by students and it is expected that students who want to express their reasons in their own sentences can be channeled well (Salirawati, 2011). If using an open-ended test with closed reasons can lead to wrong conclusions because the choice of answers is very limited (Shui-Te, Kusuma, Wardani & Harjito, 2018).

Based on the description above, a study was carried out on the development of an open-ended test for the identification of misconceptions on biology teacher candidates for Universitas Negeri Malang. The purpose of this study was to determine the percentage of misconceptions of prospective biology teacher students using open-ended tests on 21st-century biology learning material.

2. METHOD

The development research model used is the ADDIE development model, namely (1) Analyze, (2) Design, (3) Develop, (4) Implement, and (5) Evaluate (Branch, 2009). The population in this study were semester VII Biology Education students who were taking 21st century biology learning courses, while the sample used was 26 students semester VII Biology Education who were taking 21st century Biology learning courses Class A-A.

The research instrument used was an open-ended test for three materials, namely innovative biology learning, life-based learning, and 21st-century learning characteristics. There were 10 open-ended tests for each material. The procedure for developing open-ended test is divided into five stages as follows.

1. Analyze

The analysis phase is carried out by analyzing learning problems in 21st century biology learning courses.

2. Design

The design phase is carried out by verifying the purpose of implementing the development of open-ended tests and compiling an assessment strategy and costs required.

3. Develop

The design phase is carried out by making a questions grid about innovative biology learning materials, life-based learning, and 21st-century learning characteristics, then compiling open-ended test, validating, and revising open-ended test based on the validation results.

4. Implement

The implementation stage of the open-ended test is done during two lessons for three learning materials in 21st century biology learning courses with 26 students. Each student works on the open-ended test after the learning process is finished. The time to work on each material of open-ended test is 15 minutes.

The dependent variable is the result of students doing open-ended test, the control variable is the number of open-ended test, the way the lecturer teaches, learning time, models and learning methods, while the independent variables are learning material.

5. Evaluate

The evaluation phase serves to determine the quality of the learning process and student misconceptions that have been identified through the open-ended test. Categories of students' level of understanding can be identified using Table 1.

Table 1. Categories of Students' Understanding Levels through Open-ended Test

No	Student Answer Pattern	Understanding Categories
1	The core test answers are correct-the reason is correct	understand (U)
2	The core test answers are correct-the reason is false	misconception (Mi-1)
3	The core test answers are false-the reason is correct	misconception (Mi-1)
4	The core test answers are false-the reason is false	lack of knowledge (LK-1)
5	The core test answers are false - reason is not filled	lack of knowledge (LK-2)
6	The core test answers are correct- reason is not filled	understand in part without misconceptions (MS-1)
7	The core test and reason are not filled	lack of knowledge (LK-3)

(Source: Abraham, Grzybowski, Renner & Marek, 1992)

3. RESULT AND DISCUSSION

Based on the analysis of the identification of students' misconceptions using open-ended test in Table 2., it can be seen that students who take 21st century biology learning courses still have misconceptions about innovative biology learning, life-based learning, and 21st-century learning characteristics. The results of filling in open-ended test by students on three materials have been filled as a whole for answers and reasons of open-ended test, so that there is no

Categories of students' understanding levels for LK-2, MS-1, and LK-3.

Table 2. Results of the Identification of Students' Misconception Using Open-ended Test

Materials	Results of the Identification of Students' Misconception		
	Understand (U)	**Misconception (Mi-1)**	**Lack of knowledge (LK-1)**
Innovative biology learning	47.692%	23.076%	29.230%
Life-based learning	55.769%	18.846%	25.384%
21st-century learning characteristics	55.600%	18.400%	26.000%
Average	53.020%	20.110%	26.870%

Based on the results of the identification of misconceptions using open-ended test it can be seen that the highest misconceptions are found in innovative biology learning material by 23,076%, while students' understanding of concepts from material 1 to material 3 is increasing. According to Utami, Agung & Bahriah (2017) student misconceptions on the three subjects of 21st century biology learning courses are relatively low because they are still in the 0-30% range, namely 20.110%.

Students who understand the material means that they can choose multiple-choice answers correctly and can provide appropriate and logical reasons. Students who have misconceptions can choose the right multiple choice answers and give the wrong reasons or vice versa. Students who do not understand the material answer wrong multiple choice questions and give wrong reasons.

Student misconceptions on innovative biology learning material are found in how to apply innovative biology learning, choosing methods and models that are appropriate for biology material, innovative biology learning, the stage of applying innovative biology learning. Student misconceptions on life-based learning material are often found in measuring tools used in the implementation of life-based learning, differences in competencies and capabilities, as well as aspects needed for the implementation of life-based learning. Whereas students' misconceptions on 21st century learning characteristic material are found in the explanation of 21st century learning characteristics, analysis of one of 21st century learning characteristics is using high order thingking skills, analysis of critical thinking and problem-solving abilities, communication, collaboration, creativity and innovation (4C) 21st century.

Misconceptions experienced by every student in the class can be caused by different things. Students in one class there can be a variety misconception with different causes (Zafitri, Fitriyanto & Yahya, 2018). Some factors causing misconceptions are students' preconceptions, lecturers do not master the material, textbooks used as guidelines have incorrect explanations, different student experiences, and

ways of teaching lecturers which only contain lectures and writing (Suparno, 2005).

The process of learning activities undertaken in 21st century learning courses is apperception from lecturers, presentations of student learning tools in the form of mind maps/concept maps/resumes, group presentations, class discussions, reinforcement, and work on open-ended test. Based on Tasdere & Ercan (2011), research data collected at the end of the learning process can indicate that student misconceptions can also be caused by learning activities, so more effective learning activities are needed.

The use of learning models and methods that fit the material and students can reduce misconceptions on students. According to Muna (2015), misconceptions experienced by students often disrupt the learning process, especially when students are asked to construct knowledge. Therefore, misconceptions held by students should not be left too long (Fatmahanik, 2018). Lecturers can discuss misconceptions that have been found as apperception at the beginning of learning, then this apperception is used as student discussion material, so that at the end of learning students can know that their concepts are wrong (Kowalski & Taylor, 2017).

Professional lecturers of the 21st century can also use learning models or methods that can reduce students' misconceptions, such as (1) the Children Learning in Science (CLIS) learning model that asks students to develop ideas or opinions about a problem in learning and reconstruct them based on observations (Saputra , Halim & Khaldun, 2013), (2) investigative method by means of lecturers asking students to conduct an investigation of a problem in groups and then presenting the results of their investigations so that students can develop a concept (Wijayanti, Raharjo, Saputro & Mulyani, 2018) , (3) the discovery-inquiry model that combines the syntax of discovery and inquiry has been considered valid, practical, and effective to reduce student misconceptions (Tompo, Ahmad & Muris, 2016).

4. CONCLUSION

The results of identification misconception using open-ended test for prospective biology teacher students of Universitas Negeri Malang on innovative biology learning materials, life-based learning, and 21st-century learning

characteristics can be qualified in the low category of misconception. The population in this study were semester VII Biology Education students who were taking 21st century

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