
Development of Inquiry-Based Student Worksheets in Analytical Microbiology Subjects for Bacterial Growth Dynamics in Biology Education Students at Riau University

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Abstract The inquiry-based Student Development Worksheet Research aims to create LKM products that are suitable for use in the Analytical Microbiology course on Bacterial Growth Dynamics. The research was carried out at the University of Riau's Biology Education Study Program. The research subjects used included a validation team, and 30 students of Riau University Biology Education. Research stages include; problem analysis, MFI preparation, Validation, Revision, small group test, limited group test and MFI Products. The validation of the developed MFI was considered to be in the very good / very feasible category with the worthiness of the material worthiness of 90.41%, content presentation 88.83%, inquiry component 87.29%, design 86.66% and students 86%

Keywords: Student Worksheets, Inquiry, Analytical Microbiology

1. Introduction

Analytical Microbiology course is one of the courses provided by the University of Riau Biology Education Study Program in semester VI. This course is an advanced microbiology focused on microbiology study techniques and their applications. Microbiology is very close to everyday human life because its studies involve micro organisms that live everywhere (cosmopolitan). The life of microorganisms like this directly also has an influence on human life, for example in terms of health, food, environment, technology and so on. Therefore the study of microbiology in general and analytical microbiology in particular is an important matter.

One of the lectures on Analytical Microbiology is studying the pattern of bacterial growth on the substrate. Bacteria in everyday life have a beneficial role for humans. One of them is in environmental aspect. Sayuti (2018) mentioned that bacteria play a role in the bioremediation process of hydrocarbon degradation in petroleum-contaminated environments. One method in bioremediation studies is the analysis of growth patterns of hydrocarbonoclastic bacteria. Therefore, in analytical microbiology lectures students are also taught analysis of growth patterns or bacterial growth dynamics. To support the lecture, it can be done by practicum method of bacterial growth dynamics, the equipment of which can be used Student Worksheet (LKM)

Requirements in the curriculum require student lectures to have harmony in three areas, namely cognitive, affective and psychomotor in every product development, process, attitude and provision of science lessons. This can all be realized in the learning activities that are equipped with a student worksheet (LKM). In this case the learning activities required a guided guide, the student worksheet (LKM) (Ministry of National Education, 2008). Based on observations and responses of students who have taken analytical microbiology courses, it is known that students need an inquiry-based Contextual Student Worksheet on Bacterial Growth Dynamics material. Because practicum activities on the material have not used Student Worksheet (LKM) which involves aspects that contain contextual inquiry.

Development of a learning tool / lecture in this case becomes an important matter so that the aims and benefits of lectures can be well received by students. According to Rahmat (2017) The principles underlying research development are: (1) development research has implications for models and tools for overcoming learning problems; (2) Learning tools are an integral part of learning where development is in accordance with problems encountered in the classroom or in the laboratory and development through product development procedures; (3) Product development techniques and procedures are carried out through scientific stages and rules, alternative problem solving, design and implementation of expert validity and product revisions. Further development research must support practical problem solving in education, especially learning problems in the classroom or in the laboratory. Research development bridges the gap between research and the implementation of research results in the form of learning in class or in the laboratory. So before the development process begins, it is necessary to first examine and select the products to be developed, including the products produced must be relevant to meet the needs of learning problems.

The development of Student Worksheets is considered necessary because this tool is a guide for students in working on each project / assignment in class and laboratory. According to Prastowo (2011) LKM is printed teaching material in the form of sheets which are arranged systematically containing material, summaries and instructions for the implementation of learning aimed at being able to determine which students carry out active activities referring to basic competition. The benefits of LKM in learning activities are (1) Activating students in the learning process; (2) Assist students in developing concepts; (3) Train students in finding and developing process skills; (4) Train students to solve problems and think critically; (5) As a guide for students in implementing the learning process; (6) Helping students obtain notes about the material learned through learning activities; and (7) Helping students add information about concepts learned in learning activities systematically (Yusnita.et.al., 2018)

The lecture process is the same thing as the learning process at school, lecturers are required to have a learning model that will be used. Inquiry is one of the learning models that can be used in delivering lecture material. Inquiry is a series of learning activities that emphasizes the process of thinking critically and analytically to seek and find the answers themselves to a problem in question. This inquiry is part of contextual learning. Inquiry (find) is the third component of the main component in contextual learning. The steps of the learning process using a contextual inquiry approach are; orientation, formulating problems, formulating hypotheses, collecting data, testing hypotheses, formulating conclusions (Dhita et al., 2018).

2. Methodology

This research was conducted in the Laboratory of PMIPA Biology Education, University of Riau. The study was conducted in April - June 2018. The trial subjects consisted of a team of validation experts, a team of design experts, 10 biology education students for small group tests and 20 biology education students for limited group tests. This research includes research and development (Research and Development). The product to be developed is an MFI based on the contextual inquiry of Bacterial Growth Dynamics material whose development refers to research into the development of the Borg & Gall model. This development research is based on the results of needs analysis and problem analysis.

The research procedures carried out were divided into several stages, namely: (1) Phase I: Needs analysis aimed at gathering information relevant to the development of inquiry-based MFIs. This stage is carried out by distributing a needs analysis questionnaire to students; (2) Phase II: Design of MFI products, this stage aims to create MFI designs. Each LKM is designed according to contextual inquiry standards and to produce an initial product before testing it to students; (3) Phase III: Making

initial MFI products that contain contextual inquiry, material validation and design. The purpose of this stage is to determine the appropriateness of products developed in a contextual inquiry-based MFI; (4) Stage IV: Small group test; (5) Stage V: Limited group testing; (6) Stage VI: The final result, is a MFI product that has been valid and revised in accordance with input and suggestions, so that an MFI is formed based on contextual inquiry.

3. Result and Discussion

3.1. Analyze of problem and needs

Analysis of needs and problems that have been carried out by reviewing the material and questionnaire to students who have taken lectures, obtained several important points needed in analytical microbiology lectures. The material of bacterial growth dynamics in analytical microbiology courses aims to have students have the skills to observe, count and analyze bacterial growth patterns. Learning resources used in this lecture include the book Pelczar Basic Microbiology 2, Basic Microbiology Capucino and Shermaan, and the Principles of Microbiology. Other learning resources are microbiology articles from various journals. Meanwhile the characteristics of students who take part in lectures in general are those who are interested in microbiology even with diverse basic knowledge abilities.

3.2. Validation

Validation includes material and design validation carried out by expert validators. The results of the validation assessment can be seen in the image below:

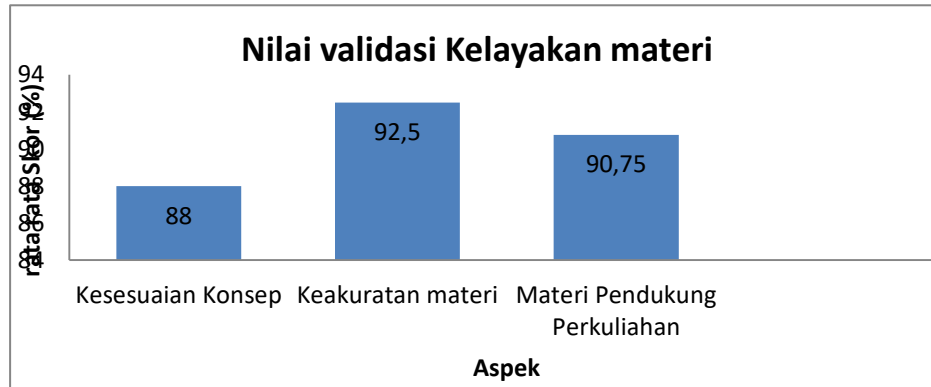


Figure 1. Validation of material

The evaluation of the material presentation has an average value of 90.41% so it is categorized as very good or very feasible. This is in accordance with the suitability of the concept, the accuracy of the material and supporting materials for lectures. Furthermore, assessing the validity of the material is presented in Figure 2

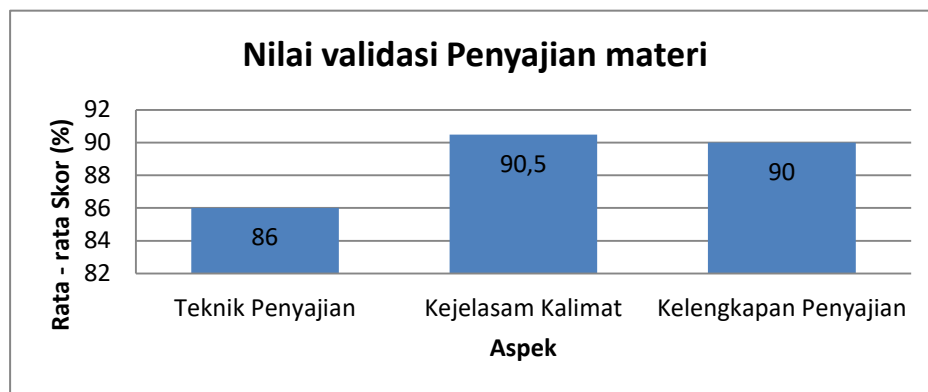


Figure 2. Material Validation

Presentation of material involves 3 aspects namely the presentation technique in this case is worth 86%, the clarity of the sentence is worth 90.5% and the completeness of the presentation is worth 90%. The average score of this assessment is 88.83%, in the very good / very decent category. This means that the presentation in the Bacteria Growth Dynamics MFI is appropriate to use.

Then the validation component of the MFI's contextual inquiry is conducted. The results of the assessment in Figure 3.

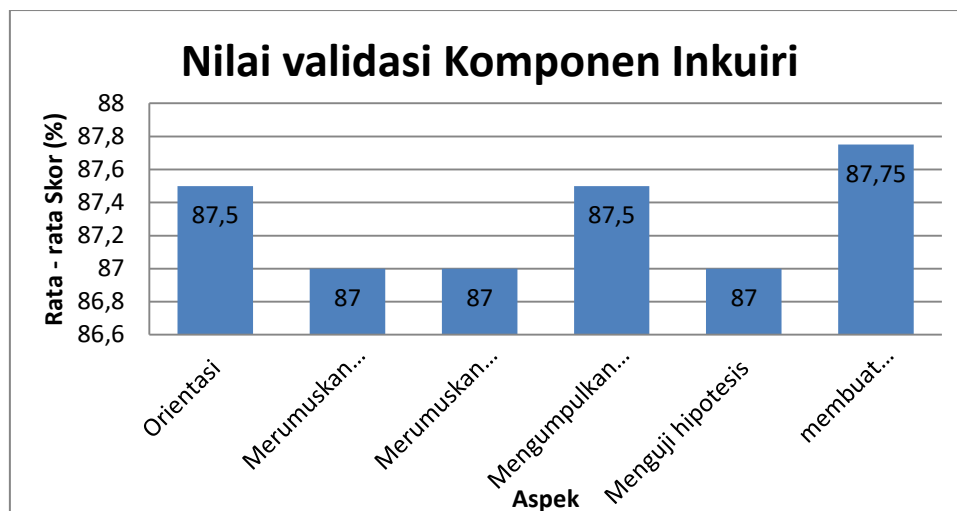


Figure 3. inquiry komponen validation

The validation of the inquiry component follows the syntax of the inquiry model, which is orientation, problem formulation, hypothesis formulation, data collection, hypothesis testing, and conclusions. The average score of this component is 87.29% and is in the very good / very decent category.

Next is the assessment / validation of the design feasibility seen in Figure 4.

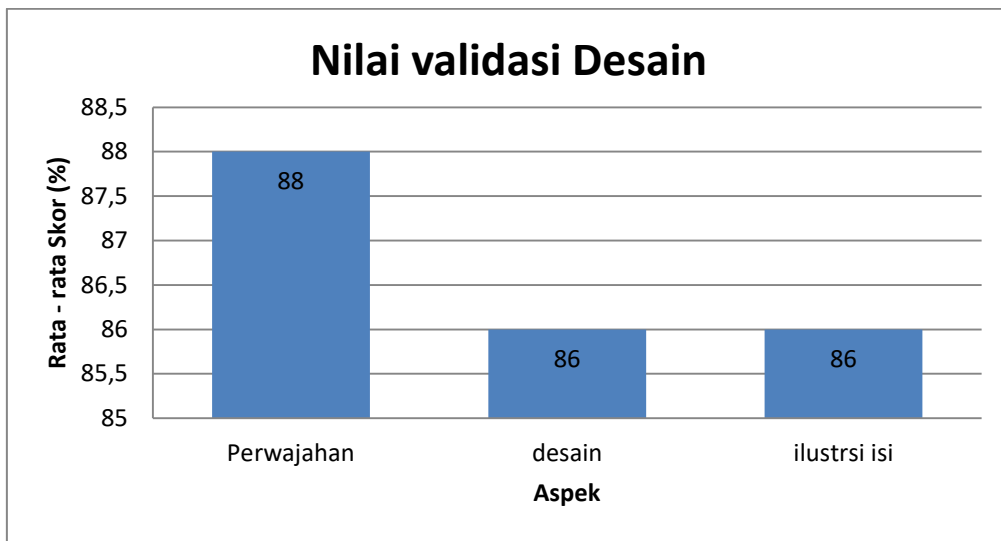


Figure 4. Design Validation

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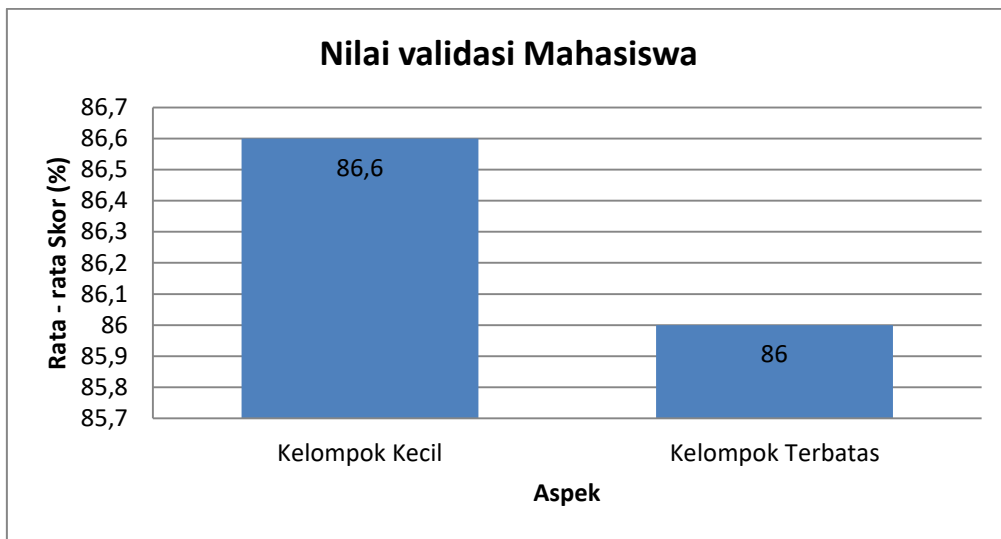


Figure 5. Students Validation

In the validation of the small group got a score of 86.6% and in the limited group a score of 86%. Thus validation by students is in the very good / very decent category.

The inquiry approach helps students to solve problems through inquiry activities that increase skills and knowledge independently, by providing an opportunity for students to build their own knowledge, use concepts that have been held to solve the problems encountered and students have the opportunity to connect new information with cognitive structure, psychomotor and effective abilities of students can also be developed (Andrini, 2016)

4. Conclusions

Development of Analytical Microbiology Student Worksheets on the Bacteria Growth Dynamics material with the Inkuri and Contextual models is said to be feasible to use after going through a series of validations. Material worthiness is 90.41%, content presentation is 88.83%, inquiry component is 87.29%, design is 86.66% and 86% students so that the developed LKM is very feasible to use

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