

THE DEVELOPMENT OF PROBLEM-BASED APPLIED MICROBIOLOGY TEXTBOOK

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Abstract

The study was aimed to develop a problem-based applied microbiology textbook based on national standard. Instructional materials such as books will guide students in carrying out learning activities in applied microbiology course. This research was conducted in Medan State University Graduate School in January-May 2014, with the development of a model consists of three phases: the analysis phase, which includes defining the front-end analysis, student analysis, material analysis, task analysis, and specification of learning objectives. Design phase, consists of: selection of media, selection of format, and initial planning. Stage of development, consist of supervisor assessment, validation of materials' expert along with limited testing of learning design and final instruments. The products being produced was in form of a textbook used by third semester Master program students of Biology Education, Graduate School, State university of Medan. The developed Applied Microbiology textbook was considered feasible by the validation team. Results of expert team's assessment showed the average of 90.30% a very feasible category and learning design experts rating this textbook 83.40%, categorizing it into feasible. Test of limited group by microbiology lecturer resulting in 91.30% which showed a very appropriate category, and from 40 students of fourth semester Biology Education Postgraduate Program, rating this textbook 83.39%, which this rate categorized into an "interesting" one.

Keywords: Research and Development, Textbooks, Applied Microbiology, Problem Based Learning.

Introduction

Textbooks are all forms of materials used to assist lecturers to carry out teaching and learning activities in the classroom or in laboratory. Textbook has an important role to enhance learning process and students' understanding of science, including biology, and the success of the learning process is determined by how much the students can master curriculum materials. Thus, the material which is not well studied can never be maintained and the material being transferred will only be remembered. Textbook, part of the teaching materials, were designed so that learners master the achieved competencies. Learning science also incorporates two important things, terminology and concepts; problem-based textbook is also a major source of scientific knowledge. Students who were taught using textbook will be able to: (1) independently study and negotiate learning; (2) Access and accredit of prior experiential learning; (3) Generalize competencies and capabilities; and (4) labor and learning, which is similar to work-based learning (Boud and Nicky, 2001).

Efforts can be made to improve students' scientific thinking, for example, students have to improve critical thinking and teachers/lecturers use inquiry method so that learners acquire knowledge and skills that are not of the result of remembering facts, but finding it themselves. Science lessons should emphasize mastery of competencies through a series of scientific process, so learning science including biology should be conducted with problem Based Learning because it can foster ability to think, work, and act scientifically and communicate the aspects of life skills. The main characteristic of problem-based learning includes orienting students to authentic problem or question.

Applied Microbiology is the study of microorganisms, which includes a variety of microscopic organisms, as single cells that are microscopic. The absence of Problem-based Applied Microbiology textbook can hinder learning process of students. Non-availability of textbooks can actually be overcome if the students can find literature or browse various internet sites. The problem then comes when students do not find correct and appropriate literature necessary to problem-based learning. Developing instructional strategies for this course is necessary for competent courses to be achieved. Development of the textbook as a source of problems' learning in students learning activities is expected to improve the ability of critical thinking and problem solving skills. Applied Microbiology textbook is designed to suit the course syllabus with attention was paid on the needs and abilities of students in implementation of learning. So the use of textbooks are able to support, attract, and motivate students and provide a positive influence to cultivate a scientific attitude for a better learning outcomes.

Problem Statement

The problem statement of this research were as follow:

1. How was eligibility categories of Applied Microbiology textbook contents based on feasibility, appropriateness of language, and presentation legibility in problem-based component as reference for master students of biology education, Graduate School, State University of Medan?
2. How did microbiology lecturers' notion on Problem-based Applied Microbiology textbook, which to be used as a reference for Applied Microbiology course?
3. How was the assessment of master students of biology education, Graduate School State University of Medan on this Problem-based Applied Microbiology textbook?

Literature Review

Researches related to problem-based learning has been carried out. In the study of biology, the application of problem-based learning in health education can improve the basic knowledge and a good understanding (Coliver, 2000). Chin & Chia (2004) conducted a study on the implementation of problem-based learning in biology lessons. She concluded that Problem Based Learning can improve students' thinking. Results of research conducted by Brickman (2009) showed greater improvement in the skills of students who perform research on discovery-based learning in the lab, which learning was done through scientific reports reading, designing their

own experiments, and evaluating the results of their experiments, compared with students studying through traditional laboratory. The results of research conducted by Coil, et al. (2010) about the process of teaching science, showed that scientific skills in the beginning of the lesson can improve understanding of the science content. Scientists and science teachers agree that a hallmark of successful graduates is the mastery of skills like: data interpretation, problem solving, experimental designing, writing scientific papers, communication, critical analysis of the literature, collaborative work, along with the control and regulation of their own learning process.

Methodology

Development of research carried out at University of Medan (UNIMED), which is located on Medan Estate on fourth semester students of the Graduate School. This study was conducted in January-May 2014. Textbooks which were developed in this study are based on applied microbiology textbook problem. Model development consists of four phases: define, stage design, and develop stage), and disseminate. Product trials conducted through two stages, namely expert testing and focus group testing. Data were collected using questionnaire. There were four types of questionnaires used to capture the information and data gathering in the development of textbooks, which is based on the need and appropriateness of information for students in Applied Microbiology lecture, namely: Questionnaire A, B, C and D. Questionnaire A were given to team of expert, intended to provide advice or criticism of problem-based applied microbiology textbook. B questionnaire were filled out by a team of expert learning design. C questionnaire were filled out by microbiology lecturer, consisting of four aspects, namely: content, presentation design, legibility, and problem-based learning component. Questionnaire D were filled by students who were intended to see their response to the products being developed. The descriptive analysis of data were performed to describe the problem or situation as it is and not intended to test for hypothesis. The data obtained in this study is qualitative data obtained from a questionnaire completed by the respondent, students and a team of experts.

Research Findings and Discussions

The process of implementing the development of problem-based applied microbiology textbook were done gradually starting from in front-end analysis stage, validation by a team of experts stage, and test a limited group stage.

1. Draft Assessment Based on Expert of Materials

Based on the assessment of two expert of learning materials, the draft of problem based applied microbiology textbook were assessed in terms of its feasibility of content (completeness of the materials; complexity of material; depths of matter; accuracy of concepts and definitions; accuracy of facts and data, accuracy of pictures, diagrams and illustrations presented; accuracy of the term; accuracy of the listed references; suitability of the material; examples of actual cases; pictures, diagrams and illustrations of actual cases; the use of most recent references; systematic of table of contents; material on section title; the presentation of purposes, tools, materials and experimental laboratory safety procedure; accuracy of materials in accordance to the Standard Competence and Basic Competence, and development the thinking ability). The assessment of feasible readability (sentence elements accuracy, sentence effectiveness, the standard of terminologies, reader's motivational phrases, sentence

encouragement for critical thinking, grammatical correctness, spelling accuracy, consistency, the use of scientific terms, and the prevalence of the term). Results of matter expert team's assessment showed the average of 90.30% which categorized the textbook as very feasible. Expert assessment for the material can be seen in Table 1 and Figure 1.

Table 1. Average Percentage of Matter Expert Assessment about Feasibility of Content and Feasibility of Readability

Aspects being Assessed	Lecturer I	Lecturer II	Average Rate	Category
Feasibility of content	89.70%	91.00%	90.35%	Very feasible
Feasibility of Readability	88.88%	91.67%	90.27%	Very feasible

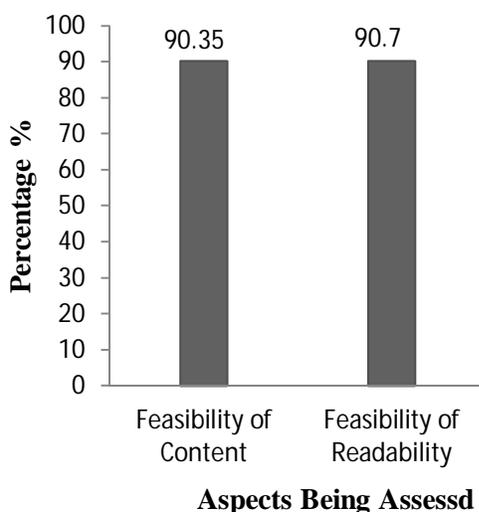


Figure 1. Percentage of Experts' Assessment for Problem-based Applied Microbiology Textbook Material

As presented by Belawati (2006), the focus of content validation is to measure the construct or feasibility component content of the textbooks which linkages with Standard Competence and Basic Competence. The accuracy component of concept includes the truth of fact, the principle of definition, the term applied microbiology textbook-based problems were developed by fulfill those aspects. It is appropriate with the explanation of the Directorate of National Education (2004) that learning resources can help enrich the information and learn certain competences. Feasibility language sentence includes precision elements, the term spelling and able to encourage students to think critically. Rusyana (2004) stated that instructional media is a device for channeling messages or information learned. By these statements it can be concluded that sentence structure of a media must be able to represent the content of the message by preventing the double interpretation and irrelevant of information because the message is a learning information.

2. Draft Assessment Based on Expert of Learning Design

Presentation and design need to be considered to show the physical qualities of interest so as to support the learning process. Feasibility presentation consists of 4 components: presentation techniques, lesson presentation, presentation design and problem-based learning component. Based on expert assessment of learning design, draft book of applied microbiology assessed based on presentation techniques; presentation techniques of learning; the completeness of the presentation; feasibility of problem-based component demonstrate the average score of 83.4% in viable category. Validator gives advice to clarify the concept, adding illustration images, and variations in presentation to make it more interesting, using communicative language in propose the problem. The draft assessment of expert of learning design can be seen in Table 2 and Figure 2.

Table 2. Average Percentage of Learning Design Expert Assessment

Aspects Being Assessed	Lecture I	Lecture II	Average	Category
Techniques Presentation	75%	87.50%	81.25%	feasible
Lesson Presentation	69%	87.50%	78.25%	feasible
Completeness	76.78%	96.42%	86.6%	very feasible
Problem-Based Component	80%	95%	87.5%	very feasible

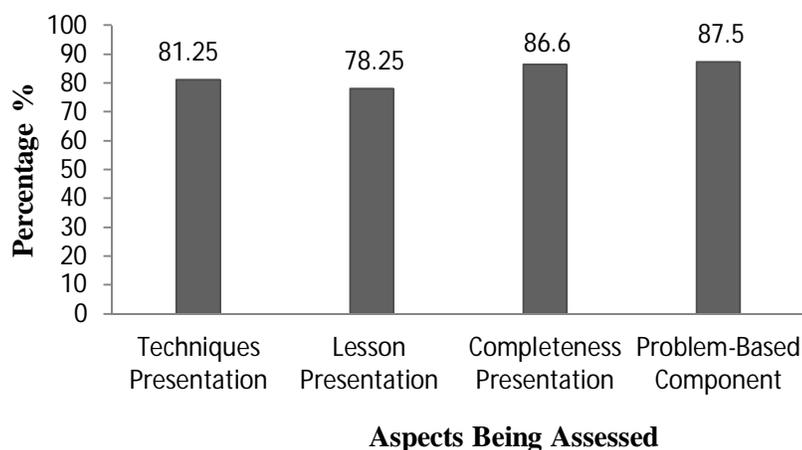


Figure 2. Percentage of Assessment for Problem-based Applied Microbiology Textbook by Experts' of Learning Design

3. Draft Assessment of Problem-Based Applied Microbiology Textbook Based on Lecturer of Microbiology

Problem-Based Applied Microbiology Textbook has been assessed by two lecturers of microbiology. Aspects which assessed are the suitability of the content, presentation, language, and problem-based component revealed the results of 91.30% which include into very appropriate category. The advice given is to multiply the troubleshooting information. Microbiology lecturer assessment results can be seen in Table 3 and Figure 3.

Table 3. Average Percentage of Microbiology Lecturer Assessment

Aspects Being Assessed	Lecturer I	Lecturer II	Average	Category
Content Feasibility	91.17%	92.64%	91.90%	Very feasible
Presentation Feasibility	90.90%	95.45%	93.17%	Very feasible
Readability	86.11%	86.11%	88.89%	Very feasible
Problem-Based Component	87.5%	87.5%	91.25%	Very feasible

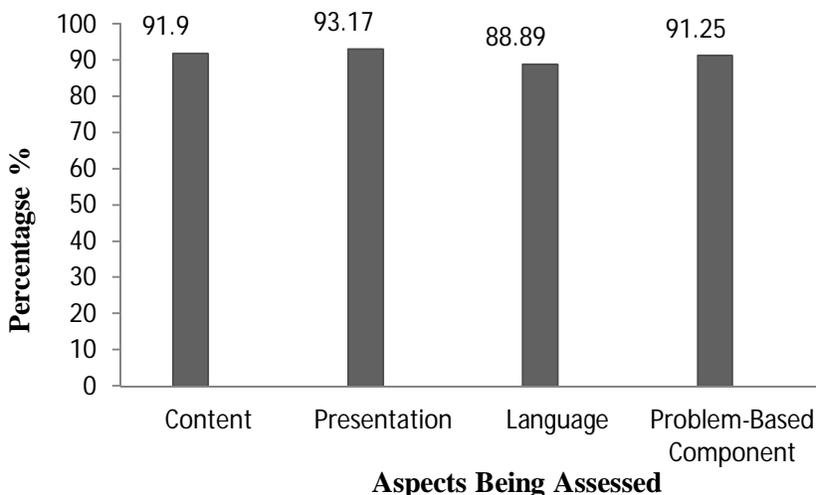


Figure 3. Percentage of Assessment for Problem-based Applied Microbiology Textbook by Microbiology Lecturer

4. Draft Assessment of Problem-Based Applied Microbiology Textbook Based on Students of Microbiology

Problem-Based Applied Microbiology Textbook that have been validated by an expert of material, expert of learning design and assessed by the lecturer microbiology (reviewer) then rated by 40 students of the graduate students of fourth semester from Biology program in State University of Medan. The questionnaire is used to collecting the data were consist of four aspects namely; appearance of book consists of 4 indicators, the concept of book consists of 4 indicators, learning motivation consists of 3 indicators and sources of information consists of 4 indicators. Problem-Based Applied Microbiology Textbook is rate about 83.39% into interest category by the students. Assessment results can be seen in Figure 4.

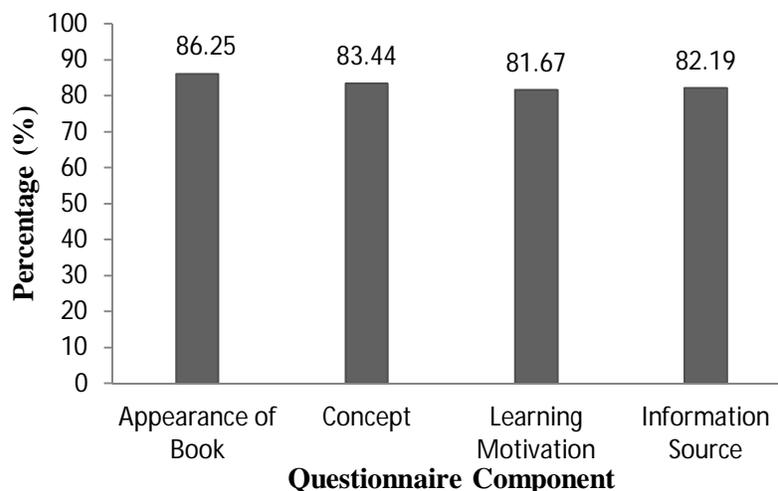


Figure 4. Percentage of Assessment for Problem-based Applied Microbiology Textbook by 40 graduate students

Results of the assessment of problem-based applied microbiology textbook is still on a small scale (limited test group). To achieved better results, it need to be tested on a medium and large group (continue test). The designed and developed textbook based on the principles of good instructional can help students in the learning process, reduce time of lecturer for presenting the material and multiply time for mentoring of students, assist college in completing curriculum and achieve instructional goals with the available time (Ekawarna, 2007). The interesting presentation make students happy to read it because it increases their intrinsic motivation in the learning process (Pintrich and Schunk, 2002).

Conclusion

Based on the formulation, objectives, results and discussion of research development of problem-based applied microbiology textbook proposed earlier it can be concluded that problem-based applied microbiology textbook is arranged and obtained for third semester Biology students in Master Program. Validation result of four experts based on the contents of the feasibility, feasibility linguistic component based presentation and legibility issues, including the overall category of feasible. The results of the assessment conducted by two professors of microbiology states that problem-based applied microbiology textbook suitable for use as a guidance on subjects Applied Microbiology. Result of assessment by 40 students of master program of Biology Education states that problem-based applied microbiology textbook is interest in use.

Recommendations

Based on the findings described in the conclusion of the study, there are some suggestions for problem-based applied microbiology textbook, namely: problem-based applied microbiology textbook is compiled based on the needs of the students and also through testing by some experts. Therefore, the problem-based applied microbiology textbook can be used as guidelines in the learning process. To know the further development of

products, it is need to be applied in the classroom and involve instructor as a facilitator in presenting the material in the textbook.

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