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The Feasibility of Cell-Metabolism Module Using Stim-HOTs Model: A Quality Analysis Based on the Experts' Validation in Developing Biology Learning Module

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Abstract. Cell metabolism is a term which is studied in biology learning at high school level in Indonesia. The purpose of this study is to analyze the quality of learning modules developed using Stimulating Higher Order Thinking Skills (Stim-HOTs) model on cell metabolism topic based on the experts' validation. This study uses qualitative and quantitative methods. The quantitative data were analyzed based on the results of the scoring validation form from experts while the qualitative data were obtained from the comprehensible comments on the suggestion form. The results showed that 92.18% of cell metabolism module developed in the qualification was very good. Therefore, the cell metabolism module which is developed based on the Stim-HOTs model is worthy to be used in the biology learning process in schools and it is also useful to be considered as the new material to treat higher order thinking skills.

1. Introduction

The 21st century is a century where science and technology are growing rapidly [1,2]. Education has an important role in preparing each student to have competencies that are compatible with the development of the 21st century [3,4]. Science learning, especially biology, is one of the ways that learners can have 21stcentury skills according to the needs and the development of the times [5]. This is because science can provide competence in learners to be able to choose attitudes and make decisions based on the knowledge they have through scientific work processes. The development of a biology curriculum at the senior high school level is also prepared by taking into account future trends related to biological processes [6].

Cell metabolism is a topic in biology learning in high schools that have much to do with the development of future trends in the 21st century [7]. This topic discusses the process of metabolism as an enzymatic reaction in the body of living things and involves various basic concepts such as physiological anatomy, biochemistry, and energy changes. Cell metabolism is an important topic because it becomes a necessity for the application of biology in everyday life as well as various fields of science [8,9]. Therefore, the 2013 curriculum in Indonesia in biology learning places the cell metabolism topic as a compulsory subject studied in the 12th grade of high school as set out in the learning syllabus [6]. However, the complex nature of the topic, based on observations and interviews also showed that the students were still having difficulty in learning the topic because the learning contents available in the school only presented the material described in the book along with other chapter materials. In addition, the learning contents in schools also did not present a place for students to do activities that facilitated them to learn cell metabolism easily. Further, in this era, the demand to have HOTs will cover us to confront and compete with the globalization worldwide [10]

[11]. Hence, the integration of developing the cell metabolism modules becomes new solutions. In addition, the characteristics of this module are arranged based on a model of basic syntax [12]. The chosen-model is a Stimulating Higher Order Thinking Skills (Stim-HOTs) [3]. It is used as a basic reference to create such activities that developing the HOTs skills towards the students' critical thinking.

The development of a product such as a module requires validation to obtain expert judgments on products developed before use on a small and large scale [13]. Validation was done to seek approval and legitimation from the practitioner who is expert in accordance with the module related field as well as the suitability of the module to the needs [14]. Module development on cell metabolism topic based on Stim-HOTs model was also done with the validation from the expert of materials, module development design, learning and evaluation instruments, and language who have expertise in their respective fields. This validation result is important to determine the feasibility of the developed cell metabolic module. Therefore, this study aims to analyze the feasibility of modules on cell metabolism topics based on expert validation in the module development that can be used for biology learning in schools.

1.1 Research Question

To underline the focus of the study, the researchers formulated the following question: How is the feasibility of the module which developed using Stimulating Higher Order Thinking Skills model on cell metabolism topic based on experts' validation to be used in biology learning at school?

2. Literature Review

2.1 Module

A module is a learning content that is arranged systematically with understandable language for students according to the level of knowledge and age so that they can learn independently, and it is equipped with minimal guidance from the teacher [15]. The module is structured in a self-contained, complete unit and consists of a series of learning activities that help students achieve some clearly defined and specific objectives [16]. The module becomes a systematically and attractively organized resource that includes content, methods, and evaluations that can be used independently to achieve the expected competencies [13].

2.2. Cell Metabolism

Cell metabolism material in the biology lesson of 12^{th} grade of Senior High School in this material discusses the metabolic process as an enzymatic reaction in the body of living things and involves various basic concepts such as physiological anatomy, biochemistry, and energy changes in three sub-subjects namely enzyme, catabolism, and anabolism [6] [7].

2.3 Stimulating Higher Order Thinking Skill Model (Stim-HOTs)

The model of Stim-HOTs is a new learning model based on inquires learning's developed through some literature-based learning which is the basis of how to teach the students' skills. This model is adjusted to encourage the liberty of students' thinking that followed by the collaborative, communicative, and ICT skills. It is also developed to stimulate the higher order thinking skills through employing the six activities: orientation, questioning, exploration, discussion, explanation, and reflection [3].

3. Method

This research was a mixture of qualitative and quantitative research [17]. Quantitative data were obtained from the results on the scoring form prepared on the Likert scale of the material expert,

module development expert, linguist, as well as the expert of the learning and evaluation instruments while the qualitative data were obtained from the expert input on the suggestion form. The data obtained were analyzed quantitatively in the form of percentages and qualitatively based on the comments given.

4. Result and Discussion

Module on cell metabolism topics was developed specifically to be used in biology learning at the high school level. Module product development was carried out with research and development procedures [18]. Module-based development began with the results of needs analysis conducted through field studies and literature studies. The cell metabolism module was arranged in the form of a printed module containing learning activity based six syntaxes of Stimulating Higher Thinking Skill learning model because this module was also structured to empower higher order thinking skill, especially critical thinking skills [3].

Stimulating Higher Thinking Skill (Stim-HOTs) learning model is utilized to teach the students' skills via six activities: ***Orientation*** which is supported by the Piaget's theory. It is the skill that shows the role of cognitive skill to train the students' interpretation of something. ***Questioning*** is an inventive thinking and a Socratic dialogue method which is based on Dewey's theory that can train the aspect of analysis because the students are asked to express such questions related to HOTs. ***Exploration*** is also suggested by Dewey's and Bruner's theory to make the students can do an analysis well. It is because, in this level, the students are to explore the information their knowledge to answers the questions. ***Discussion*****,** which is based on the Vygotsky's theory that is the constructivism, has trained the aspect of deep analysis and evaluation because in this level the students will analyze the findings in the group and evaluate the given information. ***Explanation*** which is based on Dewey's theory trains the aspect of how to infer and explain to conclude the result or the finding and then explain it to answer the question. In this case, the students are asked to do so. ***Reflection*** which is based on Dewey's theory and Marzano's relates to the habits of mind that train the aspect of control towards the process of something which encourages the students to know how effective the process of their learning [3].

The feasibility of the developed module on cell metabolism topic was determined from the results of expert validation according to the validation from the material expert, the module design development expert, the expert of learning and evaluation instruments, and the linguist to know the legibility of the module. Validation results that have been done are as follows.

4.1. The Results of Material Expert Validation

The result of the material expert validation can be seen in Table 1.

Table 1. The Results of Material Expert Validation

Aspect	The result (%)	Qualification
Material completeness	100	Very Good
Material accuracy	100	Very Good
Activities that support learning	87.5	Very Good
Material sophistication	100	Very Good
The material can improve critical thinking skills	83.33	Very Good
The material follows the scientific system	87.5	Very Good
The material develops thinking skills	100	Very Good
The material can be applied to the model of Stimulating Higher Order Thinking Skill	87.5	Very Good
Average	**93.23**	**Very Good**

The result of the validation of the material expert on the cell metabolism module shows an average result of 93.23% with excellent qualification but needs to be improved according to the advice of the expert validator to complete the material in the module with a reliable reference.

4.2. The Result of Module Design Development Expert Validation

The result of module design development validation can be seen in Table 2 below.

Table 2. The Validation Results of the Module Design Development Expert

Aspect	The result (%)	Qualification
The organization of general presentation	100	Very Good
The presentation takes into account meaningfulness and usefulness	87.5	Very Good
Engaging the students actively	100	Very Good
General presentation	100	Very Good
Variations in the delivery of information	87.5	Very Good
Anatomy of textbooks	100	Very Good
Taking into account the code of ethics and copyright	100	Very Good
Average	**96.43**	**Very Good**

The validation result of the module design development expert shows that the average assessment in the student module shows 96.43% result with very good qualification and need improvement according to the suggestion from the expert of module development by adding dots in activity column that require student answers.

4.3. The Validation Results of the Expert of Learning and Evaluation Instruments

The validation result of the expert of learning and evaluation instruments on the module can be seen in Table 3 below.

Table 3. The Validation Results of the Expert of Learning and Evaluation

Aspect	The result (%)	Qualification
The formulation of indicators	91.75	Very Good
The selection and the organization of teaching materials	87.5	Very Good
The selection of learning resources and teaching media	91.67	Very Good
Approach, model, and learning method	100	Very Good
The assessment of learning outcomes	83.33	Very Good
The materials of question items	91.67	Very Good
Question item presentation	75	Good
Scoring	100	Very Good
The aspects of critical thinking skills	75	Good
Average	**88.44**	**Very Good**

The results of the validation of learning and evaluation instruments show an average of 88.44 with excellent qualification with improvements to the evaluation manual according to expert advice.

4.4. The Validation Results of the Linguist

The validation of the legibility of the module was done by the expert linguist The validation result of the legibility in the student module can be seen in Table 4.

Table 4. The Validation Results of Language Expert

Aspect	The result (%)	Qualification
The clarity of instructions for module usage	75	Good
Term accuracy	100	Very Good
The ease of understanding the flow of the materials through the use of language	100	Very Good
The politeness of language use		Very Good
The precision of dialogue or discourse text on the material	100	Very Good
The compatibility of language with students' level of thinking	75	Good
The ability to encourage curiosity	100	Very Good
The compatibility with General Spelling Guidance for Indonesian	75	Good
Average	**90.63**	**Very Good**

An average rating of 90.63% with excellent qualifications was obtained from the validation results of the linguist to the legibility of the module. According his advice, the improvements were to write foreign terms in italics and that some incorrectly worded words should be corrected in accordance with Indonesian rules

Based on the validation from the four validators/experts, the module developed regarding materials, module design development, learning and evaluation instruments, and the module legibility show average results of 92.18% with excellent qualifications. Appropriate improvements were made to the four module components assessed. The material in the module was corrected according to the suggestion because this section is important in the development of module errors in its preparation[19]. Module design is an important factor in the preparation of a module because the good module design will make the module also developed good and interesting to be used by teachers and students in classroom learning [20, 21]. Improvements made to the components of the learning and evaluation instruments were performed as these components are essential for achieving the desired learning objectives [22,23]. The use of language was good in facilitating the delivery of information especially in the learning module [24,25]. The results of the assessment of the four expert validators as a whole show that the module developed is a product that has been eligible for subsequent use on a limited trial or large-scale trial after an improvement as suggested by the validators. This result states that the feasibility of a product is important to know its quality in the process of product development to be used on a wide scale [26,27].

5. Conclusion

Cell metabolism module in biological learning is developed using six activities of Stimulating Higher Order Thinking Skill model. Assessment of the module feasibility for use in learning is conducted by four experts including material experts, module design development experts, evaluation experts, and linguists. Module validation results through validation performed by four experts showed the average assessment result of 92.18% and showed in very good qualification with some minor improvements according to suggestion. Therefore, the developed module has been eligible for widespread use in biology learning at high school in Indonesia. In addition, the modules developed

also have the potential to improve students' higher-order thinking skills through the content, activities, and evaluations that are in the module based on expert judgment results.

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