
Development of Biology Module Based on Critical Thinking Skills on Grade X Plantae Materials

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ABSTRACT

The purpose of this study is: to see the characteristics, feasibility, and practicality of the development of biology modules based on critical thinking skills grade x Plantae material. Modules developed based on the 4-D development model proposed by Thiagarajan are define, design, develop, and disseminate. The product validation was carried out by four validation professors and three biology teachers at SMA Negeri 4 Palembang as practitioners. Limited trials conducted by 15 students in grade x. Data analysis techniques using qualitative descriptive analysis using formulas from Aiken's V and azwar formulas in excel. The results of the study are as follows: (1) the characteristics of the modules developed are printed using A4 paper. The module consists of a cover, title page, identity page, preface, table of contents, list of pictures, list of tables, instructions for using the module, indicators of critical thinking skills, matter of activities, Plantae material, exercises, summaries, self-reflection, bibliography, glossary, and answer guidelines; (2) biology module based on critical thinking skills on even semester grade X Plantae material is said to be very feasible in terms of the validation results; and (3) the results of practical responses by students when in the field are stated with very practical criteria.

Keywords: biology module, critical thinking skills, Plantae

INTRODUCTION

Education is an effort that is able to develop the potential of students in facing world developments, especially in the field of science and technology. Science is closely related to the educational process. Through education, science is not just transferred, but more than that, it is equipped with values, attitudes, and character (Fikri et al., 2022). Educational institutions present material that must be mastered by students, one of which is the subject of Biology. Biology learning is a science that deals with how to find out and understand nature systematically so that learning biology is not only mastery of a collection of knowledge in the form of facts, concepts, but also a process of discovery, so students are required to be able to think critically. Therefore, to foster change and develop thinking skills and fulfill curiosity, an innovative strategy in learning is needed (Tanjung, 2016).

According (Azizah et al., 2018), critical thinking skills are students' cognitive processes in systematically and specifically analyzing the problems at hand, distinguishing these problems carefully and thoroughly, as well as identifying and reviewing information in order to plan problem solving strategies. One of the abilities that must be possessed by teachers is how to apply a learning model that can improve students' critical thinking skills in accordance with the objectives or competencies to be achieved. A teacher must be able to use a variety of learning models in organizing a learning process. The use of various learning models is intended so that students do not get bored and improve students' critical thinking skills in understanding the material being taught (Yudiana, 2015). In addition to the learning model applied in the teaching and learning process, teaching materials can improve learning outcomes and improve students' critical thinking skills.

Teaching materials are all forms of materials used to help teachers and students in order to achieve learning objectives. Teaching materials are very decisive in the success of a learning. Teaching materials must be mastered and understood by students because they help in achieving learning objectives (Ashari, 2016). One of the teaching materials used in the learning process is a module.

Modules are printed teaching materials designed to be studied independently by learning participants. Modules are also called media for self-study because they are equipped with instructions for self-study. This means that readers can carry out learning activities without the presence of the teacher directly. The language, patterns, and other features of the completeness contained in this module are arranged so that it looks as if it is the "teaching language" or the language of the teacher who is teaching his students. Therefore, this media is often called independent instructional materials. Teachers do not directly give lessons or teach something to their students face-to-face, but only with these modules (Direktorat Jendral Pengembangan Mutu Pendidikan Dan Tenaga Pendidikan, 2008).

Based on the results of the initial needs analysis for teachers at SMA Unggul Negeri 4 Palembang on November 29, 2018, it can be concluded that the teaching materials that teachers use in the learning process are 2013 curriculum printed books, student worksheets and handouts. In the learning process the teacher does not use the module because the time does not allow the teacher to make the module. The module is an alternative for problems regarding teaching materials used in SMA Negeri 4 Palembang, because with the module with systematic material, and there are activity questions, practice questions that are adapted to critical thinking skills indicators so that they can train students to have critical thinking skills that can be learned independently.

The learning resources used during the learning process are from the internet and the learning media used are Power-point and Video. In the learning process commonly used by teachers are the Inquiry model, the Discovery learning model, the Problem based learning

model and the Problem project learning model. The results of interviews and filling out questionnaires by class XI students showed that the material that was difficult to understand was in the kingdom Plantae (plants) material because there were many scientific names and classifications of names from plants. Furthermore, in even semester biology subjects, learning outcomes on Plantae material are low. The low learning outcomes on Plantae material are also seen from the final score, based on the final grades of 2017-2018, it shows that in Plantae material, the average score of learning outcomes that students have is 64.00. In the SMA Unggul Negeri 4 Palembang, teachers have measured students' critical thinking skills using written tests such as essay questions, multiple choice questions, and multiple choice questions. It is better to practice critical thinking skills, the teacher also trains these critical thinking skills during the learning process.

The research that has been used by Yuyun Oktaria (2016) regarding the development of a guided inquiry-based biology learning module on environmental pollution material for class X high school students. Based on the results of material expert validation, the results obtained 91.05%, media experts obtained 81.00%, linguists obtained 87.14% results, thus the product developed was declared very feasible to use.

Research on improving critical thinking skills through the application of the deep dialogue critical thinking learning model in economic learning in SMK Negeri 1 Yogyakarta students (Yudiana, 2015). Based on the results of the analysis, it shows that: (1) Learning Deep Dialog Critical Thinking in economics subjects for students of SMK N 1 Yogyakarta has been carried out well. In the first cycle the value of the teacher's learning implementation was 70 or included in the criteria quite good and increased in the second cycle to 91.6 or included in the very good criteria. (2) The application of this learning model can improve students' critical thinking skills. The average value of students' critical thinking skills in the initial condition of 2.83 or included in the Good category (B); increased in Cycle I to 3.04 in the Good category (B); increased again in Cycle II to 3.53 in the Very Good (SB) category. The criteria for completeness of the value of critical thinking skills in economic learning refers to the Minister of Education and Culture. No. 104 year 2014, namely 2.51 or in the good category. The percentage of students who obtained completeness in critical thinking skills in the initial conditions was 68.75%, increased in Cycle I to 75%, and increased again in Cycle II to become 87.50%.

Umi Zarisma's research (2015) regarding the identification of student learning difficulties in the plant world material for class X SMA Negeri 1 Sambas. This study uses a qualitative and quantitative descriptive approach. The qualitative approach in this study produces descriptive data in the form of narrative writing about the types of student learning difficulties based on learning indicators. While the quantitative approach produces data in the form of numbers. Based on the results of daily tests on the material in the plant world at SMA Negeri 1 Sambas, it is low, this shows that students have learning difficulties.

METHOD

The development model used is a 4-D model from Thiagarajan which consists of define, design, develop, and disseminate (Thiagarajan & Dkk, 1974). The module developed is a biology module based on critical thinking skills that is adapted to indicators from Facione namely interpretation, analysis, inference, evaluation, explanation, and self-regulation (Facione, 2015). Research instruments in the form of interview sheets, questionnaire sheets, questionnaire sheets, and validation sheets. The validation of this module is the validation of material experts, teaching materials experts, evaluation experts, learning device experts, language experts, and teachers as practitioners. This module was tested in class XI IPA at SMA Negeri 4 Palembang.

The data analysis technique used is descriptive qualitative. Qualitative data were obtained from questionnaire interviews given to practitioners (teachers) and students. The first step is the verification and interpretation of the data which aims to draw conclusions based on the data from the interviews that have been obtained. The second step is the process of analyzing the validation sheet of the experts. The quality of the biology learning module obtained from filling out the validation (assessment) sheet by four experts is contained in the form of a product feasibility table and suggestions for improvement. The scoring of each criterion is in accordance with the provisions of Table 1.

Table 1. Likert scale used

Interprestasi	Skor
Sangat Baik (SB)	5
Baik (B)	4
Cukup Baik (CB)	3
Kurang Baik (KB)	2
Tidak Baik (TB)	1

(Sumber: Azwar, 2014: 147—148).

Next step is to conclude the results of the calculations carried out by categorizing them into five criteria, with the formulation as used by Azwar (Azwar, 2014)

Table 2. Categorization of Feasibility Assessment

Rentang Skor	Interpretasi
$\mu + 1,5 \sigma < X$	Sangat Layak (SL)/Praktis
$\mu + 0,5 \sigma < X \leq \mu + 1,5 \sigma$	Layak (L)/Praktis
$\mu - 0,5 \sigma < X \leq \mu + 0,5 \sigma$	Cukup Layak (CL)/Praktis
$\mu - 1,5 \sigma < X \leq \mu - 0,5 \sigma$	Kurang Layak (KL)/Praktis
$X \leq \mu - 1,5 \sigma$	Sangat Tidak Layak (STL)/Praktis

(Sumber: Azwar, 2014: 147–148).

Keterangan:

X = Skor responden

μ = Mean ideal

σ = Simpangan baku ideal

μ = $\frac{1}{2}$ (skor tertinggi + skor terendah)

σ = $\frac{1}{6}$ (skor tertinggi – skor terendah)

Based on the calculation results, it can be concluded that the module assessment criteria by material experts (Table 3), teaching materials experts (Table 4), learning device experts (Table 5), linguists (Table 6), evaluation expert (Table 7), teacher (Table 8), and students (Table 9).

Table 3. Module Assessment Criteria by Material Expert

Rentang Skor	Interpretasi
$151,95 < X$	Sangat Layak
$126,65 < X \leq 151,95$	Layak
$101,35 < X \leq 126,65$	Cukup Layak
$76,05 < X \leq 101,35$	Kurang Layak
$X \leq 76,05$	Sangat Kurang Layak

Table 4. Module Assessment Criteria by Teaching Material Experts

Rentang Skor	Interpretasi
$163,95 < X$	Sangat Layak
$136,65 < X \leq 163,95$	Layak
$109,35 < X \leq 136,65$	Cukup Layak
$82,05 < X \leq 109,35$	Kurang Layak
$X \leq 82,05$	Sangat Kurang Layak

Table 5. Module Assessment Criteria by Learning Device Experts

Rentang Skor	Interpretasi
$75,9 < X$	Sangat Layak
$63,3 < X \leq 75,9$	Layak
$50,7 < X \leq 63,3$	Cukup Layak
$38,1 < X \leq 50,7$	Kurang Layak
$X \leq 38,1$	Sangat Kurang Layak

Table 6. Module Assessment Criteria by Linguists

Rentang Skor	Interpretasi
$55,95 < X$	Sangat Layak
$46,65 < X \leq 55,95$	Layak
$37,35 < X \leq 46,65$	Cukup Layak
$28,05 < X \leq 37,35$	Kurang Layak
$X \leq 28,05$	Sangat Kurang Layak

Table 7. Module Assessment Criteria by Evaluation Expert

Rentang Skor	Interpretasi
$55,95 < X$	Sangat Layak
$46,65 < X \leq 55,95$	Layak
$37,35 < X \leq 46,65$	Cukup Layak
$28,05 < X \leq 37,35$	Kurang Layak
$X \leq 28,05$	Sangat Kurang Layak

Table 8. Module Assessment Criteria by Teacher

Rentang Skor	Interpretasi
$103,95 < X$	Sangat Layak
$86,65 < X \leq 103,95$	Layak
$69,35 < X \leq 86,65$	Cukup Layak
$52,05 < X \leq 69,35$	Kurang Layak
$X \leq 52,05$	Sangat Kurang Layak

Table 9. Module Assessment Criteria by Students

Rentang Skor	Interpretasi
$96 < X$	Sangat Praktis
$80 < X \leq 96$	Praktis
$64 < X \leq 80$	Cukup Praktis
$48 < X \leq 64$	Kurang Praktis
$X \leq 48$	Sangat Kurang Praktis

RESULT AND DISCUSSION

The result of product validation by material experts is to have a total score per indicator obtained with a total of 152, which is contained in the appropriate material indicators, namely 16, material accuracy is 28, material up-to-date is 12, the basic concept of material is 16, material systematics is 24, supporting presentation which is 16, the presentation of learning is 16, and the practice questions to develop critical thinking skills are 24. Thus, it can be concluded that the results of the material expert validation are categorized as very feasible with a score range of $151.95 < X$.

Product validation by teaching materials experts with a total score per indicator was obtained with a total of 166, namely the test was found on the model size indicator, namely 50, module content design, 93, and critical thinking skills indicator, 23. Thus, it can be concluded that the results of the validation of teaching materials experts are categorized very feasible with a score range of $163.95 < X$.

Product validation by learning device experts with a total score per indicator obtained with a total of 80, which is contained in the teaching material indicators, namely 17, the learning process is 21, assessment is 15, format is 14, and language is 13. Thus, it can be concluded that it is very feasible with score range $75.9 < X$.

Product validation by linguists the total score per indicator was obtained with a total of 56, namely there were indicators of conformity with language rules, namely 7, straightforward, namely 11, communicative, namely 21, conformity with the development of students, namely 10, and the use of terms, symbols, and icons, namely 7. Thus, it can be concluded that the results of the language validation experts are categorized as very feasible with a score range of $55.95 < X$. The results of the validation by the evaluation experts and teachers show that the criteria are very feasible.

The image shows a page from a biology module titled "MODUL BIOLOGI Berbasis Keterampilan Berpikir Kritis HINGSA PLANTAE (KASIA HINGSIAN)". It is intended for SMA/MA Class X Semester Genap. The page is divided into three main sections:

- Left Column:** Contains the module title, target audience (SMA/MA Class X Semester Genap), a logo of Universitas Muhammadiyah Palembang, and the program name: "Program Studi Pendidikan Biologi Fakultas Keguruan dan Ilmu Pendidikan Universitas Muhammadiyah Palembang 2019".
- Middle Column (PETUNJUK PENGGUNAAN MODUL):** Lists 8 guidelines for students:
 1. Pelajari modul sesuai dengan kegiatan belajar yang disediakan dan sesuai petunjuk guru!
 2. Bacalah dengan cermat setiap pernyataan dan petunjuk dalam modul!
 3. Bekerjasamalah dengan sungguh-sungguh dalam menyelesaikan tugas!
 4. Kerjakan setiap tugas dalam modul secara sistematis dan teliti!
 5. Berusahalah untuk selalu aktif berdiskusi dalam proses pembelajaran!
 6. Lakukanlah referensi dari setiap kegiatan belajar, seperti internet atau sumber lain yang sesuai dengan materi yang dipelajari!
 7. Perhatikan materi sampai tuntas sebelum beranjak ke sub bab selanjutnya!
 8. Kembalikan kembali modul setelah mempelajari atau bab agar dapat diperiksa oleh guru!
- Right Column (INDIKATOR KETERAMPILAN BERPIKIR KRITIS):** Lists six critical thinking skills with their corresponding indicators:
 - Interpretasi:** Mengelompokkan, Mempadukan Arti, Menperjelas Makna
 - Analisis:** Memeriksa Gagasan, Mengidentifikasi Argumen, Menganalisa Argumen
 - Kesimpulan:** Menarik Inferensi, Menarik Kesimpulan
 - Evaluasi:** Menilai Kredibilitas Pernyataan, Menilai Argumen, Menentukan Paksi
 - Penjelasan:** Menyatakan Hasil, Menunjukkan Proses, Menyajikan Argumen
 - Pengaturan Diri:** Pemantauan Diri, Koreksi Diri

Product validation carried out by teachers at SMA Negeri 4 Palembang as practitioners showed very practical criteria and for student responses as many as 15 people showed very practical criteria. The developed module is a biology module based on critical thinking skills on plantae material. This research is a type of research and development or Research and Development (R&D) and the module developed using the development model of 4-D (Four-D) is only carried out at the Develop stage, namely in a limited trial conducted for 15 students. At the Develop stage, it is to produce a biology module based on critical thinking skills that has been revised before field trials are carried out based on input from the validators. This is in line with the research conducted by (Bachtiar, 2013) that product revision on expert validation needs to be done before entering the product trial.

The purpose of this development is to help students to think critically in learning biology. This is in line with research conducted by (Luzyawati, 2017) the learning process of biology is one of the fields of study in the science section that is logical and critical, this is to increase efforts in advancing human thinking power. Thinking is a mental activity experienced by a person when they are faced with a problem or situation that must be solved. One of the objectives of learning biology is to teach students how to think critically.

The material presented includes the material contained in the Competency Standards. The material presented reflects a description that supports students to achieve all Basic Competencies, namely 3.8 grouping plants into divisions based on general characteristics, as well as linking their role in life. The material presented starts from the introduction of concepts, definitions, procedures, output displays, examples, questions such as activity questions and practice questions, to interaction between concepts according to the level of education in high school and in accordance with what is mandated by Basic Competence. This is in accordance with (Tamara, 2018), the right teaching material is teaching material that can help students achieve competence. In the curriculum and syllabus, teaching materials/materials will only be written in outline in the form of "subject matter". The teacher's task is to describe the subject matter, so that it becomes a complete teaching material.

This module shows that it can help students to have critical thinking skills. There are questions at the end of the chapter, there are answer guidelines, and summaries and glossaries in the module. However, there are some things that must be revised, especially in the format of writing and the questions contained in the module. At the time of learning the success of students is influenced by the teaching materials used. This is in accordance with (Ningrum et al., 2017), the success of a learning course is not only influenced by the teacher, but the teaching materials used by the teacher. In the teaching materials of the module there are also advantages of the module. The advantage of the module compared to other teaching materials is that students can learn independently without the presence of a teacher.

In addition, they can learn according to their respective abilities/speeds to understand the material being taught. The language used in the module is also simple so that students can easily understand the concepts of the material presented. In the module there are also questions for each sub-topic so that students can understand the concepts that are explained in stages. The module can also enrich students' insight because it was developed using various references (Rahmi et al., 2015).

The use of language in the module uses language rules, namely: the sentences used to represent the content of the message or information to be conveyed while still following the Indonesian grammar. The sentences used are simple and straight to the point. The terms used are in accordance with the Big Indonesian Dictionary, the General Guidelines for Indonesian Spelling and technical terms that have been standardized in Plantae science. According to Solchan in (Purnanto & Mustadi, 2016), the language in textbooks must use correct and standard language, and use standardized transliteration. Standardization is conformity with the rules of spelling, pronunciation, structure, and usage. The terms used in accordance with the Big Indonesian Dictionary are technical terms that have been standardized in the language.

This critical thinking skill-based biology module uses questions that can train students to have critical thinking skills. This is in accordance with (Mukhlisuddin, 2016), students' critical thinking skills really need to be developed for their success in education and in applying knowledge in everyday life. Critical thinking skills can be developed through the learning process. That is, in addition to learning to develop cognitive abilities for a particular subject, learning can also develop critical thinking skills (logical, analytical, creative, problem solving abilities and the ability to communicate ideas) of students in expressing ideas, applying knowledge and responsibilities.

The module is equipped with a summary that can make it easier for students to understand the material by presenting main ideas that are adapted to the learning content in the module. The presentation of the module is equipped with a glossary, this module contains a formative test that can test how far students' understanding of the kingdom Plantae material is, the presentation of the module is equipped with a bibliography, the presentation of material in the module starts from easy to difficult, this module contains questions that encourage me to think critically. This is in accordance with (Hidayat et al., 2017) that the components contained in the module include: titles, basic competencies and indicators of competency achievement, study instructions, materials, exercises, answers to exercises, summaries, formative tests, feedback, answer keys, glossary, and bibliography.

CONCLUSION

The characteristics of the product developed is a biology module based on critical thinking skills in the even semester X grade material on Plantae Material of SMA Negeri 4

Palembang by using activity questions and practice questions that are in accordance with the indicators of critical thinking skills from Facione, namely interpretation indicators, analysis indicators, conclusion indicators, evaluation indicators, explanation indicators and self-regulation indicators. The feasibility of the biology module based on critical thinking skills based on the validation of material experts, teaching materials and learning device experts, linguists, evaluation experts, and teachers as learning practitioners stated that this module was "very feasible" to use. The practicality of biology modules based on critical thinking skills based on student responses can be categorized as very practical.

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