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Module Based on 5e Learning Cycle to Train Critical Thinking in Circulatory System Concept

Nugraheni Ngesti Rahayu[1]✉, Rindi Novitri Antika[1], Nizkon[2]

Biology Education Department, FKIP, Universitas Muhammadiyah Palembang, Indonesia

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Abstract

This study aimed to 1) Know the module product description based on 5E learning cycle models developed to train critical thinking skills, 2) Know the feasibility of modules based on 5E learning cycle models on the circulatory system material designed to train students critical thinking skills. This research was done by research and development according to Borg and Gall (2003) which was limited to step 7. The data analysied by descriptive qualitative and quantitative data analysis. Qualitative descriptive used to process the overall questionnaire assessment data in the form of opinions and suggestions from the material expert validators, media experts, linguists, evaluation experts, education practitioners (biology teachers) and XII science students. Quantitative descriptive analysis was used to analyze the assessment scores of the respondents regarding the feasibility of the module. Based on the results of the validation by experts, the validation of material experts got 74,96% with good qualifications, data from the presentation or media validation results got an average of 74.49% with good qualifications, language validation got an average of 79.37% with good qualifications and evaluation validation got an average of 74.76% with good qualifications. Validation by educational practitioners got an average of 86,66% with excellent qualifications and validation by students got an average of 88,46% with good qualifications. Based on the overall percentage, it could be concluded that the module was feasible to use.

✉correspondence:
Jl. Jend. Ahmad Yani 13 Ulu, kec. Plaju, Kota Palembang
Sumatra Selatan. Telp. (0711) 513022 , Palembang 30116
Email : nugraheningestirahayu28@gmail.com

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INTRODUCTION

Challenges in the era of knowledge that are increasingly dynamic, developing, and increasingly advanced require human resources who have high intellectual skills. High intellectual skills are characterized by logical, systematic, critical, careful and creative reasoning skills and have good attitude competition in communicating ideas and solving problems. Intellectual ability, especially high-level thinking skills (higher-order thinking) is a need as a reliable workforce in the 21st century.

Critical thinking skills are one part of the skills demanded in the 21st century. Critical thinking skills play a role in equipping students to deal with problems effectively in the future. Critical thinking also plays an important role in the learning process, critical thinking is able to help students explain, analyze, interpret, evaluate, and conclude material and learning problems, so that student learning outcomes can increase.

However, the fact is that students' critical thinking skills in Indonesia are still low. Based on the results of the PISA study, critical thinking skills in Indonesia are ranked low from year to year. The average Indonesian PISA score, in 2012 ranked 64th out of 65 countries (Organization for Economic Cooperation and Development, 2014). In 2015 Indonesia experienced an increase but did not change the position of Indonesia from a low position that is ranked 62 out of 70 countries (Organization for Economic Cooperation and Development, 2016).

The low level of critical thinking skills of students is also seen in Lalan 2 Public High School. Based on the results of the initial needs analysis by giving a test of critical thinking skills made by Prayitno (2014) with the development of questions that refer to Facione's aspects of thinking, the average results for the interpretation aspects were 76.92% with high categories, 50.42% analysis aspects with categories low, 63.24% evaluation aspects with low categories, 22.22% conclusion aspects with very low categories, 4.27% explanatory aspects with very low categories, and self-regulating aspects 58.11% with low categories. Overall the results of tests on students showed that students' critical thinking skills were still included in the low category.

The low level of critical thinking skills can be caused by several things including the not optimal learning model applied in learning, media, facilities, teaching materials, and others. Based on the results of interviews and filling out questionnaires by teachers, biology teachers at Lalan 2 High School applied demonstration learning models in teaching and learning activities, but according to the teacher not all learning materials could use demonstration learning models. So to overcome this the teacher applies learning methods, namely lecture, discussion and question and answer method. Test questions given by the teacher are also still at levels C1, C2, and C3 or can be said not to include categories that require high thinking so students' ability to think critically still not enough.

Besides being caused by the problems mentioned above, the problem of critical thinking in students is caused by several things, one of which is teaching materials that have not been able to develop students' thinking skills in a comprehensive and integrated manner. Problems with teaching materials also occur in Lalan 2 Public High School through interviews with teachers and students at Lalan 2 Public High School. Students mentioned that the teaching materials used for biology learning were in the form of package books and were still very few. Teaching materials that are mostly used today are not specific to optimize students' critical thinking skills. Improving students' critical thinking skills can be developed through modules,

models, learning media and facilities and infrastructure in schools. One that has the potential to develop students' critical thinking skills is to develop module-based teaching materials. Modules that fit the problem are modules that can help students construct. Based on constructivism theory, knowledge must be constructed by students themselves, so learning is an active process carried out by students. Constructivist modules can be facilitated by integrating constructivist-based models as well. There are many learning models that can be chosen in learning activities. One consideration in choosing a learning model is that students can take an active role in learning

The development of module teaching materials by integrating the model can be done by using the 5E learning cycle model. Preparation of modules compiled based on the 5E learning cycle model aims to enable students to learn according to their learning styles, so that students will feel happy and interested in learning which results in increased learning achievement. Modules with the 5E learning cycle model have the advantage of directing students' thinking from simple things to more complex ones, which then connects knowledge into everyday life phenomena.

The stages of 5E learning cycle learning proposed by Lorsbach (2002) in Agustyaningrum (2011) are as follows. Engagement (inviting), in this phase, the teacher seeks to arouse interest, encourage thinking skills, and help students access the initial abilities they already have. Exploration, in this phase students are allowed to work independently or in groups to test their hypotheses through activities such as lab work and literature review. Explanation (explaining), at this stage students explain the concepts of their group's findings in their own words, show evidence and clarification of their explanations, and compare the arguments they have with arguments from other students. Elaboration (application / application of concepts), at this stage students apply the concepts they have to new situations through activities such as advanced practicum and problem-solving. Evaluation (evaluation), in this phase is used to evaluate the learning experience that students have gained and reflection to do a further cycle, which is for the next learning process.

The selected module material is the circulatory system. The selection of the circulatory system material is based on the results of the national examination (UN) in the 2015/2016 school year of SMA 2 Lalan students seen through the Pamer 2016 application made by the Ministry of Education and Culture, the UN results show that in the "circulatory system" material, the average Student scores are still low at 48.53% for the national level, for the Provincial level 36.32%, for the City / Regency level which is 23.89%, and for the school level which is 33.33% (Puspendik, 2016). The low level of critical thinking skills of students, especially in the circulatory system material indicated by the results of the analysis of UN scores is also supported by interviews with students in Lalan 2 Public High School. It can be seen that students generally still have difficulty understanding biological material, especially in circulatory system material. . This is because the circulatory system material consists of complex material and many sub-discussions.

Based on the background described above regarding the students 'low critical thinking skills, the authors then conducted a study entitled "Development of a 5E Learning Cycle Model for Developing Students' Critical Thinking Abilities in Circulatory System Material".

RESEARCH METHOD

This study is a research and development that uses research procedures and development according to Borg & Gall which are limited to 7 stages, namely: The procedures for research and development that are carried out are: 1) the research and information collecting stages which are the needs analysis phase including literature studies and field studies. 2) Stage of planning (planning) to design the module / initial product by determining the indicators and KD to be used then making the module matrix. 3) The stage of developing the initial product design (develop a preliminary form of product) is to make the module in accordance with the plan. 4) The initial product design validation stage (preliminary field testing) is carried out by an expert validator. 5) Product revision stage as a result of design validation (main product revision) as the first product revision. 6) Limited field testing stage (main field testing) is carried out by education practitioners and students as small groups. 7) Second product revision phase after operational product revision.

RESULTS AND DISCUSSION

Module Products Based on the 5E Learning Cycle Model in the Circulatory System Concept

The module based on the 5E learning cycle model on circulatory system material was developed according to the modified procedure of Borg and Gall into seven stages. The module aims to train students' critical thinking skills. The module based on the 5E learning cycle model was developed based on the results of book analysis in schools which showed that content (objectives, material, activities, and evaluation questions) did not fully meet the six aspects of critical thinking, so teaching materials needed to support the fulfillment of six aspects of critical thinking This aspect of critical thinking used, namely the aspect of critical thinking according to Facione (2011) includes aspects of interpretation, analysis, evaluation, conclusions, explanations, and self-regulation.

To improve students' motivation and learning achievement, there needs to be a strategy that is able to develop students' ways of thinking to construct students' knowledge. These strategies include using modules. The module is expected to be a vehicle for channeling messages or learning information that stimulates thoughts, attention, interests, so that the learning process occurs (Lusia, 2013). Also, the module is used as a solution because it has a series of systematic activities that accommodate critical thinking skills in learning through specially designed instructions and practices. Modules can improve students' critical thinking skills if the contents of the module are able to encourage students to think of analyzing or evaluating information (Wijayanti, 2016).

A literature study was also conducted on the learning model of learning cycle 5E. The selection of the 5E learning cycle model because this model is one of the models developed in constructivist learning. Based on constructivism theory, knowledge must be constructed by students themselves, so learning is an active process carried out by students. Module compilation based on the 5E learning cycle model aims so that students can learn according to their learning style and act actively, so that students will feel happy and interested in learning which results in increased learning achievement. Modules with the 5E learning cycle model have the advantage of directing students' thinking from simple things to more complex directions, which then connects knowledge into everyday life phenomena. This learning model

suggests that the learning process involves students in active learning activities resulting in the process of assimilation, accommodation, and organization in cognitive structures (equilibration). The 5E learning cycle model connects students' initial knowledge to form new experience through several stages namely engagement (arousing interest and curiosity), exploration (exploration), explanation (concept explanation), elaboration (application of concepts), and evaluation (evaluation) (Lusia , 2013). Modules used by developing five stages in the learning cycle model are expected to facilitate students' understanding of concepts in the text, communicative illustrations and make it easier for students to associate theories and concepts with problems that occur in everyday life. The application of learning with modules based on the learning cycle model will make it easier for teachers to organize learning by activating students in learning. Through a series of activities in the module based on the learning cycle model, students will more easily construct the knowledge (cognitive) that they obtain through practical activities and discuss to share information so that student achievement will increase.

The results of the national exam (UN) analysis in the 2015/2016 school year of SMA 2 Lalan students showed that mastery of the "circulatory system" material, the average score of students was still low, reaching only 33.33% for the school level, percentage mastery of the material general circulatory system issues are also still very low, namely 36.32% for the provincial level, for the City / Regency level namely 23.89%, and 48.53% for the national level (Puspendik, 2016). So based on the results of the UN analysis circulatory system material was chosen, because the percentage of student mastery was low on this material. This module is expected to be able to develop students' understanding of circulatory system material.

Module products based on cycle 5E learning models are developed based on basic competencies3.6 which states "*analyze the relationship between the structure of tissue composing organs in the circulatory system and linking them with bioprocesses so that they can explain the mechanism of blood circulation and function disorders that may occur in the human circulation system through literature studies, observations, experiments, and simulation*". In addition to basic competence of 3.6, modules are also developed based on basic competencies 4.6 which states "*Presenting the results of analysis of data from various sources (literature studies, observations, experiments, and simulations) abnormalities in the structure and function of blood, heart and blood vessels that cause disruption of the human circulatory system and system related technology circulation through various forms of presentation media.*

The module product based on the 5E learning cycle model has advantages compared to the modules in the school because the content (objectives, material, activities and evaluation questions) of the module has a percentage of fulfillment of aspects of critical thinking. Indicators of aspects of critical thinking skills are accommodated through activities in the module which are guided by the syntax of the learning model cycle 5E.

The systematics of the module content also prioritizes student activities guided by the syntax of 5E cycle learning model that is placed before the material description with the aim that students will be more active and construct knowledge effectively. The material description is placed in the order of activities so that students are easier to understand each important point that must be mastered by students. Each sub-chapter of the material will be given a practice exercise to measure students' abilities after learning the material.

Student activities in the module include five stages of activities namely engagement, exploration, explanation, elaboration, and evaluation. The first activity is engagement

(building a concept), in this section the activities in the module are designed to generate interest in student learning, encourage thinking skills, and help students access the initial abilities they already have. Interest in learning plays a very important role in learning and has a very large impact on student attitudes and behavior. This section contains a phenomenon presentation in the form of articles relating to the material or in the form of questions that allow students to activate the initial scheme / old knowledge about concepts related to learning. The aim is to help students recognize and clarify their own understanding and ideas. The questions presented will encourage students' interest in learning to understand learning material and analysis skills arise (analyzing questions related to the circulatory system that are presented) and interpretations (interpreting and giving their views on a problem) within themselves.

Exploration (digging), in this section students are allowed to work independently or in groups to test their hypotheses through activities such as lab work and literature review. After conducting the experiment students will be able to conclude the results of the experiment and the discussion that was conducted. This is in line with the research conducted by Latifa (2017), in his research after applying the 5E learning cycle model, there was an increase in conclusions at the exploration stage. Increasing the ability to infer (inference) can also occur at the exploration stage because experimental or practical activities can lead students to do inference at the end of the experiment.

Explanation (explains), this section is adapted from the syntax of the third 5E learning cycle learning model. At this stage students are encouraged to explain the results of the experiment at the exploration stage and also concepts that are being studied with their own sentences such as through presentations so that at this stage it can lead to explanatory aspects in students. This is in accordance with Sari's opinion (2013) which states that the explanation stage raises students' critical thinking skills, namely in terms of explaining, students are able to explain the topics they have understood by providing clarification in the form of relevant facts and data. In the process of explaining students will be critical in reinforcing to maintain what they have discussed and given a conclusion to what they have explained.

Elaboration (application / applying concepts), learning activities in this section students develop concepts that they already have through new learning experiences so that understanding students' concepts becomes more meaningful and broad. According to Prayogi (2013), through new learning experiences students can build deeper and broader understanding, obtain information, and skills. Critical thinking skills that can be raised in the elaboration stage are training students to apply concepts that are understood to a real situation. Students apply their understanding of certain concepts by conducting additional learning activities such as additional practicums and discussions.

Evaluation, this section is an adaptation of the fifth syntax of the 5E learning cycle learning model, used to evaluate the learning experience that students have gained and reflection to do a further cycle, which is for the next learning process. Students in this section must work on questions in the form of essay-based indicators of critical thinking according to Facione (interpretation, analysis, evaluation, conclusions, explanations, and self-regulation) that are presented, this activity is an individual responsibility, so that students are not allowed to help each other.

At this stage students are encouraged to assess their understanding and abilities. Students are guided independently to examine the answers to the questions that have been done by looking at the answer keys that have been provided so that students are expected to be able to

regulate themselves by measuring their understanding of the learning material through the problem assessment column provided.

Feasibility of Modules Based on the 5E Learning Cycle Model on Circulatory System Material

The feasibility of the module based on the 5E learning cycle on circulatory system material was tested through expert validation stages, practitioner assessment, and students as a small group of field users. The results of expert validation indicate that the module is in accordance with the objectives developed because it is qualified according to material experts, design experts or presenters, linguists or legibility, and evaluation experts, but requires some improvements according to the advice of each expert through the first phase revision module. (what thing is revised in this phase? Content? Picture? Etc?

Based on the results of the validation it was concluded that the module based on the 5E learning cycle model is feasible to use because it is well qualified. The results of the validation obtained are as follows.

Table 1. Recapitulation of Module Validation By Validators

No	Aspect	Percentage of Score (%)	Qualification
1.	Material Expert	74,49	Good
2.	Media Expert	74,49	Good
3.	Linguist	79,37	Good
4.	Evaluation Expert	74,76	Good
	Average	75,77	Good

The percentage of expert validation results in Table 1 shows that material validity, module presentation, readability / language, and module evaluation questions based on 5E learning cycle models on circulatory system material indicate that module products are feasible because the average validation results are good with a percentage 75.77%. The results of expert validation indicate that the feasible module products to be continued in the field test are limited, this is seen from the results of validation by experts, such as by material experts at an average of 74.96%, data from presentation or media validation results obtained on average 74.49%, language validation obtained an average of 79.37% and evaluation validation obtained an average of 74.76%. But still need some improvements according to the input from expert validation. Module assessment is also carried out by education practitioners (biology teachers) and also students as a small group test (module users), module assessment by small groups is carried out by 30 students of class XII IPA. The results of validation by teachers and students can be seen in the following table.

Table 2. Module Validation By Educational

No	Aspect	Percentage of Score (%)	Qualification
1.	Educational practitioner (teacher)	86,66	Very Good
2.	Student	88,42	Very Good
Average		87,54	Very Good

The results of the assessment of education practitioners and students as a small group of module users indicate that the results of the first revised module are in accordance with the

objectives developed because they are very well qualified. According to the average education practitioner is 86.66% and the average student is 88.42%

CONCLUSION

Module products developed have five stages of activity according to the syntax of the 5E learning cycle model that students must do, namely the stages of engagement, exploration, explanation, elaboration, and evaluation. The results of module validation by experts indicate that the circulatory system module based on the 5E learning cycle model is well qualified. Validation results by experts, such as by material experts in getting an average of 74.96%, data from the presentation or media validation results obtained an average of 74.49%, language validation obtained an average of 79.37% and evaluation validation was obtained an average of 74.76%. This means that the module has met the criteria and is feasible to proceed to the limited field testing stage. The results of the assessment of education practitioners and students as a small group of module users indicate that the results of the first revision are in accordance with the objectives developed because they are highly qualified with an average according to education practitioners which is 86.66% and the average student validation results are 88.42 %.

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