



The Improvement of critical thinking skill by using Flipped Classroom based E-module on circulation system material for the students at senior high school

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ABSTRACT

The improvement of students critical thinking skill can be carried out in using innovative teaching material to achieve competence acquired. The aims of this research is to know the appropriateness accuracy, and effectiveness of flipped Classroom based E-module on circulation system material at XI SMA. The researcher uses R & D methodology with ADDIE development model through the stages. *Analysis, design, development, implementation and evaluation* The research subject is from the material scholars and media scholars. The instrument that used in this research are questionnaire, data analysis, that uses *Likert scale*. The results of this research indicates that the product is appropriately used to based on the material scholars and media scholars with the number is 97,91% (very appropriate) and the assessment of media scholar with the number 91,25% (very appropriate) based on the biology teacher assessment that E-Module is practical to use it with the number 100% (very practically) and the results of test little scare with the number 89,06% (very practical), and effective to improve students critical thinking skill based on *N-gain* score with 0.58 score.



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Introduction

Education is the things that should be acquired for every individual to develop the competence. As the development of knowledge quickly, obliges the institutional education to always do an innovation to increase its integrity. The education aims to construct a better individual character based on law. 2013. 20 concerns the national educational system argues that the educational system is a conscious and

throughout effort by the students to create learning atmosphere and learning process, so that they can develop their capability for themselves, and the students also can have religious spiritual forces, self control, personality, intelligence, and noble character and skill required by themselves, society, nation and country.

In 21st century is mentioned as the globalization era so that it can give the various aspect of life. (Wijaya et al., 2016) in the 21st century as the globalization era, an education must be able to prepare the

students so that they can have a skill to deal with the feature. There are several skills that should be required by the students are critical thinking competence, creative, innovative, collaborative skill, and communication. In 21st century the students are required to train their critical thinking competence. (Sumarni & Kadarwati, 2020). Critical thinking skill is very important had by the students (Darmaji et al., 2022). The development of science increases rapidly, so that it makes easier to create interesting learning conditions. The technological development in the word, education can facilitate learning activities when developing, processing, and presenting material (Komikesari et al., 2020).

In 2013' curriculum has a learning concept which demands teacher' creativity in teaching and learning activities. Creativity is being able to innovate and be creative in designing meaningful learning models for the development of the students' critical thinking skill using method, learning model resources, teaching material and learning. According to (Ramdani et al., 2020), lacks of modification to implement learning model in the classroom can result uninteresting learning. When learning process takes place, the teachers have a major role of learning activities in the classroom, so they can create a learning activities efficiently.

When a learning process takes place, the teachers dominate which conveyed to the students, so that the students can understand the material clearly. The activities of the educational situation which involve the teacher and students to achieve the learning goal. Based on the indicator. When the learning takes place, the students can construct the material which have been learned and associate the experience event and truth. (Irfan et al., 2019). Biology is a science that studies the relationship between living things and nature. Biology contains the truth, concept and relationship between suitable concept.

Learning process in the classroom is not detached from the problem. The appearance of the paradigm in learning context has an impact in learning aspect. One of the way is development of teaching material that integrates with technological development, innovative technology based learning, which

encourages the students to be more active when participating in learning activity. (Coşkun et al., 2019). The teacher holds important role in utilizing the teaching material to fulfill the character learning. Teaching material is one of the important guidance to the teacher when learning process takes place, but some of the teachers only use the book.

The interview with the biological teacher at SMA N 1 Bumi Raya in central Sulawesi province. The information that acquired is low of students critical thinking. It is indicated that a lack of optimal daily test score of the students particularly on circulation system material is more than 50% score still do not fulfill the minimum competence (KKM). It is because using the teaching material which is not interesting, and the students are less engagement in learning activities. As the effect that the students feel that they do not have fully understand the material that provided by the teacher. Based on the analysis students need, the method is used less varied and there are limited in supporting teaching material when the learning takes place. The students want to module based electronic as the teaching material. Some of the things above are the cause factor of the students have a lack of enthusiasm when they participate in learning activities in the classroom. It has an impact in learning process which is not optimum and learning outcomes influences low a critical thinking. Critical thinking is the skill to solve the problem in life. (Hidayat & Sari, 2019) state that critical thinking is very important to solve the problem in life.

According to research (Santika et al., 2018) conducted in one of high school in Subang city. It indicates that as many as 73% of the students have low a critical thinking skill and 27% of the students have a low critical thinking skill, so it is really needed an innovation when learning is carrying out, it can improve learning outcomes particularly for critical thinking skill at high school level (Zuhra et al., 2021). The critical thinking skill is one of the main prioritize to solve the problem, reasoning, generating conclusion through induction and deduction, and making an assessment (Arsal, 2017). According to (Sugianto et al., 2017) critical

thinking skill is a skill to interpret and evaluate.

The interview results and need analysis, information is obtained that is very important to develop teaching material to help the students' improvement for their critical thinking. The selection and use of teaching material to solve the problem, is teaching material which easily understood and there is an evaluation which can improve students understand. The teaching material which can fulfill the requirement students need are E-module based flipped classroom on circulation system material which can improve students critical thinking Depdiknas, 2008 E-Module characteristics include self instruction, , Self Contain, Stand Alone, Adaptive, User Friendly.

An E-Module is a teaching material which is arranged systematically to achieve the indicator learning. The form of its presentation based on E-Module, and there are video, picture, audio that interesting and suitable with material. An E-Module is a teaching material that is arranged systematically with the form of electronic which can facilitate the students access anywhere and anytime As the research is from (Hung et al., 2019) states that a school in China indicates that the use of Flipped Classroom is be able to improve critical thinking skill and student learning motivation (Fulgueras & Bautista, 2020) indicates that flipped classroom is able to improve critical thinking skill and the level of students literation understanding This research is to look the ability of thinking openly with several idea based on the fact. The learning which focus on the students are be able to improve the critical thinking skill (Agustini & Suyatna, 2018). The use of flipped a classroom can improve students performance (Tune et al., 2013)

E-Module is viewed as the facilitate to study independently. And prioritize the technology advance. E-Module is one of the device which can encourage the learning process (Sumiati et al., 2018). the benefit of E-Moule as a teaching material is more interesting, interactive, and can be accessed anywhere and anytime. Then it can improve the learning process. The teacher can share the material as well as synchronous and asynchronous (Cari et al., 2022). E-Module

based a flipped classroom is the learning which minimize a direct learning, but maximize indirect learning. By supporting the material which can be accessed anytime by the students. Flipped Classroom is interpreted as a learning method which Flipped learning model (Wijaya et al., 2022). Based on the problem that occurs, so the researcher needs to develop flipped classroom based E-Module which can improve the students critical thinking at the students eleventh grade at Senior high school)

Method

This research is the development research as known as research and development (R & D). According to (Sugiyono, 2014), this method will obtain the certain product, including the effectiveness test of the product. The development model that used is ADDIE (Analysis, Design, Development, Implementation, and Evaluation).

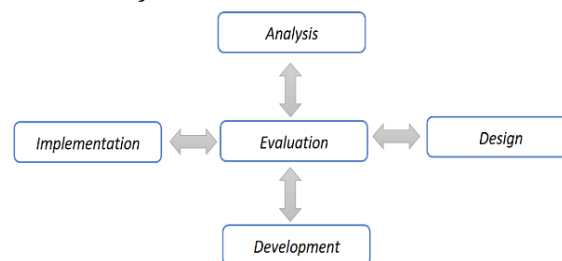


Figure 1. Plot ADDIE

This research is carried out in 2023 of July to September SMA N 1 Bumi Raya as the located of research is in Morowali, central Sulawesi province. The population of this research is the students on eleventh grade at senior high school. The subjective text is the students on eleventh grade of Mathematics and Natural Science (MIPA) with the number of 26 students. The experimental research uses flipped classroom based E-Module However the control class uses the book which general used at the school. The small scale test is 10 students and wide scale test is 26 students.

The data of research required which can be required from observation technique, interview, questionnaires, instrument validation, the instrument test of critical thinking ability, and documentation. Subject

validation are consist of the scholars. (material and media), biology teacher assessment. Research data are from scholars and teacher are qualitative data as the suggestion of product improvement, and quantitative is questionnaire score test by using an instrument.

The development phase of the flipped classroom based E-Module on circulation system material as follows.:

The first phase is analysis to keep a teaching material' need is flipped classroom based E-module , so it obtains some of ideas about the development of teaching material. Analysis stage is: need analysis, product, curriculum, material and students.

Designing stage is done to design the product this phase designs based E-module framework based flipped classroom in circulation system material. Any aspect which is designed such as audiovisual, layout, picture and video that support the material so that the display of the product is attractive. The attractive display is an available to give visual stimulation, so the learning process is more meaningful. (Idris *et al.*, 2018) indicates that the teaching material with audiovisual can create environmental learning compulsively. To arrange the lesson plan or syllabus, and arrange the devices of the evaluation (questionnaire and instrument) which will use in this research.

The development phase aims to produce which is appropriate, practical used for the students. Validation Product with material scholars that consist of the appropriateness aspect. Material presentation, and language. Validation Product with media' scholar that consists of the communication visual aspect, display quality, ease of operation, application reliability, and illustration (image and video). Biology teacher assessment includes material/content, language, media, and learning. The test of flipped classroom based E-module to determine its implementation and feasibility use.

The research instrument is validated by material scholar, media scholar, and practitioner, use a Likert scale. An acquisition score is converted into percentage and categorize based on the range of feasibility product scale. The initial

analysis used based on the score which refers to the formulation as follows:

$$M = \frac{\sum fx}{N}$$

Information

- M = average per aspect
- $\sum fx$ = The number of score per aspect
- N = The number of component

Table 1. Criteria scale and Likert Scale assessment

Scale	Assessment Category
1	Very lack/ Very disagree
2	Lack/Disagree
3	Good / Agree
4	Very good /Very agree

Source : (Sugiyono, 2017)

After the researcher acquires the average per-aspect, next, converted the average score to 100 score by using the formulation:

$$\text{The score per-aspect} = \frac{\text{Average score}}{\text{maximum score}} \times 100$$

Next, to interpret the appropriateness score category and practical product which conveyed by (Riduwan, 2010).

Table 2. the appropriateness score category and practical product

Score	Category
81-100	Very appropriate
61-80	Appropriate
41-60	Enough
21-40	Lack of appropriate
≤ 20	Very lack of appropriate

(Source : Riduwan, 2010)

The *implementation* phase aims to achieve the result from product development which can improve a critical thinking skill. Small scale phase is the test that carried out by 10 students to discover an initial data of readability product. This phase is carried out to analyze the effectiveness to improve students critical thinking skill, practicality and response from eleventh grade in senior high school (XI SMA) to the use of flipped classroom based E-module which has been

developed on the wide scale test includes the actual test which is 26 students.

In this phase. *N-gain* score is one of the formulation that uses to analyze. It aims to know the progress of students critical thinking Hake, (1998) classifies

The criteria to improve students critical thinking skill by using the formulation as follows:

$$g = \frac{Sf - Si}{Smax - Si}$$

g = normalize gain score

Sf = post test score

Si = pre test score

Smax = maximum score

Table 3. Interpretation criteria in *n-gain*

No.	Score	Criteria
1	$g > 0,70$	High
2	$0,30 < g \leq 0,70$	Medium
3	$g \leq 0,30$	Low

Source : (Hake, 1998)

The *evaluation'* phase aims to know students response and an appropriateness acquired based on the scholar's assessment, teacher and students on small scale test and wide scale. In the next phase is carried out an evaluation so that the researcher knows the lack of product, then the researcher carries out the revision based on the evaluation results.

The results and Discussion

This research has the initial phase is need analysis, and technique to collect data with interview, and distributing questionnaire to the educator, students, class observation and literature study to determine the problem in the classroom. Interview with the biology teacher is acquired the information that in 2013 curriculum particularly on the biology lesson has not been suitable expectation, after the researcher observes and the teaching material which is used actually still has not been fulfilled the purpose in 2013 curriculum KD. 3.6 dan 4.6 Then basic competence is carried out indicator achievement of the competence which is used as fundamental development of *flipped classroom* based E-module. During learning

process takes place that the students still lack of engagement because of the method that used such as lecture, and the students are difficult on circulation system material, so need the guidance.

In *designing* phase is carried out by lesson plan is a flipped classroom based E-module and the project that required in the form of circulation system material, the resource which used based on the book and journal. a design of research instrument as follows designing the paper assessment in material scholars and media scholars, and biology teacher's assessment and students' readability sheet in the test phase, then the test is carried to determine critical thinking skill and students' response sheet on wide scale trial. Designing E-module based *Flipped Classroom* used Canva application, google form, and live worksheet.

The design of product development design is designed in such way as to become interesting and easy to understand. This product contains attractive image. The product design includes front and back cover and other sheet. E-module is arranged systematically so that the students can be easy to study. The research instrument which is used to collect data are validation sheet questionnaire, interview, and test of the students' critical thinking skill as the example the design product which is developed.

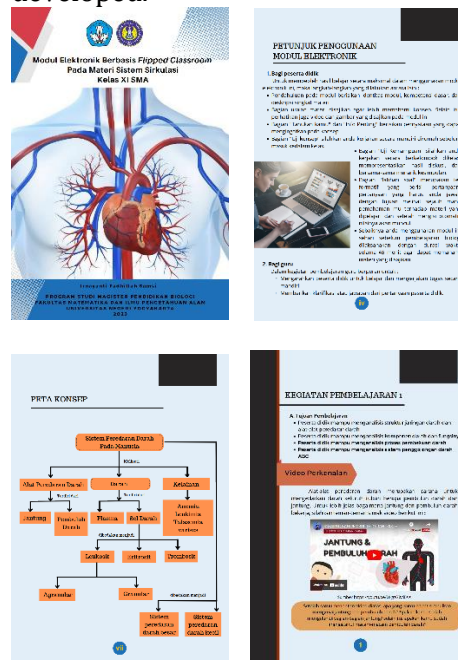


Figure 2. The example of content design an E-module based *Flipped Classroom*

The development phase consist of product validation which engages material scholar and media scholar, biology teacher and product testing. The instrument sheet of this research is validated by material scholar, to determine the product which will be used. The assessment which done by the material scholars including several aspects as follows an appropriateness aspect, material presentation and language.

Table 4. The validation result of material scholars

No	Aspect	Score	category
1	Appropriateness	93,75	Very appropriate
2	Material presentation	100	Very appropriate
3	Language	100	Very appropriate
Average		97,91	Very appropriate

Table 4 indicates that the average is 97,91 score with criteria "Very appropriate" it indicates that the product which is developed is appropriate used. Then material scholars give a suggestion before the product is tested. The material in E-module is added narration which related to the picture explanation, adding the picture or video on circulatory system disorder abnormalities. The revision has been done until the scholars consider that there is no need revision.

The appropriateness of the product which will be developed, given the assessment by the media scholars. The aspects that given the assessment by the media scholar is the aspect of visual communication, display quality operation, application reliability, illustration (images and videos).

Table 5. the validation results from media scholars

No	Aspect	Score	Category
1	Visual communication	100	Very appropriate
2	Quality display	100	Very appropriate
3	Operation	81,25	Very appropriate
4	Reliability application	87,50	Very appropriate

No	Aspect	Score	Category
5	Illustration quality (picture and video)	87,50	Very appropriate
Average		91,25	Very appropriate

Table 5 indicates that the average is 91,25 score with criteria "Very Appropriate" it indicates that the product is very appropriate used. Then the media scholar gives the suggestion before the product is tested. The suggestion that given by the media scholar. revised in several parts of aspect. The picture and video should attach the resource. Revise in concept map and bibliography use the journal. The revision is done until the scholars assume that there is no need the revision.

The biology teacher aims to know the practicality of E-module based *Flipped Classroom*. The biology teacher assessment as follows: material aspect, language aspect, media ad learning aspect.

Tabel 6. The result of biology teacher assessment

No	Aspect	Score	Category
1	Material/content	100	Very appropriate
2	Language	100	Very appropriate
3	Media	100	Very practical
4	Learning	100	Very practical
Average		100	Very practical

Table 6 indicates the average 100 score with the criteria "very practical" it indicates that the module which developed is practical, there is a suggestion from the biology teacher to revise the sentence spelling in the module. The revision is also done in E-module based *Flipped Classroom*.

The assessment of readability product in E-module based *Flipped Classroom* on circulation system material by 10 students. Every students give the response to the structure aspect, language aspect and content aspect.

Table 7. The assessment result of readability product in the Flipped Classroom based E-module

No	Aspect	Score	Category
1	Structure	89,50	Very practical
2	Language	89	Very practical
3	Content	90,50	Very practical
Average		89,66	Very practical

Table 7 indicates that the average are 89, 66 with the criteria “very practical” it indicates that the *flipped Classroom* based E-module product can be tested on wide scale.

The product includes flipped classroom based E-module declared that appropriate and practical by the scholars. The small scale result is declared that appropriate, so the product can be tested on wide scale.

in the *implementation* phase is the activity that obtained from the result of learning implementation. The wide scale aims to assess and see the Flipped Classroom effectiveness based E-module which developed. Based on its effectiveness in learning, E-module is very beneficial because it can give a learning outcomes, and the students are active to interact. The result of wide scale, flipped classroom based E-module product on circulation system material which number of 26 students including easily used and attractive display.

Table 8. the assessment result of the product practicality in E-module based *flipped classroom*

No	Aspect	Score	Category
1	Ease of understanding material	89,25	Very practical
2	Ease of use	87,25	Ver practical
3	Attractive display	89,25	Very practical
Average		88,58	Very practical

Table 8 indicates that the average scores are 97,91 with the criteria of 88,58 with the criteria every aspect has the number of scores which show very practical

On the other side. The use of *Flipped Classroom* based E-module as the biology

teaching material on circulation system material can improve the critical thinking skill for the students on eleventh grade at high school. The critical thinking skill is analyzed by statistic. descriptive

Table 9. Data comparison of critical thinking variable

Analysis	Class experiment		Class control	
	Pre test	Post Test	Pre Test	Post Test
A number of sample	26	26	26	26
Total score	1170	2012	962	1724
Standard deviation score	8,47	4,92	10,02	6,68
lowest score	34	68	20	54
Highest score	66	88	52	80

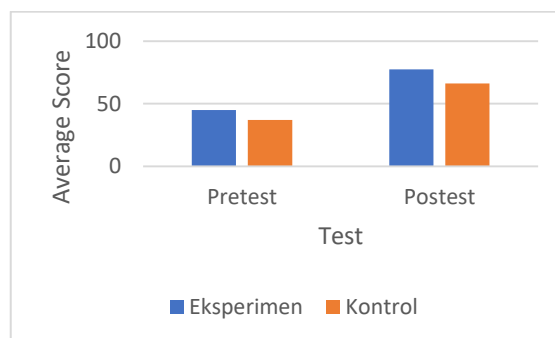


Figure 3. Comparison graph of average critical thinking skill score.

Table 10. *n-gain analysis score*

Class	Average score		n-gain score	Criteria
	Pre test	Post test		
Experiment	45	77,3	0,5	Medium
Control	37	66,3	0,4	Medium
		0	6	

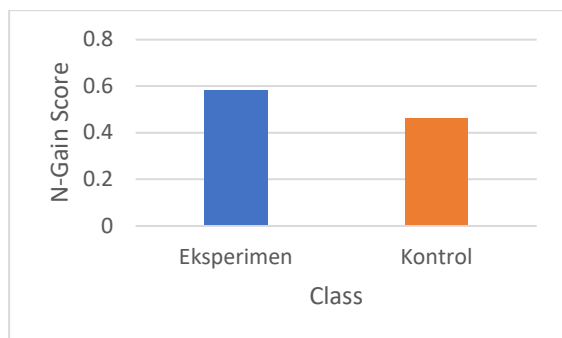


Figure 4. Graph *n-gain* score.

Figure 4 is acquired the information that there has been improvement I critical thinking skill. The improvement in critical thinking skill in the experimental class is higher as seen from *n-gain* score is 0,58 (medium). The improvement of critical thinking skill in control class due to the influence of using an *flipped classroom* based E-module. Putri & Aznam, (2019) *Flipped Classroom* based E-module can stimulate critical thinking skill holistically and systematically, so it can improve critical thinking skill.

Conclusion

The development of E-module based flipped classroom on circulation system material is categorized as valid because it has passed through the appropriate test. is an average appropriateness of E-module by material scholar and media scholar achieved 97,91 and 91,25. With very feasibility category.

The flipped classroom based E-module on circulation system material is implemented practically with very practical category which acquired from the biology teacher assessment and students response. The use of the flipped classroom based E-module on circulation system material can improve students' critical thinking skill.

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