Original Research Article

Developing a weblog-based additive and addictive substance teaching module to improve critical thinking skills

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ABSTRACT

This study aims to develop and obtain a webb-based teaching module on the material of additives and addictive substances. Also to determine the feasibility of the module, improvement think critical students, knowing which is better, learning using developed modules or existing books and to find out students' responses after being taught with the module substance additives and addictive based webb developed. The research method with R&D using the ADDIE model. The Webb-based teaching module was validated by 7 validators, then the valid module was presented to 20 students as a limited trial. The subjects of this study were 2 classes of class VIII students of Junior High School 8 Binjai, each class consisting of 28 students. The test instrument consisted of 15 critical thinking questions and non-test instruments in the form of BSNP questionnaires and student response questionnaires. The results of the study showed that the webb-based learning module on the material of Additive and Addictive Substances developed was categorized as Valid at a validity of 3.4 or an average percentage of 85%. While the results of the n-gain test were 82% in the experimental class with a high category and 73% in the control class with high category. t- test results shows that critical thinking skills student which using module teach based on webb which has developed more higher than the critical thinking skills of students who are taught using books package which exists at school. Results of student response questionnaire analysis show that student give response positive as big as 86%. Thus, the webb-based teaching module developed is ready to be used in learning the material on additives and addictive substances in food in order to improve students' critical thinking skills.

Introduction

Indonesia has introduced a curriculum in 2013 called the Indonesian national qualifications framework which is intended to meet the requirements of industry 4.0 (Habók & Nagy, 2016). Learning innovation is very appropriate to facilitate learners to learn optimally, improve learning memory, and make learning more effective and efficient in junior high school country 8 Binjai still uses the revised K-13, which give opportunities for students to develop all their potential which owned, good aspect attitude (affective), knowledge (cognitive) as well as aspect skills (psychomotor) with balanced (Pardomuan, 2013). Claims curriculum K-13 to wish quality learning which can make participant educate become creative, independent, cooperation, solidarity, leadership empathy, tolerance and life skills. In accordance with the demands of the curriculum, then required process learning which capable hone ability skills, attitude and knowledge in a way comprehensive (Junaidi, 2021), then learning must reflect learning active and critical.

Science is one of the difficult lessons because always there are experiments and it is not easy to memorize without understanding the concept. Hisbullah & Firman (2019) said that s considered difficult and No interesting Because no only learn theory just but always need practice or application. By because that, teacher must integrate Science in experiment real for student skills and capable maintain knowledge knowledge more long in memory they (Nainggolan et al., 2020).

One effort to overcome these difficulties is to integrate technology into science learning. Science and technology are inseparable parts where technology plays a role in making learning more interesting and motivating for students (DeBoer, 2000). One of the uses of technology in learning is the use of web learning. Utilizing the web by utilizing internet technology can present virtual classes that can make learning more effective and improve the learning process (Poon et al., 2004). This is in line with research (Sugiharti & Anugrah, 2023) which states that students' difficulties in using textbooks as textbooks can be helped by utilizing the internet as a learning resource. Meanwhile, the web is one of the uses of the internet that is widely used today.

The use of web learning will be more effective if supported by learning that actively involves students so that students can develop critical thinking skills (Babalola & Abiola 2013; Rubini et al., 2017). In terms of this integrated use of web learning with learning models based on supporting issues formation environment learning. Problem-based learning is learning that involves student in a way active in the process of solving problem Good in a way individual and also group with the teacher playing a role as facilitator (Newman, 2005). The use of problem-based learning in the learning process this will capable help student develop skills think critical (Şendağ & Odabaşı, 2009; Tayyeb, 2013), obtaining knowledge, collaboration in groups, and increase independence and skills breakdown problem (Newman, 2005; Tosun & Taskesenligil, 2013).

Learning using web media integrated with problem-based learning models requires students to actively seek information on their own, so that students are motivated to be responsible for their own learning (Newman, 2005; Sesen & Tarhan, 2013). Students are also required to have the ability to work together with others to increase the depth and breadth of their own learning. Therefore, the use of the web in learning requires student learning independence.

The low science learning outcomes at junior high school negeri 8 Binjai where 30% of students were found to have not completed in exam middle semester on lesson science, brings up disappointment for teachers who have been feel like i've provided a lesson which best for his students, with complete devices learning. Possible weaknesses, the teaching materials used still use textbooks available at school, book package which available during this not yet fully accommodate 21st century thinking skills, (Putri et al., 2024) namely books that can accommodate students to think logically, critically and creatively, and can argue correctly. This is because the textbook still contains a lot of evaluations in form choice multiple which make student junior high school specifically guess answer which may not necessarily be true, and does not improve thinking skills.

Additives are one of the science materials that are closely related to everyday life, but students have difficulty solving problems in everyday life. real, because teachers do not accustom students to think critically. This is It looks like there are a lot of students fighting to buy snacks at school during break time. Students are not yet aware of the dangers of using additives for health, student which tend to silent in class, seldom ask, because no critical, lack of critical thinking, and this is also because we are used to the form model question in book handle which generally in form choice multiple and no develop ability think critical. The amount substance additives which endanger for health make ability think critical become very important for student. Siahaan & Meilani (2019) say ability think critical important owned by students because it can help students produce the best answer, so that in learning teacher must get used to student for can critical thinking. Dewi & Kamaludin (2022) said that low critical thinking skills critical will affect learning outcomes.

Critical thinking skills can be applied, trained, and developed through the learning and assessment process. Critical thinking skills are defined as a process of intellectual discipline that reflects consistency in thinking and acting (Davies & Barnett, 2015). Critical thinking aims to achieve logical and reflective judgments about what should be believed, accepted, or done (Astleitner, 2002). Critical thinking is different from high-level thinking. Sugiharti & Azura (2021) states that high-level thinking skills involve the process of analyzing, evaluating, and creating.

In a learning process, pedagogical activities are needed that can make all students become critical and creative thinkers (Larkin, 2016). Teachers who act as mediators and facilitators should design and implement certain methods, models, or strategies that can train and develop students' critical thinking skills. Critical thinking skills are seen as helping students compare information, such as information they have, with information received from outside. Students who have critical thinking skills can decide something with their intellectual abilities (Sadhu & Wijayanti, 2018; Taimur & Sattar, 2018; Rahmawati et al., 2019). An innovative learning process is needed that provides opportunities for students to develop critical thinking skills (Haryanti, 2017; Seibert, 2021; Silberman et al., 2021). So, critical thinking skills will have a positive effect on students' readiness in the learning process, which of course will have an impact on learning outcomes. In other words, critical thinking skills will have an impact on learning outcomes.

This way of critical thinking can developed with use material teach innovative which associated with work aids in the form of information technology (Arlinwibowo et al., 2020). Material teach which will developed in study this is in module form. The module developed is a Webb-based module). Kossasy (2018) said that by using webb, all information related to the material The lessons taught can be uploaded by adding multimedia (pictures, animations, sound effects and videos) to make it interesting and easy to learn. Meanwhile (Dumgair, 2013), wrote that web-based learning can made into source study independent for student. Study other which relate with webb, Jiang (2014) find that learning web-based can improve knowledge and communication skills student.

Webb-based teaching modules that developed No only contains material and map draft like on general, but there are critical thinking training instruments, learning videos and worksheets. work and interesting video links related to Additives. With use material teaching in the form of module based on Webb developed integrated problem-base learning on material Substance additives so the end of this study found increasing students' thinking skills. Thus, this research aims to compile and develop module teach based on webblog, knowing its feasibility, improvement think critical, to see which critical thinking is higher which is taught with the developed module or existing textbook and to find out the students' response after being taught with module substance additives and addictive based Webb developed? and in relation to that (Kusmawan, 2015) stated that the use of the web in learning provides an opportunity for students to be able to build their own knowledge and develop critical thinking skills.

Methods

This study develop material teach based on Webb, in the form of a teaching module, in connection with this, the essence stage development consists of on stage studies introduction, development and testing. Its implementation is based on the steps development ADDIE Approach model design (Analysis, Design, Development, Implementation and Evaluation). According to Branch (2009) every phase approach ADDIE is input for process on phase furthermore. Sugiharti et al. (2019). Writes that development research is known as Research & Development (R&D) which is a research method used to produce certain products and test their effectiveness.

Study development this produce product module teach based on webb and test eligibility module teach and implementing it in the field, to see the improvement in students' critical thinking on the material on additives and addictive substances in food. Sugiono (2010) write that study and development in field education can be in the form of models, media, teaching aids, modules, evaluation tools, and/or devices learning. The concept of systematic learning development has existed since the formation of social communities, and made product uses process ADDIE still become wrong one process tool which most effective.

At the analysis stage (Analysis) is carried out analysis need, syllabus analysis and analysis module analysis module aims to determine strengths and weaknesses teaching module on additive materials in the field. Material analysis includes the contents of the module, namely the presence or absence of an introduction. modules, glossary, bibliography, summary, index, answer key, and regarding evaluation and also conducting analysis on the sub-topic of substances additives contained in the module. In the needs analysis in the schools studied, it was found that the teaching modules used the evaluation Not yet load skills think critical, question only in form multiple choice and low level. On analysis syllabus, syllabus which used K-13 And later arranged draft of the developed learning module.

Next is the design stage which is carried out by designing a science teaching material platform based on webb on the material of additives and additives in food. Based on the results of the analysis stage from the previous stage. Meanwhile, the development (design) stage compiles a conceptual framework for the application development module teach based on webb. In stage development, the conceptual framework is realized into a teaching module free webb which ready implemented. At the stage this after module teach completed, using expert validation, the validator will provide assessment, suggestions and criticism of products, both platforms, teaching materials and instruments study through questionnaire validation, from validation expert. The implementation stage is the application stage, namely conducting limited trials of validated teaching modules in one class in one school. Evaluation stage (evaluation) which become reject measuring is existence improving critical thinking skills students who are taught with module teach based on webb which developed. stage evaluation this for to know students' critical thinking skills by providing knowledge beginning that is done pretest furthermore will done learning with use material teach based on webb has been developed, and next will done evaluation study or posttest, as well as for know student responses, a questionnaire will be given. Testing done with using the average test of learning outcome improvement. design study in a way short stages study development can be seen in Fig-1.
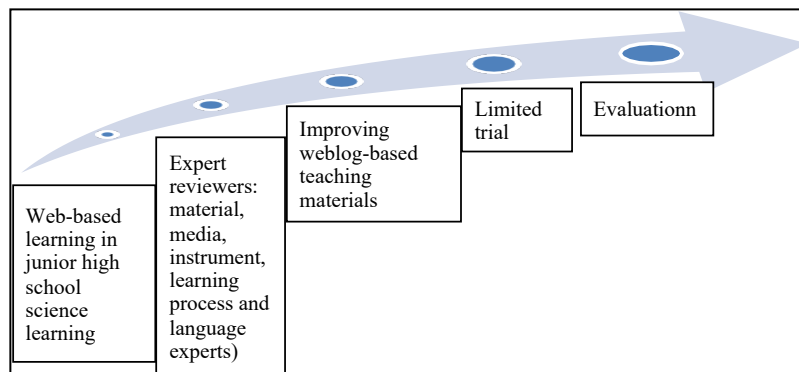

Fig-1. Flowchart of webb-based teaching material trial design developed

The trial was limited in nature, namely only limited to one class. After conducting a trial in the class, the researcher analyzed the increase in students' critical thinking while the Evaluation Stage was carried out by distributing questionnaires to students and teachers and by observing the results of learning observations. At the evaluation stage, it was also carried out by revising the shortcomings by revising the shortcomings that still existed in the developed teaching module. This stage determines the success of the developed teaching module. Experimental research stages in the development of webb-based teaching materials can be seen in Fig-2.
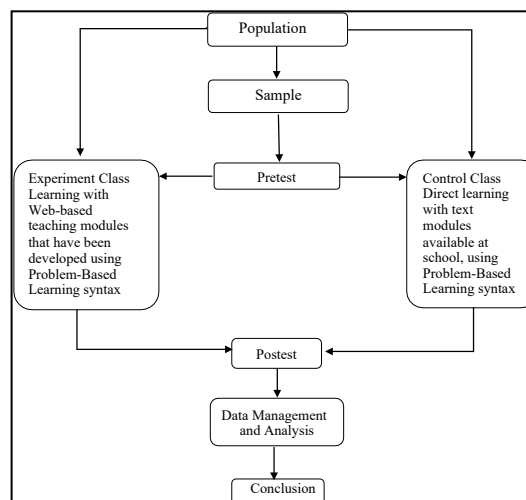

Fig-2. Design scheme for experimental research on teaching material development based on webb

Instrument test which used in study this is question essay test skills think critical as many as 15 question from a narrative, aiming for measure students' critical thinking skills with predetermined indicators according to Fernandes et al. (2024), And validated by expert evaluation. Matter this because previously, students were accustomed to working on questions in multiple choice and grade level. low until not develop skills think critical.

Non-test instruments in the form of questionnaires from BSNP to assess eligibility webb-based teaching modules developed in science learning, and questionnaire student responses. The form of the questionnaire used in the study this modified from standard eligibility according to body Standard National Education (BNSP). The scale used in the eligibility questionnaire is the scale likert scale with about 1 (strongly disagree), 2 (disagree), 3 (agree), and 4 (very agree). Questionnaire given to lecturer expert in his field with qualification minimum of S2 and minimum teaching experience of more than 5 years. While for questionnaire response participant educate given on class which done treatment which must filled by every student. Matter this aiming for obtain data or information regarding student responses to implementation module teach webb based which has been developed.

Results and Discussion

Analysis

The analysis stage is the first stage in the ADDIE model. Stage analysis done for identify problem and need target as well as learn condition criteria which needed for module. The analysis includes two activities, namely competency analysis and material analysis. Yesiati et al. (2017), the analysis stage is used to clarify whether there are problems that will be faced so that later a solution can be found which appropriate for face problem in the implementation learning.

The things that are done at this stage are: 1) analyzing problem and need student; and 2) analysis curriculum which related with materials to create indicators and learning objectives in the materials teach. Like which it is said Bahja et al. (2023) that objective learning can be a guideline in the preparation and development module learning in class. Analysis source Study done for know situation and source learning used in school.

On study This done three stage analysis that is analysis needs, syllabus analysis and book analysis. In the needs analysis on the schools studied do not yet have learning modules that can support learning, books used in schools use evaluation with level cognitive C1-C3. On analysis syllabus, in school which thorough use syllabus 2013, from syllabus the will arranged draft module Which developed. The book analysis conducted by the researcher was an analysis of three books Science which is often used in schools, the three books analyzed have advantages and disadvantages. of the three books analyzed will be used researcher as a source addition to the module which is developed.

Design

After the analysis stage, the next stage is the design stage. At this stage, data and references are collected that will be used in module development. After the data and references are collected, a module draft is made. Sari & Pathoni (2017), the design stage carried out is to determine the design of the development of the teaching module and the design of the development of the learning implementation plan. From this stage, a module development design is obtained which consists of determining core competencies, basic competencies and main material according to the syllabus and the design of the learning implementation plan. Najuah et al. (2021), design is an activity of art and science regarding the process that produces the framework and design of a model of something. Prasetya (2021), in the design stage, the design of the learning module is carried out with the steps of formulating indicators and learning objectives, analyzing discourse from the material, making concept maps and determining the design of practicums on the material. Teaching materials in the form of this module are arranged into a module consisting of an introduction, content and conclusion. The learning objectives in this teaching material are adjusted to the curriculum analysis. This teaching material is equipped with examples and readings taken from everyday events so that it can help students contextually and is also equipped with activities that guide students to work scientifically and plan an experiment and observation of the steps of activities in learning activities so as to facilitate students to improve student skills, and their level of thinking. Panggabean (2022), the design stage is carried out with the following framework of reference: a) for whom is the learning designed? (students); b) what skills do you want to learn? (competencies to improve critical thinking); c) how can the subject matter or skills be learned well? (using Webb-based modules); d) how do you determine the level of mastery of the lesson that has been achieved? (assessment and evaluation).

Based on these questions, in designing learning focused on 3 activities, namely the selection of materials according to the characteristics of students and competency demands, learning models, forms and methods of assessment and evaluation. So at this design stage, designing the components that will be made in the module is carried out, such as module covers, contents and other supporting components, all of which will be combined in the Webb that will be used. This stage can also be categorized as a design stage and which will be more focused on in the next stage.

Development

The next stage is the development stage. Sugianto et al. (2018) state, activity development that is activity translate specification design into the form physique, so that activity the produce product development prototypes. At the development stage validity and reliability assessments were carried out on the module by material experts and subject matter experts. media/materials teach, expert Language And expert instrument Yesiati, et al. (2017), development is the third step in implementing the model ADDIE learning system design. At this stage the design of the teaching module is in the form of mapping the lesson plan to the teaching module which will be used as a guideline for create teaching modules. Purwanto (2019), the development method is a method which is used to produce the product. In this case it will produce Webb-based learning module. So at this stage we have started to select and determine substance which in accordance with material teach. Then on stage here we start mapping the lesson plan to teaching materials. The development of teaching materials is based on determining core competencies, basic competencies and materials. Tegeh & Kirna (2013), state that

stage third is activity development which includes activities to prepare teaching materials. Activities of collecting teaching materials/materials, making pictures illustration, typing, and etc coloring activity on stage this development. At this development stage, standardization is also carried out and validation of webb-based modules that have been developed to as many as 7 UNS and Unimed lecturers as expert validators respectively. Standardization which done use questionnaire BSNP. Results evaluation validator expert are then totaled and averaged to determine whether they are valid or not. whether or not the Webb-based module was developed. From the validation results of the expert known that module which developed worthy used with revision (Table 4, Table 5, Table 6, Table 7, and Table 8).

Table 4. Average results validation by 3 expert material

No	Assessment Components	Assessor			Average
		Validation 1	Validation 2	Validation 3	
1.	Content eligibility	2.85	3.28	3.57	3.23
2.	Presentation eligibility	3.0	3.33	3.67	3.33
3.	Language eligibility	3.62	3.25	3.62	3.5
4.	Module eligibility and critical thinking	3.5	3.67	4.0	3.67
	Average	3.24	3.38	3.72	3.43

Table 5. Average results validation by 2 expert media

No.	Assessment Components	Validator 1	Validator 2	Average
1	Module size	4	3.5	3.75
2	Content cover design	3.28	3.71	3.5
3	Content design	3.67	3.67	3.67
	Average	3.65	3.63	3.64

Table 6. Average results validation by expert language

No.	Assessment Components	Expert Validator
1	Straightforward	4.0
2	Dialogic and interactive	3.0
3	In accordance with student development	3.0
4	In accordance with language rules	4.0
	Average	3.67

Table 7. Average validation results by experts instrument

No.	Assessment Components	Expert Validator
1	Question material	3.83
2	Construction	3.66
3	Language	4.0
4	General assessment of test devices	4.0
	Average	3.87

Table 8. Average results validation by expert learning

No.	Assessment Components	Expert Validator
1	Lesson plan component aspects	3.35
2	Problem-based learning aspects	3.43
	Average	3.39

In general overall chart results analysis by 7 validators can seen in Fig-3. This it can be concluded that the weblog-based module on the subject matter substance additive and addictive in class VIII, the validation results were at an average of 3.40 (feasible) and could be used for the implementation stage.

Implementation

Stage furthermore is stage implementation. Panggabean (2022) states, the implementation stage is implementing the module developed to student. On study this stage implementation done with implement module based on webb use model problem-based learning to class limited trial, with give questionnaire response student and learning material substance additive and addictive. Class trials consists of from 20 student which taught by Teacher in his class in school which not yet learn materia l.

Evaluation

Sari & Pathoni (2017) stated that at this stage the product is evaluated as a revision. end of module teach that developed. Evaluation stage of the test class try showed good learning outcomes of 77.80 (High), and the response results student show

module teach based on webb use model problem-based learning (3.48) very good and taken conclusion module teach based on webb use problem-based learning no need to be revised and can be used for field test.
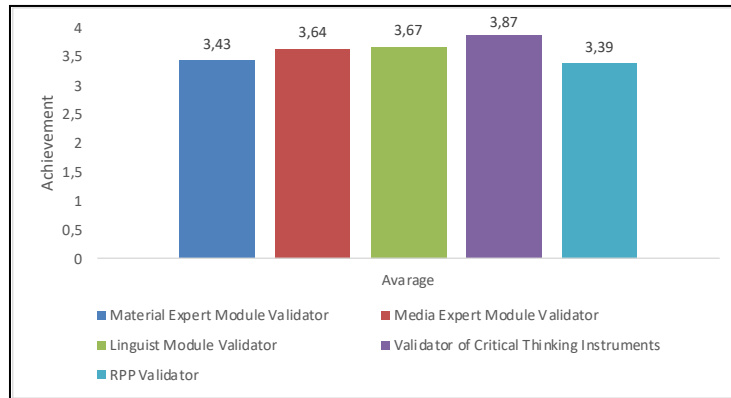

Fig-3. Graph of the overall average results of the validator analysis

Results evaluation end product stated worthy used, so furthermore module based on weblog which developed tested to student in field. In this study uses two sample classes. Where the implementation of the module is used in the experimental class, namely class VIII-2 and as a comparison class, namely class control class VIII-3 use book package at school, each class uses problem-based learning steps. before do study, moreover formerly given a pretest as an initial test for students to see the students' initial abilities in additive and addictive substance material. The questions given to students are critical thinking essay questions. By using the application Ms, Office excel, the final result is in the form of a mean value of learning outcomes from student as in Table 9 and Table 10.

Table 9. Value ability think critical on class experiment

Mark Average	N	Min	Max	Mean
Pretest	28	33.33	53.33	43.17
Posttest	28	80	97.78	90

Table 10. Ability value critical thinking on class control

Mark Average	N	Min	Max	Mean
Pretest	28	35.56	48.89	40.95
Posttest	28	71.11	93.33	83.81

Based on on data the, seen experience an increase that can be interpreted as an increase in students' critical thinking abilities after being taught by implementing a weblog-based module on the material of additives and addictive. To see the improvement in learning outcomes and whether students' critical thinking skills use modular teaching materials. Webblog based on the topic of addictive and addictive substances is higher than ability think critical of students who use book package in school, then first the prerequisite analysis test is carried out, namely the homogeneity and normality test of the experimental class and the control class. The results obtained are normally distributed and homogeneous data, then statistical tests are carried out, namely the Gain Test and the t-test. one party. This test was conducted to find out whether there was an increase in students' critical thinking and to see whether students' critical thinking skills used the module teaching materials. Webblog based on the topic of Addictive and Addictive Substances is higher than ability think critical student use book package in school known as the alternative hypothesis (Ha). Criteria implementation of this test if the alternative hypothesis (Ha) is declared accepted and hypothesis zero (Ho) rejected.

Test gain to measure improvement think critical student on class experiment and control by using pretest and posttest data. The n-gain value obtained was 82% in the experimental class with a high category and 73% in the control class with high category. Research which done by Samosir et al. (2016) that use webblog as source study effective used in learning And increase results learning by 71.30%. Meanwhile, Jiang (2014) said that learning based on web can increase knowledge and ability communicate student. Results from implementation test t one party from ability think critical student can seen on Table 11.

Table 11. Test hypothesis one party

Data	Mean	Stdev	N	t_{count}	t_{table}	Information
Class posttest experiment	90	4.70	28	5.02	1.67	Ha Accepted
Class posttest control	83.81	4.52	28			

Table 11 above shows that critical thinking skills student which using module teach based on webb which has developed more higher than the critical thinking skills of students who are taught using books package which exists at school. Results study Bernice et al. (2021) find that results Study using weblogs is higher and there is an increase in learning outcomes of

56.2% on use media web. This relate with which it is said (Kosassy et al., 2018) that by using the web all information related to with the learning materials taught can be uploaded to more material interesting and easy studied. Web is wrong one media with using technology and (Norman & Fornes, 2016), shows that by Study use technology digital more meaningful in matter metacognition participant education than non-digital. Meanwhile, Ning (2024) said that Web-based learning offers great opportunities for learning and access to a number of great knowledge and information. Likewise, research Sugiharti et al. (2024) found that using the web can improve student competence, and learning using the web is better than without using the web and found a high response to using the Web.

Student Response

In general overall response student to module teach based on web which developed is at on category worthy and very worthy. Response student to module teach based on web which developed collected with using a questionnaire. The questionnaire was filled out by 28 students. The results of the questionnaire that have been analyzed show that student give response positive as big as 86%. Matter this shows web-based teaching materials using problem-based learning on substance materials additives and addictives are very interesting for students, so they can be used as wrong one source of learning in learning science.

Response student to module teach based on web which developed related with research by Fatah et al., (2021) which found that 100% of students like study use web, 100% interested study science use web, 100% of students stated that they were interested and motivated to learn using the web, and 100% student state learning use web interesting and pleasant, and 90% student state learning Science use web is not matter new. Findings this also in accordance with study Which done by (Tee et al., 2013; Zakaria & David, 2013; Yuen et al., 2019) which state that student show satisfaction using internet technology-based services as a learning medium on line to learn.

Conclusion

The Webb-based learning module integrated with the problem-based learning model on the material of additive and addictive substances developed is categorized as valid. The results of the study showed that the average percentage of validity was 3.4 or 85% with valid criteria. The n-gain test results were 82% in the experimental class with a high category and 73% in the control class with high category. Meanwhile, the one-tailed t-test shows that critical thinking skills student which using module teach based on webb which has developed more higher than the critical thinking skills of students who are taught using books package which exists at school. Results of student response questionnaire analysis show that student give response positive as big as 86%. Thus, the webb-based teaching module that was developed is ready to be used in learning the material on food additives and addictive substances in order to improve students' critical thinking skills.

Conflict of Interests

The author declares that there is no conflict of interest in this research and manuscript.

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