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Development of E-module Food Chemistry Constructivism-Based 5-Phase Needham

A. Rachman Ibrahim[1*], Andi Suharman[1], Diah Kartika Sari[1]

[1] Chemistry Education, Universitas Sriwijaya, Indralaya, Indonesia

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Abstract: This study aims to produce a valid and practical e-module of food chemistry constructivism based 5-phase Needham's. This research is development research with ADDIE development model combined with Tessmer formative evaluation. The stages of ADDIE development used in this study include the analysis stage, the design stage, and the development stage only, which then proceeds to the Tessmer formative evaluation stage which includes expert review, one to one, and small group. At the expert review stage, the e-module food chemistry was validated by experts from the fields of pedagogic experts, material experts and design experts. The results of the validation assessment scores obtained at the expert review stage in the pedagogic field are 0.848 (high), the material field is 0.895 (high), and the design field is 0.889 (high). This shows that the e-module constructivism based 5-phase Needham's that has been developed is valid. The practicality of the e-module constructivism based 5-phase Needham's is seen from the practicality questionnaire scores at the one-to-one stage and the small group stage. The one to one stage resulted in a score of 0.865 (high) and in the small group stage it was 0.865 (high), which means that the e-module based constructivism 5-phase Needham has been practically developed.

Keywords: E-module; Needham; Needhem 5 Phase constructivism

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Introduction

Quality education can be achieved through various innovations in order to form a good and effective learning process in order to improve students' creative and innovative thinking skills. Therefore, it is very necessary to improve the quality of education to be able to create creative and innovative human resources. From education, it is expected to be able to build integrated human resources with good quality and can contribute greatly to Indonesia in this era of globalization (Ulfah et al., 2016).

The purpose of education is to be able to make students able to apply creative thinking skills both in terms of solving or solving problems independently (Nur, 2016). Creative thinking ability is one of the higher-order thinking skills that must be developed in students and becomes one of the goals in learning activities in order to create a learning that can encourage students to be able to express new ideas and ideas in learning activities (Dewi et al., 2018). Therefore, in learning activities, educators should be able to direct students to develop attitudes and abilities that can help them in dealing with various problems in the future creatively and innovatively.

Digital learning can be one of the innovations to create good learning activities to increase the independence and creativity of students. In general, digital learning is an information technology-based learning using the internet or websites. The use of digital learning systems is triggered by the intensity of the use of information technology which is growing very quickly and widely throughout the world, and can substantially affect various kinds of educational support

* Corresponding Author: a_rachman_ibrahim@fkip.unsri.ac.id

components, for example, various forms of digital teaching materials such as e-modules, learning videos, learning scenarios appear. digital based, and so on. This of course can be used as a form of effort to increase students' abilities, knowledge, competencies, and ways of thinking to be more creative and innovative in a better learning (Suciati, 2018). Thus, one of the innovations that can be used to create a good learning is by developing digital teaching materials in the form of E-modules that provide various information.

E-module is a teaching material that comes from the basic words e-(electronic) and module. The definition of a module according to Daryanto (in Khoiriyani, 2019), is one of the printed teaching materials that can be used in the learning process efficiently and effectively. So that the E-module is an electronic teaching material that is intended to be able to help students to know as well as their ability to the material presented independently without being accompanied by a teacher. Therefore, E-module teaching materials were developed to facilitate the learning process. In addition, the development of E-modules also pays attention to the use of models or approaches that will be used so that students can understand and study the module independently and be able to increase their creativity.

In creating a meaningful learning can be realized by choosing the right learning model. According to Firdatama, (2018), it is revealed that the constructivism approach is a good approach to be applied in the teaching and learning process because this theory emphasizes active student involvement where students build their experiences independently based on the perception of the experience they have. Meanwhile, according to Nair & Muthiah, (2005) revealed that the constructivism approach is very important in the learning process because students are encouraged to build their own concepts by linking the things they learn with their existing knowledge. In this learning process, students are expected to play an active and independent role to increase their understanding of a case.

According to research that has been done by Wahyuningsih, (2021) shows that there is an influence through a constructivism learning approach on student achievement on the subject matter of the set. This shows that the constructivism approach can be one approach that can be used in learning activities to activate students. So that in learning activities students can express their ideas independently with or without teacher guidance. So that the development of E-modules through the Needham Five Phases Constructivism learning model can be an alternative in learning activities to increase creativity and independence of students. Therefore, in this study, researchers are interested in developing a constructivism-based Food Chemistry module with five needham phases.

Method

This research is development research with ADDIE design combined with Tessmer formative evaluation. The stages of this ADDIE model are analysis, design, development, implementation, and evaluation, but in the development of the food chemistry e-module this time the researchers only arrived at the development stage, so for the evaluation stage a formative evaluation modification was used (Tessmer, 1998).

The subjects in this study were students who took the Food Chemistry course, Chemistry Education Study Program, Sriwijaya University. The object of this research is the Food Chemistry module. This research involves various parties, namely material experts, design experts, pedagogical experts and students of the Chemical Education Study Program, Sriwijaya University. The data collection technique that the researcher will use in this study is through three types, the first is a walkthrough which is carried out at the expert review stage and one to one. The second is interviews conducted during the analysis stage. The third is a questionnaire conducted during the expert review, one to one, and small group stages. Questionnaire made using a Likert scale. which consists of 4 items, namely very good with a value of 4, good with a value of 3, not good with a value of 2, very not good with a value of 1 (Sugiyono, 2017). And the last is the test conducted at the field test stage. The tests carried out were pretest (beginning of the meeting) and posttest (end of the meeting) with the same questions.

Data analysis techniques that will be used by researchers in this study are questionnaire data analysis and test data analysis. Questionnaire data analysis was used to assess the validity at the expert review stage and to assess practicality at the one to one and small group stages using the V Aiken formula. The formula proposed by Aiken is as follows:

$$V = \frac{\sum s}{[n(c-1)]} \quad (1)$$

(Aiken, 1985)

Note:

$s = r - lo$

lo = lowest score of validity (eg 1)

c = highest validity rating score (eg 4)

r = the score given by the assessor

The results of calculations using the V Aiken formula that have been obtained are then analyzed for validity and practicality using the V Aiken score category contained in Table 1 below.

Table 1. Category Score V Aiken (Aiken, 1985)

Score	Category
0.68-1.00	High
0.34-0.67	Moderate
0.00-0.33	Low

E-module Food Chemistry with high or medium validity and practicality category is declared valid and practical. A valid and practical E Food Chemistry module can then advance to the next stage. Meanwhile, the E Food Chemistry module with a low category stated that the student worksheet was invalid and impractical, so it was necessary to revise and repeat back to the expert review stage, one to one and small group.

The test was carried out at the field test stage to see the effectiveness of the constructivism-based Food Chemistry E module with five needham phases. The test is given at the beginning of the meeting (pre-test) and at the end of the meeting (post-test) with the same test questions.

Analysis of test results data using the gain score formula as follows.

$$< g >= \frac{<\%Sf> - <\%Si>}{(100 - <\%Si>)} \quad (2)$$

(Hake, 1998)

g = average normalized gain score
Sf = score final (post-test)
Si = score initial (pre-test)
100 = score maximal

The gain score obtained is then adjusted to the criteria for determining the gain score: high, medium, or low. The table of criteria for obtaining the gain scores obtained by students can be observed in Table 2 below.

Table 2. Criteria for Gain Score (Hake, 1998)

Criteria	Category
$g \geq 0,7$	High
$0,3 \leq g < 0,7$	Moderate
$g < 0,3$	Low

Result and Discussion

Development research is research that is used to produce certain products and test the effectiveness of these products (Sugiyono, 2017). The resulting product can be in the form of teaching materials such as modules, interactive multimedia, student worksheets and others. In this study, the product that has been developed by the researcher is a constructivism-based Food Chemistry module with five phases of needham for Chemistry Education students. The development model used is the ADDIE model which is only used until the development stage and is combined with Tessmer's formative evaluation. The steps taken to produce a constructivism-based food chemistry module with five needham phases are starting from the analysis stage, followed by the design stage and the development stage. At the development stage, an evaluation of the constructivism-based Food Chemistry module with five phases of needham was carried out which was developed using Tessmer's formative evaluation.

The analysis stage is divided into three stages, namely needs analysis, curriculum analysis, and student character analysis. This stage is carried out to find out what teaching materials should be developed by researchers. Needs analysis and student character analysis were carried out by interviewing powerful lecturers in the Food Chemistry course and distributing questionnaires to students, while curriculum analysis was only done by interviewing and discussing with influential lecturers in the Food Chemistry course. The results of interviews with influential lecturers in the Food Chemistry course show that students' understanding of the concept of Food Chemistry is still low so that student learning outcomes are still unsatisfactory. This is supported by the results of student questionnaires which stated that although students liked the Food Chemistry course, students' reading interest in reading supporting literature sources during lectures was still lacking. Students are very dependent on the teaching materials provided by the lecturer without looking for other literature sources. Based on this, researchers will develop a constructivism-based Food Chemistry module with five needham phases.

Interviews with influential lecturers in the Food Chemistry course show the need for teaching materials that can improve students' conceptual understanding and creativity so as to improve student learning outcomes. Pradita (2015) said that high creativity will make it easier for students to understand the material being studied, so knowledge or cognitive will be high as well. Therefore, the teaching materials to be developed must be able to make students find concepts and creativity through independent literature studies. Curriculum analysis also states that the Chemistry education study program has graduate competencies for Chemistry Education students, one of which is having high creativity both as educators, researchers, and education processors.

The analysis phase resulted in the need for the development of teaching materials in the form of constructivism-based food chemistry modules with five needham phases that were able to make students find concepts and creativity independently so as to improve student learning outcomes. Constructivism-based Food Chemistry E-module with five phases of Needham which was developed contains the syntax of five phases of Needham. This E module is able to facilitate students

to find concepts and creativity independently and can improve student learning outcomes.

The constructivism-based Food Chemistry module with five phases of Needham which was developed by the researcher was then designed for appearance and content at the design stage. At this stage the researcher also conducted a literature study to obtain supporting materials and questions that would be included in the constructivism-based food chemistry module with five phases of needham. Furthermore, the constructivism-based Food Chemistry module with five phases of Needham that has been designed will enter the development stage.

The development stage is the stage where the constructivism-based Food Chemistry module with five needham phases is developed and evaluated using Tessmer evaluation. Before entering the Tessmer evaluation stage, the constructivism-based Food Chemistry module with five Needham phases that had been designed at the design stage was further developed and produced a specific prototype which then entered the self-evaluation stage. At this stage the specific prototype is evaluated by researchers, supervisors, lecturers in Food Chemistry courses, and colleagues. The results of this self-evaluation stage include improving text, images, sentence structure and punctuation, as well as designing the appearance of teaching materials as a whole. Furthermore, prototype I will be evaluated using Tessmer's evaluation starting from Expert Review and One to One.

The Expert Review and One to One stage are carried out simultaneously. At the Expert Review stage, the validity test is carried out. This validation was carried out by 6 experts (validators) consisting of 2 material experts (validators), 2 pedagogic experts (validators), and 2 design experts (validators). The following are the results of the validation scores in this study:

Tabel 3. Score Expert

Experts	Validation score	Category
Pedagogic expert	0.848	High
Material expert	0.895	High
Design expert	0.889	High
Average	0.877	High

Based on the results of the validation scores from several experts, an average validation score of 0.877 was obtained which was categorized as high which stated that prototype I was valid. Prototype I which is being validated by the validator is also tested through a one to one trial with the aim of seeing the initial readability and practicality of Prototype I being tested on 3 students. The following are the results of the initial readability scores and the practicality of the one to one stage in this study:

Table 4. Score on One to One stage

Student	Score	Category
Student 1	0.833	High
Student 2	0.880	High
Student 3	0.880	High
Average	0.865	High

Based on the results of the scores above, an average score of 0.865 is obtained which is categorized as high which states that prototype I has good initial legibility and practicality.

The constructivism-based Food Chemistry module with five phases of needham that has gone through the Expert Review and One to One stage with validation values and high initial and pre-practical readability values is referred to as prototype II. Prototype II was then tested again through a small group trial to see the practicality of the constructivism-based Food Chemistry module with five phases of Needham being developed. This trial was carried out by 9 students by giving prototype II to students and asking them to study it and then giving an assessment of prototype II through a questionnaire provided by the researcher. The following are the results of the recapitulation of the assessment questionnaire scores for the small group stage:

Tabel 5. Score on The Small Group

Student	Score	Category
Student 1	0.809	High
Student 2	0.809	High
Student 3	0.762	High
Student 4	0.905	High
Student 5	0.881	High
Student 6	0.905	High
Student 7	0.905	High
Student 8	0.905	High
Student 9	0.905	High
Average	0.865	High

Based on the results of the score above, an average score of 0.865 is obtained which is categorized as high which states that prototype II has good practicality. In this small group stage, constructivism-based Food Chemistry modules are produced with five valid and practical needham phases (prototype III) which will then be tested to the next stage, namely Field Test.

Field test is the last stage in the development of teaching materials that researchers do. At the field test stage, the actual learning with Chemistry Education students was carried out in two meetings. This field trial was conducted to determine the effectiveness of the constructivism-based Food Chemistry module with five phases of Needham being developed. At the first meeting, students were given prototype III and given a pre-test. Furthermore, students are asked to fill out

prototype III. Filling in prototype III can be done outside of lecture hours.

At the second meeting, students were given a post-test. The average value of student learning outcomes is in the form of pre-test and post-test, then these results will be entered into the N-gain formula. The Figure 1 is the average value of student learning outcomes.

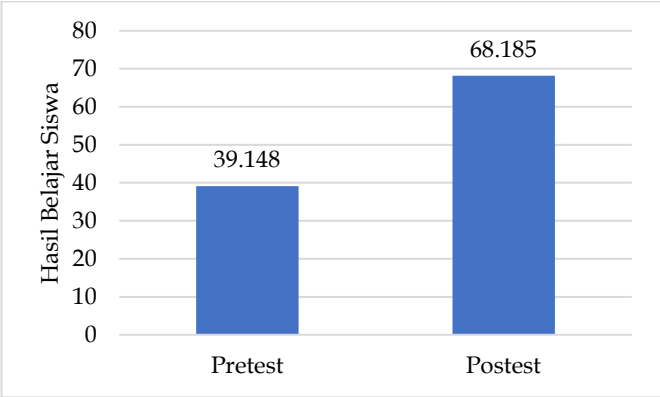

Figure 1. Pre-test and Post-test

Based on the data obtained, the N-gain value obtained in this study was 0.46 which was categorized as moderate so that it can be said that the constructivism-based Food Chemistry module with five needham phases that had been developed by researchers was categorized as effective for improving student learning outcomes.

Nieveen (1999) revealed that the product of teaching materials must meet three criteria, namely valid, practical, and effective. The teaching materials that have been developed by the researchers, namely the constructivism-based Food Chemistry module with five phases, need to meet the criteria for teaching material products, namely valid, practical, and effective for Chemistry Education students. The constructivism-based Food Chemistry module with five phases of Needham developed by the researcher also has the advantage of loading the syntax of the five phases of Needham so that students will be more independent in finding concepts that will improve student learning outcomes.

Conclusion

Based on the results of the research that has been done, it can be concluded that the constructivism-based food chemistry module with five phases of needham in chemistry education students is categorized as valid with an average validation score of 0.877 (high). The constructivism-based Food Chemistry module with five phases of needham in chemistry education students is categorized as practical with an average score of 0.865 for the one-to-one questionnaire, which is high and the small group stage is 0.865, which is also high. Constructivism-based Food Chemistry module with five phases of needham in chemistry education students is categorized as effective with an N-gain score of 0.46 which is categorized as moderate

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