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Validity of Inquiry-Based Buffer Solution E-Module STEAM Integrated Supervising for SMA/MA

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ABSTRACT

In general, students have difficulty understanding this buffer solution material. This is because the buffer solution material requires the ability to think critically in solving problems. This study aims to produce STEAM integrated buffer solution e-modules to reveal the level of validity and practicality of emodules. With the e-module, it is hoped that it can increase student's interest in learning and the e-module is designed so that students can study the material independently and actively. The development model used in this study is the 4-D model. The validity test of the e-module was carried out by two Chemistry lecturers at FMIPA UNP, one lecturer at Faculty of Engineering UNP, and 4 chemistry teachers at SMAN 1 Bukittinggi. The practicality test was carried out by 2 chemistry teachers and 30 class XII students at SMAN 1 Bukittinggi in the 2022/2023 academic year. The research instrument is a validity and practicality questionnaire. The validity questionnaire was analyzed using the Aiken V formula and the practicality questionnaire was analyzed using descriptive statistical percentages. From the research results, it was found that the average value of Aiken V was 0.83 with a valid category. Based on the research results, it can be concluded that the e-modul is valid. Therefore this research can be continued to the effectiveness test stage, so that this e-module can be used in the learning process.

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1. Introduction

The STEAM approach is a multi-disciplinary approach that evolves from a STEM approach by adding an element of Art to its learning. The element of art (art) is excellent for both students and teachers through forms of expression, communication, creativity, imagination, observation, perception, and thought to develop cognitive skills such as listening, solving problems, matching form to function, and decision making [1]. One of the teaching materials that can be made to captivate students' learning desires is a learning module that has an attractive design [2]. A good module requires parts that can produce modules that can motivate its users [3]. One of the disadvantages of the module that has been developed is that it is still in print form so it is difficult to spread it quickly. However, this module that has been developed has a high value of validity and practicality so that the category is valid and practical.

Based on the results of observations that have been made by distributing questionnaires to 4 chemistry teachers from SMAN 1 Bukittinggi and SMAN 4 Bukittinggi and distributing questionnaires to 100 students consisting of 50 students from SMAN 1 Bukittinggi and 50 students from SMAN 4 Bukittinggi, it was found that: (a) 81.1% of students had difficulty understanding chemical material, especially buffer solution material, (b) 72.1% of the teaching materials used by students for chemistry learning, especially buffer solution material, were still in the form of printed books, (c) 60.6% of students are more interested in having discussions in chemistry learning, especially buffer solution material, (d) 50% of teachers still use printed teaching materials in carrying out chemistry learning especially buffer solution material, (e) 97 .3% of students already have smartphones, (f) 75% of teachers and 94.6% of students are interested in using e-modules in the chemistry learning process especially the buffer solution material. This study aims to produce STEAM integrated guided inquiry-based buffer solution e-modules for SMA/MA to analyze the validity and practicality of the e-modules.

2. Experimental

2.1 Figure Properties

The type of research used is Research and Development (R&D) or commonly called development research. Development research is research that produces a product and tests the effectiveness of the resulting product. The development model used in this study is the 4-D development model [4]. The subjects of this study were lecturers in the chemistry department at FMIPA UNP, high school chemistry teachers, and class XII students at SMAN 1 Bukittinggi. The instrument used to collect data in this study was a questionnaire, namely a questionnaire to test the validity and practicality test. The validity test was carried out by 7 validators. The questionnaire was prepared based on a modified Likert scale from Riduwan (2012). The data analysis technique used to analyze the validator's assessment is by using the aiken moment formula.

3. Results and discussion

The product resulting from this research is an e-module of STEAM integrated guided inquiry-based buffer solution for SMA/MA. Then the e-module validation stage was carried out by lecturers

and chemistry teachers. This study uses the first 3 stages of the 4-D development model which consists of define, design, and development, with the results described as follows.

1) Define (definition)

This stage is carried out with five steps of analysis, namely front end analysis, student analysis, task analysis, concept analysis and learning objectives analysis. The results of these stages are as follows:

a) Front-end analysis

This analysis was carried out by distributing questionnaires to 4 chemistry teachers from SMAN 1 Bukittinggi and SMAN 4 Bukittinggi and distributing questionnaires to 111 students consisting of 56 students from SMAN 1 Bukittinggi and 55 students from SMAN 4 Bukittinggi .

Based on the results of a questionnaire of four chemistry teachers, it is known that (1) the shortcomings of the module used by the teacher are the absence of supporting animation and the lack of percentage of movement from students, (2) there are still many students who do not respond to the module given (3) students still constrained by the internet network and constrained by internet packages. Then based on the results of the questionnaire distributed to students it can be seen that (1) in learning, the teacher has used a variety of learning media even though not all students have them, (2) the part of the material from the buffer solution that students find difficult is quite diverse, but most students choose the part to calculate the pH or pOH value of the buffer solution with the addition of acid, base or dilution.

b) Student analysis

The stages of student analysis are carried out by distributing questionnaires to teachers and students. Based on the questionnaire distributed, it is known that students have been able to fulfill the KKM (Minimum Passing Criteria) but in their learning students still do not respond to the modules given and students are less active in learning. Then students are still constrained in the internet network during learning because at that time it was done online.

c) Task Analysis

At this stage an analysis of Learning Outcomes (CP) is carried out on the buffer solution material. Task analysis is carried out to determine the content of the material

and competencies that must be achieved in learning. The preparation of e-modules refers to learning outcomes (CP) and learning objectives (ATP) in the independent curriculum. Based on the learning outcomes, the learning objectives flow is obtained, namely analyzing the electrical conductivity properties of a solution in everyday life.

d) Concept analysis

Concept analysis is obtained by tabulating important concepts in the material of electrolyte and non-electrolyte solutions so that concept labels, concept definitions, types of concepts, attributes, factual concept positions, and principles are known. The concept analysis is compiled into a concept map

e) Analysis of Learning Objectives

In this stage of analysis, learning objectives are formulated based on the flow of learning objectives that have been previously formulated in the buffer solution material.

2) Design

At this stage, the media is determined according to the learning objectives, chooses a format and an initial design is carried out for the development of the electronic module. The e-module is designed based on the module writing format provided by the Ministry of Education and Culture guidelines (2018) which has been modified [5]

3) Development

In this stage the results of the validity test of the e-module buffer solution based on STEAM integrated guided inquiry were given by UNP chemistry lecturers, UNP engineering lecturers, chemistry teachers at SMAN 1 Bukittinggi, and students at SMAN 1 Bukittinggi. This stage consists of two steps, namely validity test, and revision. The quality of the results of a product being developed can be seen from three criteria, namely validity, practicality, and effectiveness (Rochmad, 2012). The following is a description of each step.

a. Validity Test

The validity test consists of four components, namely content feasibility, language, presentation and graphics. The validity test questionnaire was prepared based on modifications from the Ministry of National Education [6]. Validation was carried out by two chemistry lecturers from FMIPA UNP, one UNP engineering lecturer, and four chemistry teachers from SMAN 1 Bukittinggi. The results of the analysis of the module validity data obtained from the seven validators can be seen in Table.

Tabel 1. Validity Data Analysis Results

Rated aspect	V	Validity Category
Content eligibility	0,82	Valid
Presentation	0,93	Valid
Language	0,83	Valid
Graphics	0,88	Valid
V total	0,86	Valid

Based on table, the average value of validity is obtained on all aspects assessed in the e-module of 0.86 with a valid category. The average V value for the content feasibility assessment is 0.82 with a valid category. The average V value for language assessment is 0.93 with a valid category. The average V value for presentation assessment is 0.83 with a valid validity category. The average V value for graphical assessment is 0.88 with a valid category.

b. Revision

This stage aims to improve the module section deemed inappropriate by the validator before the product was tested. Comparison of the appearance of the STEAM integrated guided inquiry-based buffer solution e-module before and after the revision is as follows:

a) E-Modul Cover

Based on input and suggestions from supervisors and validator then the e-module cover is revised by replacing image design, this is done so that the appearance of the cover becomes more attractive. Then re-editing was also carried out on the logo, which originally had a white part on the outside of the logo circle, now there is no white part anymore. Comparison of the cover display can be seen in Figure 1.
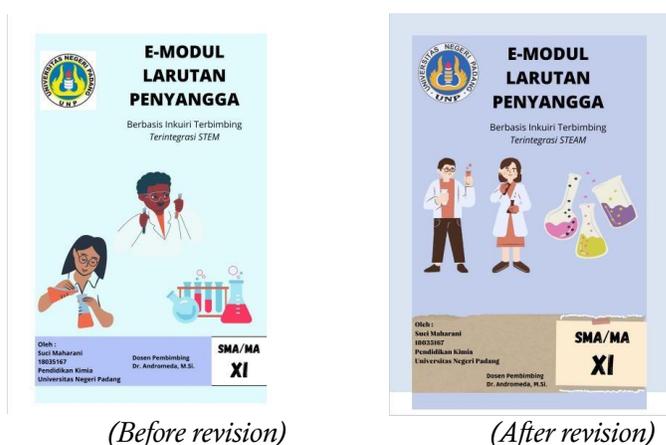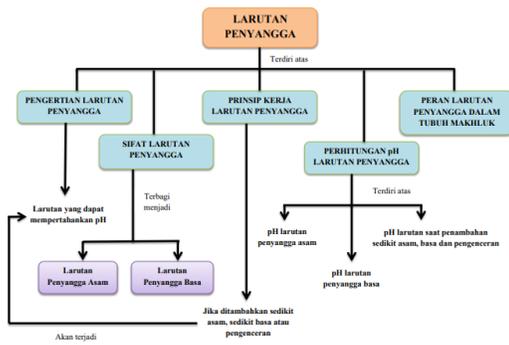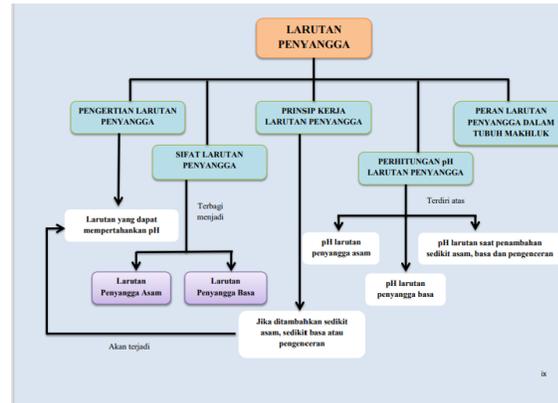
(Before revision)   *(After revision)*

Figure 1. *Comparison of the appearance of the E-module cover before and after revision*

b) Fixed the use of adverbs on arrows in concept maps.

Based on input and suggestions from the validator, the part of the adverb on the first arrow is omitted so that students do not experience confusion when understanding the concept map. Differences in the display of concept maps can be seen in Figure 2.

(Before revisi)   (After Revisi)

Figure 2. *Comparison of Concept Map Views Before and After Revision*

c) Add a Pancasila profile that has not been seen in each and replace the GPA with learning objectives

Based on the input and suggestions from the validator, the "Competency Achievement Indicators" section was replaced with "Learning Objectives", this was to comply with the rules in the independent curriculum. Then given an additional Pancasila profile at each opening of learning activities. Comparison of the opening display of learning activities can be seen in Figure 3.

(before revision)   (after revision)

Figure 3. *Comparison of the Opening Display of Learning Activities Before and After being revised*

d) Improving the contents of the exploration section in Learning Activity 3

Based on suggestions and input from the validator, the exploration section in learning activity 3 was replaced with activities that can fulfill the learning objectives because this section was previously considered not to have fulfilled the contents of the learning objectives. Comparison of the contents of the exploration section in activity 3 can be seen in Figure 4.

(before revision)   *(After revision)*

Figure 4. Comparison of the contents of the Exploratory Section in Learning Activity 3 before and after revision

e) Adding STEAM labels to each learning activity

    Based on suggestions and input from supervisors and validators, the STEAM label was added to the STEAM integrated activities section. Comparison of the appearance of adding the STEAM label can be seen in Figure 5.

(before revision)   *(After revision)*

Figure 5. Comparison of Appearance of STEAM Label Addition Before and After Revision

f) Fixed the conclusion column section

    Based on the suggestions and input from the validator, the conclusion section is given a blank space without being given a direction for the points that should be obtained. This is so that students can explore their own conclusions from the learning activities carried out. Comparison of display conclusions can be seen in Figure 6.

(Before revisi)   *(After Revisi)*
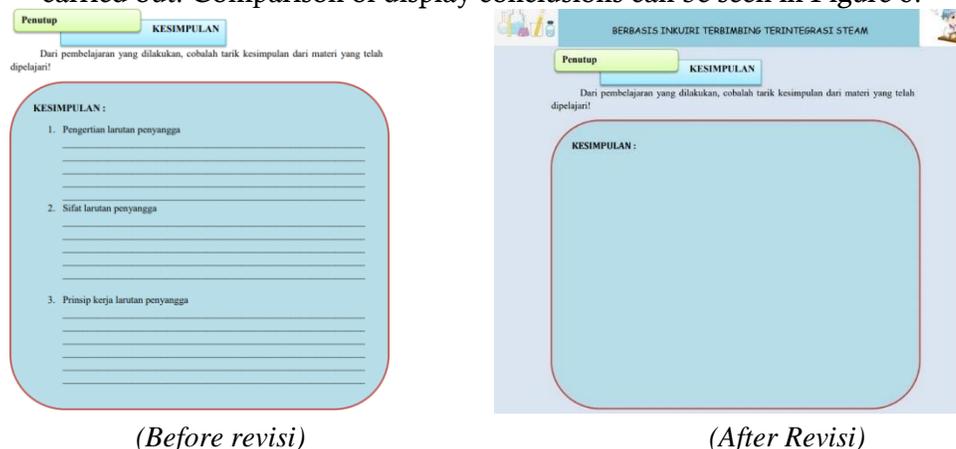
FIgure 6. Comparison of the display of conclusions before and after revision

4. Conclusion

Based on the results of research and data analysis, the following conclusions are obtained:

1) STEAM integrated guided inquiry-based buffer solution e-module has been developed for SMA/MA using the 4D development model.
2) The E-Module of the buffer solution developed is declared valid.

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