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Validity and Practicality of Acid-Base E-Module Based on Guided Discovery Learning for Class XI SMA

Nadya Afrilianti, Yerimadesi Yerimadesi*

Departement of Chemistry, Faculty of Math and Science, Universitas Negeri Padang
Padang, Indonesia

Abstract— This study aims to analyze the validity and practicality of the acid and base e-module based on guided discovery learning. The development model used in this research is the Plomp development model. The e-module validity test was carried out by two Chemistry lecturers, FMIPA UNP, three chemistry teachers, and two Informatics Engineering lecturers, FT UNP. The practicality test was carried out by three chemistry teachers and twenty-seven students of class XI at SMAN 2 Payakumbuh in the January-June 2021 semester. The instruments used were validity and practicality questionnaires. The validity questionnaire was analyzed using the Aikens'V formula and the practicality questionnaire was analyzed using descriptive statistical percentages. From the results of the study, the average value of Aikens'V for content validity, construct validity, and the media validity is 0.81; 0.85; 0.95 with high validity category. The practicality value of e-modules obtained from teachers and students is 91%, 91% each with a very practical category. Based on the results of the study, it can be concluded that the acid-base e-module based on guided discovery learning produced is valid and practical. This research needs to be continued with testing the effectiveness of e-modules to be used in the learning process.

Keywords— E-module, acid and base, guided discovery learning, validity, practicality.

I. INTRODUCTION

Chemistry is a science that is very useful in life, for example acids and bases. Acids and bases are one of the chemical materials taught to high school/MA students in class XI in the even semester. Acid and base materials include basic chemistry material that students must understand to be able to learn the next material.

Based on the results of observations made by giving questionnaires to three chemistry teachers, namely two chemistry teachers at SMAN 2 Payakumbuh and one chemistry teacher at SMAN 5 Solok Selatan and fifty students of class XII MIPA at SMAN 2 Payakumbuh, it was obtained: (a) 90% of students think that chemical materials, especially acids and bases are difficult to understand, (b) 96% of teaching materials used by students to learn chemistry, especially acids and bases are still in the form of printed teaching materials, (c) 62% of students have not been able to learn independently to be able to understand the concept of chemical materials, especially acids and bases with printed teaching materials, (d) 100% of teachers still use printed teaching materials in chemistry learning, especially acids and bases, (e) 100% of teachers and 66% of students are interested in using e-modules in the learning process, especially for acids and bases. One material that is considered difficult by students is acid-base material [1].

In the process of learning acids and bases students are required to be able to understand the material in the form of knowledge and skills. Students can understand acid and base material in the learning process by using a learning model. One of the learning models that can be used is guided discovery learning. Guided discovery learning learning model is the learning model that most motivates students because of the reinforcement provided by the teacher in the form of encouragement and support, even if students do not find the right answer, the teacher continues to motivate students to work until finally students become more motivated in the process learning [2]. The guided discovery learning model is effective in solving chemistry problems [3], improving learning outcomes such as in science learning [4], has a significant effect on student learning outcomes [5], effective on student learning outcomes [6], improve the ability to understand mathematical concepts [7].

In the learning process, a teaching material is needed. The use of teaching materials that have high appeal and use technology will certainly greatly affect student learning outcomes. One of the teaching materials that can be used as a support in the learning process in this technological era is e-module (electronic module) [8]. E-module is one of the independent teaching materials that is presented in electronic form [9]. The development of this e-module is also based on the demands of education in the Industrial Revolution Era (ERI) 4.0, where ERI 4.0 requires the role of teachers to be able to adapt themselves to the development of Information and Communication Technology (ICT) in the learning process [10].

By using an e-module based on guided discovery learning, it is expected to improve student learning outcomes, because the guided discovery learning model is more varied and more interactive so that students can be more motivated to learn and can be actively involved in the learning process. The results of research conducted by Cholifah (2016) have proven that the application of the guided discovery learning model can improve students' learning achievement because it is more effective than using a variety of lecture model learning, this is evidenced by the average student learning outcomes. educate. Guided discovery learning-based modules make students active in carrying out learning activities through classroom and laboratory activities [11]. The use of GDL-based acid and base modules can improve Critical Thinking Skill (CTS) and student learning outcomes with a very high level of effectiveness [12]. GDL-based modules can help students define and understand concepts [13] as well as pictures, tables, and readings in the module can help students answer the questions in the module [14].

Research conducted by Asmiyunda (2018) shows that e-modules can help students in learning because they are equipped with various learning facilities [15]. E-modules can be used as alternative teaching materials because e-modules help students master the material being taught [16]. In the e-module there are pictures and videos that are relevant to the acid-base material presented so that they can improve students' understanding and learning motivation [17]. E-modules are made as attractive as possible so that they can motivate students to read the material [18].

Based on the background that has been presented, an e-module based on guided discovery learning was developed for acids and bases. This study aims to analyze the level of validity and practicality of the acid and base e-module based on guided discovery learning for class XI SMA/MA.

II. Method

The development model used in this study is the Plomp development model [19]. The Plomp development model has three stages of development, namely: (1) preliminary research (preliminary research); (2) prototyping stage (prototyping); (3) assessment phase (assessment stage).

1.1 Preliminary Research

Needs Analysis

Needs analysis was conducted to determine the extent of the fundamental problems in learning chemistry through literature study. The literature study includes acid and base materials, guided discovery learning models, the use of teaching materials in chemistry learning, and the demands of the 2013 curriculum.

Context Analysis

The context analysis stage is carried out by examining the curriculum used in the pilot school, namely the 2013 KD Essentials curriculum. The purpose of this analysis is to study the scope of learning objectives, materials, and strategies chosen as the basis for developing learning tools.

Study of literature

What is done at this stage of literature study is the search for sources and references related to research activities. The supporting sources and references are in the form of seven books and seventeen journals related to research.

Conceptual Framework Development

The activities carried out at this stage are identifying, detailing, and compiling the main concepts that must be mastered by students, namely: acid solution, base solution, acid and base theory, conjugate acid, conjugate base, strong acid, weak acid, strong base, weak base, acid ionization constant (Ka), base ionization constant (Kb), acidity degree (pH), degree of ionization, and acid base indicator. Where the preparation of the concept is presented in the form of a concept analysis table which will facilitate the making of concept maps and the preparation of materials for acids and bases.

1.2 Prototyping Stage

The activities carried out at this stage are designing initial terms of reference and prototypes. This activity is cyclical, where there are three forms of activity, namely design, formative evaluation, and revision.

Prototype I

The thing that needs to be done before designing prototype I is to determine the initial reference in the e-module component. After the initial reference, prototype I was designed in the form of an e-module based on guided discovery learning based on the basic competencies contained in the 2013 curriculum syllabus.

The design of the e-module is adapted to the stages of the guided discovery learning model which has five stages, and the model is adapted to the learning objectives of acids and bases. The design model for this e-module is in the form of animated videos, tables, pictures, and general information.

The evaluation questions are designed to measure students' ability and understanding of acids and bases. Then make answer keys from student activity sheets and evaluation questions. The purpose of making this answer key is to make it easier to check the answers that have been done by students.

Prototype II

Activities on prototype II will be carried out formative evaluation of the prototype I that has been produced. The formative evaluation is carried out in the form of self-evaluation or self-evaluation using a checklist system for the components that must be in the e-module. The instrument used in the self-evaluation is a self-evaluation questionnaire sheet. Further revisions are made to the evaluation results and prototype II will be produced.

Prototype III

Formative evaluation was carried out on prototype II which had been produced in the form of expert review and one-to-one evaluation so that prototype III was produced. The instrument used in the expert review is in the form of a validity questionnaire and one to one evaluation in the form of an interview questionnaire via google form. The validity data were analyzed using the Aikens'V scale.

Prototype IV

The test carried out at this stage is a small group evaluation. This small group evaluation was carried out by six students with different abilities. The instrument used is a practicality questionnaire with data analysis techniques using descriptive statistical percentages.

1.3 Assessment Phase

The practical test carried out at this stage of the assessment phase is a field test. Where the field test was conducted by three chemistry teachers and 21 students with different abilities.

The acid and base e-module used is based on guided discovery learning (GDL), while the syntax in this guided discovery learning learning model has five syntaxes, namely (1) motivation and problem presentation, (2) selection of learning activities, (3) data collection, (4) data processing, and (5) closure [2]. The GDL learning model is modified into five stages of learning: (1) motivation and problem presentation; (2) data collection (data collection); (3) data processing (data processing); (4) verification (verification); and (5) closure [20]. The subjects of this study were lecturers in the chemistry department, FMIPA UNP, engineering lecturers at FT UNP, high school chemistry teachers, and class XI students at SMAN 2 Payakumbuh.

The instrument used is a validity and practicality questionnaire. The validity questionnaire used aims to assess the validity of the acid and base e-module based on guided discovery learning produced. This e-module was validated by chemistry lecturers, FMIPA UNP and chemistry teachers. While the practicality questionnaire aims to determine the level of practicality of using the acid and base e-module based on guided discovery learning produced. This practicality questionnaire is addressed to chemistry teachers and students.

The type of data obtained from this research consists of quantitative data and qualitative data. The results of the quantitative data were obtained from filling out validity questionnaires by the validator, and filling out practicality questionnaires by chemistry teachers and students. Meanwhile, qualitative data were obtained from suggestions given by validators and practitioners. The data analysis technique used for content validity and construct validity is the Aikens'V formula [21]. Technical analysis of practical data using descriptive statistics.

III. Results and Discussion

1.4 Preliminary Research

Needs Analysis

The results obtained at this stage of needs analysis are acid and base material which is difficult for students to understand. Teaching materials used by students for learning acids and bases are still in the form of printed teaching materials that have not been fully able to direct students to find the concept of acid and base materials independently. To assist students in discovering the concepts of acids and bases, teaching materials in the form of an acid and base e-module based on guided discovery learning were developed for class XI SMA/MA.

Context Analysis

The results of the context analysis are the analysis of basic competencies (KD) and learning materials where the acid and base material in the syllabus is found in KD 3.8 explaining the concept of acids and bases as well as their strengths and ionizing equilibrium in solution and KD 4.8 analyzing the pH change trajectories of several indicators extracted from natural materials by experiment. Based on these basic competencies, indicators of competency achievement and learning objectives are formulated on acid and base materials.

Study of literature

The results obtained from the study of literature from sources and references related to research are in the form of a conceptual framework. The conceptual framework can be seen in Figure 1 below.

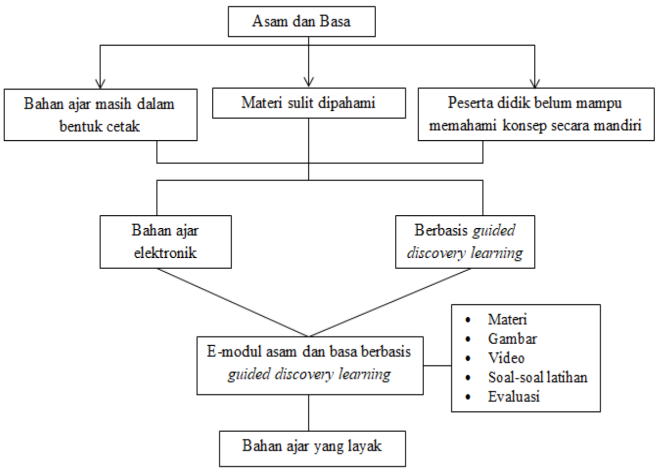

Figure 1. Conceptual framework

1.5 Prototyping Stage

Prototype I

The results obtained at the first prototype stage were the design of an acid and base e-module based on guided discovery learning. The components contained in the e-module consist of cover, introduction, table of contents, list of tables, list of pictures, glossary, concept map, brief description of the material, instructions for using the e-module, KD, GPA, activity sheet according to the syntax. guided discovery learning, practice questions, evaluations, and answer keys. The following is an example of a learning video displayed in the e-module which can be seen in Figure 2.

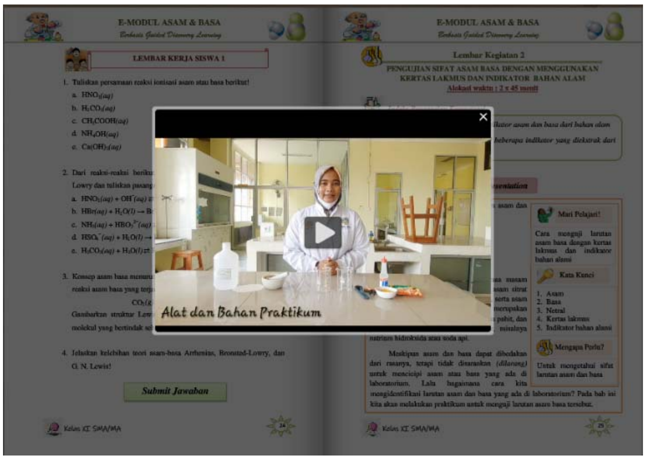

Figure 2. Video Display on E-Modul

Prototype II

The revision that was made to prototype II in the self-evaluation stage was the addition of a glossary to the e-module.

Prototype III

The results of this prototype III are in the form of expert review and one-to-one evaluation.

Expert Review

The results obtained from the expert review are the validity of the e-module. This expert review was conducted by five material experts and two media experts. This validity test is carried out in order to get a valid prototype III.

The analysis of the validity of the developed e-module content was validated based on the aspects of the suitability of the e-module content with the GDL stages and the correctness aspect of the e-module content with chemical scientific content. The content validation results obtained are 0.81 with a valid category [22].

Table 1. Content Validity Test Results

KD	*Aikens'V*	Category
3.8.1	0.81	High validity
3.8.2	0.8	High validity
3.8.3	0.79	Medium validity
3.8.4	0.86	High validity
3.8.5	0.8	High validity
3.8.6	0.8	High validity
Average	0.81	High validity

The next validity test is the construct validity test. The components assessed in construct validity are content, language, presentation, and graphics. The results of the construct validity of the e-module developed from all components are already valid, with an average of 0.86 [23]. The construct validity analysis table can be seen in Table 2.

Table 2. Construct Validity Test Results

Rated aspect	*Aikens'V*	Category
Contents	0.87	High validity
language	0.86	High validity
Presentation	0.82	High validity
Graphics	0.86	High validity
Average	0.85	High validity

This shows that the acid and base e-module produced is in accordance with the curriculum demands on acid and base material, which includes aspects of the suitability of the material to be achieved with KI, KD, and learning objectives to be achieved and adapted to the learning abilities of participants. educate.

The next validation is media expert validation, the data obtained from the media expert validation results show that the resulting e-module is valid with an average Aikens'V value of 0.95. Where the category of validity in this media expert validation consists of three aspects, namely: aspects of appearance, programming, and benefits with each Aikens'V value: 0.97; 0.96; 0.93. The results of the media expert validity analysis can be seen in Table 3.

Table 3. Media Expert Validity Test Results

Rated aspect	*Aikens'V*	Category
Appearance	0.97	High validity
Programming	0.96	High validity
Benefit	0.93	High validity
Average	0.95	High validity

From the three aspects above, it can be said that the font size on the e-module is correct and clear, the use of icons/symbols in the e-module can be understood, and some illustrations, pictures, or videos can help students understand the material. Then the acid and base e-module produced was revised according to the validator's suggestion, so prototype IV was produced.

One to One Evaluation

This one-to-one evaluation trial was conducted on three students with different abilities. The results of one to one evaluation obtained that prototype III is good in terms of presentation of material, language, questions and e-module display. It can be concluded that the developed acid and base e-module can help students understand acid and base material in the learning process.

Prototype IV

The results obtained in the small group trial for each category were ease of use; 94%, learning time efficiency; 93%, and benefits; 91%. So for the overall results obtained an average practicality value of 92% with a very practical category.

1.6 Assessment Phase

The practical test carried out at this stage of the assessment phase is a field test. The results of the field test analysis obtained for the ease of use category from teachers and students are 88% and 92%, respectively, in the very practical category. This shows that the resulting e-module is practical so that it is easy to use.

From the aspect of time efficiency, the results of practical analysis by teachers and students are as much as; 96% and 93% with the category of very practical practicality. From these data, it can be seen that using e-modules can help students learn more efficiently, can help students learn on their own according to their abilities and do not depend on other students.

In terms of the benefits of the resulting e-module, it is considered practical, this can be seen from the practicality data obtained from teachers and students by 89% and 90% with the practicality category being very practical. This proves that the e-module produced is very helpful for students in understanding the material and is assisted by the presence of photos, images, or videos contained in the e-module. The average practicality value of e-modules at this field test stage is 91% with a very high practicality category.

IV. CONCLUSION

Based on the research that has been done, it can be concluded that the acid and base e-module based on guided discovery learning that has been produced is valid and practical. It is hoped that further researchers will test the effectiveness of the acid and base e-module based on guided discovery learning that has been developed.

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