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Validity and Practicality of E-Module Chemical Equilibrium Based on Guided Discovery Learning for Class XI SMA/MA

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***Abstract*— One of the 21st century learning demands is the integration of information and communication technology in the learning process. E-Module is one of the electronic teaching materials that can help students in the learning process. This study aims to analyze the validity and practicality of the developed e-module. This type of research is development studies with the Plomp development model. The Plomp development model consists of three stages, namely preliminary research, prototyping phase and assessment phase. The e-module validity test was carried out by three chemistry lecturers of FMIPA UNP, three informatics engineering lecturers of FT UNP, and four chemistry teachers. The e-module practicality test was carried out by four chemistry teachers and 25 students of class XII IPA MAN 1 Payakumbuh for the 2021/2022 academic year. The research instrument used was a validity and practicality questionnaire. The results of the validity of the e-module content were analyzed using the CVR formula, while the results of construct validity, media validity and practicality were analyzed using the Aiken's V formula. From the result of validity data analysis, the values of content validity, construct validity and media validity were 0.90, 0.84 and 0.86 respectively, with valid categories. The results of practicality data analysis for teachers and students obtained 0.85 and 0.82 with practical categories. Based on the results of the study, it was concluded that the chemical equilibrium e-module based on guided discovery learning for class XI SMA/MA which was developed was valid and practical.**

Keywords— E-Module, Guided Discovery Learning, Chemical Equilibrium, Validity, Practicality

I. INTRODUCTION

The implementation of the 2013 curriculum in learning uses a scientific approach that requires students to be actively and independently involved in the learning process [1]. To support this, one model that can be applied is guided discovery learning. Guided discovery learning model is a learning model that encourages students to build meaningful knowledge, where students are directed to find concepts with teacher guidance [2]. The application of the guided discovery learning model in the learning process can improve learning outcomes [3], learning achievement [4], communication skills [5] and students' critical thinking skills [6].

To support the implementation of the guided discovery learning model, teaching materials are needed. One of the teaching materials that can be used is a module. The use of modules, especially in chemistry learning, can improve learning outcomes [7], critical thinking skills [8], and students' logical thinking skills [9]. However, with the demands of 21st century learning, namely the application of science and technology in the learning process, the use of print modules can be transferred to electronic modules (E-Modules).

E-Module is an electronic teaching material that can contain text, images and videos so that the learning process becomes more interesting and interactive [10]. Several e-modules based on guided discovery learning in chemistry learning have been developed and have shown valid and practical results, such as salt hydrolysis [11] and electrolyte and nonelectrolyte solutions [12]. The use

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of e-modules in the learning process is effective in improving students' learning outcomes [13] and scientific literacy [14].

One of the materials studied in class XI SMA is chemical equilibrium. Broadly speaking, chemical equilibrium studies dynamic equilibrium, equilibrium constants and the factors that affect chemical equilibrium shifts [15]. Chemical equilibrium material requires analytical skills from students because it contains abstract concepts, so in this case it can be assisted with teaching materials that can present animations and videos so that they can increase students' understanding of chemical equilibrium material.

According to the results of the questionnaire analysis given to teachers and students of class XII MAN 1 Payakumbuh and SMAN 2 Payakumbuh, it was found that most of the teaching materials used by teachers in the learning process were still in the form of printed teaching materials, while the demands of the 2013 curriculum were the application of information technology in learning. On the other hand, the readiness of student resources in the field of technology is very supportive in the learning process, such as almost all students have smartphones, and the high intensity of students in using gadgets and accessing the internet, so that this can be utilized in the learning process. From this background, a research was conducted on the development of a chemical equilibrium e-module based on guided discovery learning for class XI SMA/MA.

II. METHODOLOGY

This research is classified as development studies with the Plomp development model. This model has three stages, namely: (1) preliminary research; (2) prototyping phase; and (3) assessment phase [16]. The subjects of this study were three chemistry lecturers of FMIPA UNP, three informatics engineering lectures of FT UNP, four chemistry teachers and 25 students of class XII IPA MAN 1 Payakumbuh.

This research was conducted to the stage of testing the validity and practicality of the developed e-module. The data collection instrument used was a validity and practicality questionnaire. The types of data obtained are quantitative data and qualitative data. The data obtained were analyzed using the CVR formula and the Aiken's V formula.

III. RESULT AND DISCUSSION

Preliminary research. In the preliminary research stage, needs and context analysis, literature review and conceptual framework development were carried out. This stage is carried out by distributing questionnaires to teachers and students and looking for references from various literatures to solve problems regarding teaching materials, especially chemical equilibrium materials. The results of the analysis show that the teaching materials used in schools are generally still in the form of printed teaching materials that have not been maximally used. Meanwhile, chemical equilibrium material is a complex material that requires analytical skills from students. In accordance with the demands of the 2013 curriculum, namely the application of information technology in the learning process, then the development of teaching materials in the form of e-modules with guided discovery learning models is carried out which can direct students to be active and independent in finding concepts in chemical equilibrium material.

Prototyping Phase. At this stage, several steps are carried out. First, the design of a chemical equilibrium e-module based on guided discovery learning was carried out, where the design was realized in the form of prototype I. Prototype I was evaluated by self-evaluation to see the completeness of the components of the developed e-module. The results of the evaluation resulted in prototype II. Prototype II was re-evaluated through expert review and one to one evaluation. The expert review was conducted by seven material expert validators. The validator evaluates the e-module in terms of content and constructs. The results of the e-module content assessment can be seen in table 1 below.

Table 1. Results of E-Module Content Validity Data Analysis

No	Rated aspect	Average CVR	Validity
1	Compatibility of e-module content with guided discovery learning syntax	0.90	Valid

2	Compatibility of e-module content with chemical scientific content	0.91	Valid
Average		**0.90**	**Valid**

Based on table 1, the average CVR value for the suitability of the content of the e-module to the syntax of guided discovery learning is 0.90 and the suitability of the content of the e-module with the content of chemistry is 0.91. Overall, obtained an average value of 0.90 with a valid category for the validity of e-module content. The E-Module can be said to be valid according to the CVR if the CVR value is ≥ 0.622. The acceptance of each statement item in the validation questionnaire if it has a CVR value $\geq$ critical value based on the number of validators specified [17]. Therefore, the developed e-module can be said to be valid according to the stages of guided discovery learning and the suitability of the e-module content with chemical content. The validator also performs an assessment in terms of the e-module construct. Assessment in terms of constructs includes components of content, language, presentation and graphics. The results of the assessment can be seen in table 2 below.

Table 2. Results of E-Module Construct Validity Data Analysis

No	**Rated aspect**	***V***	**Category Validity**
1	Content Component	0.83	Valid
2	Language Component	0.84	Valid
3	Components of Serving	0.84	Valid
4	Graphics Component	0.86	Valid
Construct Validity Average		**0.84**	**Valid**

Based on table 2, the scores for each component of the assessment were obtained. From the content component, a V value of 0.83 with a valid category, meaning that the content of the e-module was in accordance with the KD and IPK as well as the learning objectives of the chemical equilibrium material. From the linguistic component, a V value of 0.84 with a valid category, meaning that the language used is in accordance with good and correct Indonesian rules and is easy to understand. From the presentation component, a V value of 0.84 with a valid category, meaning that the presentation of the e-module was in accordance with the learning objectives and the syntax of guided discovery learning. From the graphic component, a V value of 0.86 with a valid category , meaning that the e-module design is already attractive, both in terms of font, color and layout. The average value of all components is 0.84, which means that all e-module components are valid.

The e-module was also validated by three media experts. Aspects assessed include aspects of display, programming and benefits. The results of the assessment can be seen in table 3 below.

Table 3. Results of E-Module Media Validity Data Analysis

No	**Rated aspect**	***V***	**Category Validity**
1	Display aspect	0.85	Valid
2	Programming aspects	0.84	Valid
3	Benefit aspect	0.89	Valid
Average Validity of Media		**0.86**	**Valid**

From table 3 above, obtained the value of each aspect. From the display aspect, a V value of 0.85 with a valid category, meaning that the e-module display already has a good appearance and an attractive design. From the programming aspect, a V value of 0.84 with a valid category, meaning that the media used is efficient and the icons used in the e-module are easy to understand. From benefits aspect, a V value of 0.89 with a valid category, meaning that the e-module is interactive and easy to use. Overall obtained an average value of 0.86, meaning that the media used in the e-module is valid.

Furthermore, a one-to-one evaluation test was conducted by distributing questionnaires to three students with different abilities. The results of the questionnaire analysis showed that the e-module developed was very good in presenting the material. In addition, the use of models such as pictures, tables, videos and animations can help students to understand the material. Based on suggestions from expert reviews and one to one evaluation, the e-module was revised to produce a valid prototype III. Prototype III was then tested on six students (small group). Aspects assessed include ease of use, time efficiency and benefits. The results of the assessment at the small group stage can be seen in table 4 below.

Table 4. Results of Small Group Test Practicality Data Analysis

No.	**Rated aspect**	***V***	**Category**
1.	Ease of Use	0.83	Practical
2.	Time efficiency	0.83	Practical
3.	Benefit	0.81	Practical
Average		**0.83**	**Practical**

Based on table 4 above, obtained the value of each aspect. From the aspect of ease of use, a V value of 0.83 with practical category, meaning that the contents of the e-module are clear as a whole and easy to use. From the aspect of time efficiency, a V value of 0.83 with practical category, meaning that the use of e-modules in the learning process makes learning time efficient and students can learn at their own pace. From the aspect of benefits, a V value of 0.81 with practical category, means that e-modules can increase students' motivation to learn independently. Overall, the average value of all aspects is 0.83 with practical category. Furthermore, the e-module was revised to produce a practical prototype IV based on suggestions from practitioners.

Assessment phase. At this stage, a field test of the e-module was conducted by teachers and students. The assessment includes aspects of ease of use, time efficiency and benefits. The results of the assessment can be seen in table 5 below.

Table 5. Results of the Field Test Analysis of Teachers and Students

No	**Rated aspect**	**Teacher**		**Students**	
		V	**Category**	***V***	**Category**
1.	Ease of use	0.87	Practical	0.82	Practical
2.	Learning time efficiency	0.84	Practical	0.81	Practical
3.	Benefit	0.83	Practical	0.82	Practical
Average		**0.85**	**Practical**	**0.82**	**Practical**

From table 5 obtained the value of V for each component of the assessment of teachers and students. Teacher ratings for aspects of ease of use, efficiency of learning time and benefits are 0.87, 0.84 and 0.83, respectively. The average value of all aspects according to the teacher's assessment was obtained by V of 0.85 with practical category. Student assessments for aspects of ease of use, time efficiency and benefits are 0.82, 0.81, and 0.82, respectively. The average value of all aspects according to students obtained a V value of 0.82 with practical category. The results of the data analysis show that the e-module is practical in its use, the overall content of the e-module is easy to understand, and the language used is easy to understand. The developed e-module makes learning time more efficient and can be used according to the learning speed of each student. The guided discovery learning syntax used in the e-

module supports the teacher's role as a facilitator in learning. In addition, the syntax of guided discovery learning also increases students' motivation in learning activities and encourages students to learn independently.

IV. CONCLUSION

Based on the research conducted, it can be concluded that the chemical equilibrium e-module based on guided discovery learning for class XI SMA/MA that was developed is valid and practical. Future researchers are expected to be able to test the effectiveness of the discovery learning-based chemical equilibrium e-module for class XI SMA/MA.

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