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Develop of Guided Discovery Learning Based Electronic Module on Chemical Equilibrium Topic for Senior High School Grade Eleven

Silvia Darma[1], Budhi Oktavia[2], Yerimadesi[3], Syamsi Aini[4]
[1]Universitas Negeri Padang, Padang (Indonesia)
[2]Universitas Negeri Padang, Padang (Indonesia)
[3]Universitas Negeri Padang, Padang (Indonesia)
[4]Universitas Negeri Padang, Padang (Indonesia)

Abstract:- The limited use of teaching materials during the Covid-19 pandemic caused the authors to be interested in conducting research on the development of electronic-based teaching materials that can be used anytime and anywhere and equipped with a learning model suggested by the curriculum. The purpose of this research is to determine the validity and practicality of the guided discovery based chemical equilibrium factor e-module. The development of e-modules uses a type of 4-D development research which consists of the initial investigation, stagethe prototype making stage, and the assessment stage. The subjects of the research were three chemistry lecturers at Padang State University, two chemistry subject teachers, and sixteen grade eleven students at SMA Negeri 1 Airpura. The research was conducted in the environment of SMA Negeri 1 Airpura in April 2021. The assessment instrument used was a validity questionnaire and a practicality questionnaire. The data from the validity and practicality questionnaires were processed using data analysis techniques according to the kappa moment formula. The e-module validity value was obtained at 0.86 and the e-module practicality value was 0.89. Thus, it can be concluded that the e-module being developed has very high validity and practicality.

Keywords:- *E-Module, Chemical Equilibrium Factor, Guided Discovery Learning, 4-D Development Model.*

I. INTRODUCTION

The development of technology and information in every element of the field of science, including in the field of education, can be used as a support for the learning process. One of the utilization of information technology in education is the development of learning media or electronic teaching materials. This is also in line with the demands of the 2013 curriculum which hopes that learning can help students to be skilled in using the media of information, communication and technology (ICT) which is needed in the 21st century. In addition, during the Covid-19 pandemic of this time, some large education units, especially senior high schools, undertake distance learning. So that learning media or electronic-based teaching materials is needed.

Efforts that can be made to support the implementation of learning in accordance with the demands of the curriculum and technological developments can be done by developing additional teaching materials that can be used in independent learning activities in finding concepts. One of them is in the form of an electronic module which is equipped with models, approaches, and learning methods that are in accordance with the 2013 curriculum. E-module is a display of information in a book format that is presented electronically using a hard, floppy disk, CD, or flash disk, and can be read using computers, smartphones, and other electronic readers. Concluded that the result of learning using a chemical e-module based on Problem Solving is better than conventional learning, this is evidenced by the significance values obtained of 0.004 and 0.011 [8].

Based on the results of a questionnaire for students, one of the chemical lessons that is classified as a difficult lesson is Chemical Equilibrium. This corresponds with what was said by Sheehan, that one of the lessons in high school chemistry which is classified as difficult for students is chemical equilibrium. There are several factors that cause this lesson to be difficult, including: (1) the concepts in chemical equilibrium are almost entirely abstract; (2) it takes good mathematical skills from students in solving calculation problems; (3) students must understand previous concepts, such as the concepts of reaction rate, solution concentration, mole concept and stoichiometry [7]. To be able to understand this chemical equilibrium lesson, a learning model is needed that is in accordance with student needs and material characteristics. one of them is the guided discovery learning model. The teacher has a role to motivate and facilitate students during the learning process [1]. Concluded that using the guided discovery learning model showed the percentage of completeness of the biology learning outcomes of second grade students of SMA Negeri 2 Sukoharjo in the domains of knowledge, skills, and attitudes respectively (80%, 45.71%, and 80%) [10]. In addition, students' critical thinking skills can also be developed with the Guided Discovery Learning learning model [3].

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This research harvest, there are several objectives to be achieved, creating a guided discovery learning based e-module on chemical equilibrium lesson using the plomp model, revealing the validity of using e-Module Based on Guided Discovery Learning for SMA / MA class XI students, and revealing the practicality of using e-Module Based on Guided Discovery Learning for students of class XI SMA / MA.

II. LITERATURE REVIEW

A. Definition of Electronic Module (E-module)

E-module has several advantages in its use, such as: it can increase student learning motivation, because every learning activity is always clearly limited according to their abilities, after evaluating, teachers and students know the achievement of learning outcomes so that students know which parts of the lessons that has not been understood by student yet. The learning materials are evenly divided in one semester, education is more meaningful because the teaching materials are arranged according to their academic level, the presentation of material is more interactive and more dynamic, the high cost of the printed module can be reduced by presenting visual elements using video tutorials provided by electronic module [5]. Stated that one form of interactive learning media that utilizes smart phones is an android-based interactive e-module using Sigil Software [6]. Sigil Software can convert word files into ePub extension files that can be read on the Skoob ePub Ebook Reader application. Sigil is an open source editor software for epub. Epub (electronic publication) is a digital format which is a standardized format introduced by the International Digital Publishing Forum (IDPF) in 2011. The advantage of Sigil software compared to other epub format editor software is that we can access it offline and online. In addition, there is also a feature to add links that can later be opened directly from the e-module that is being opened or used.

B. Guided Discovery Learning Model

Guided discovery is a student-centered learning model with the help and guidance of the teacher by giving questions that lead to finding a point of conclusion [4]. The guided discovery model is designed to increase student activity. It is more process-oriented and finds information to achieve learning goals, and educators act as facilitators in learning activities [11]. Apart from being a facilitator, the teacher also acts as a motivator for students in the learning process [1].

Guided discovery involves students in answering questions from the teacher. The question given is a constructive question. The questions given can stimulate students to produce the right perspective on teaching material [2]. From some of these opinions, it can be concluded that the guided discovery model is a learning model that involves students actively trying to find out for themselves the expected information and knowledge with the guidance and instructions provided by the teacher. According to Markaban, it is concluded that the advantages of the guided discovery learning model are that students can be more active in learning activities, and students can have the ability to build concepts about the material that has been taught, as well as other advantages, namely learning that has been obtained can last longer in memory. because in learning students find their own concepts from the material being studied. While the drawback is that it takes a relatively long time to implement this learning model.

C. Material Characteristics of Chemical Equilibrium

Chemical equilibrium is a chemistry lessons for second grade of Senior High School (SMA) students. Chemical equilibrium is one of the subjects of chemistry with abstract and complex concepts. This subject covers concepts and calculations. Although students can solve various kinds of calculation problems on determining the value of the equilibrium constant (Kp and Kc), for example, the calculation of the value of the equilibrium constant (Kc) with other equilibrium constants is known, but it does not guarantee that these students can understand the concepts contained in the lesson. In addition, chemical equilibrium material requires several concepts such as reversible reactions, irreversible reactions, dynamic equilibrium, the influence of several factors on the direction of equilibrium shifts such as the effect of pressure, volume and concentration. Therefore, to be able to understand the lesson of chemical equilibrium as a whole, students must understand the concepts of the previous material, for example the concept of reaction rates, chemical equations and also do a lot of counting exercises.

III. METHODOLOGY

A. Data Collection Strategies

This type of research is the 4-D mode development research [9]. This research is limited to the develop stage, it is testing the validity and practicality of the e-module which is being developed. The subjects of the research were three chemistry lecturers at Padang State University, two chemistry subject teachers, and sixteen grade eleven students at SMA Negeri 1 Airpura.. The defining stage was carried out by determining and defining the conditions of learning. This stage began by analyzing the objectives of the material boundaries based on the 2013 revised 2019 Curriculum syllabus. This stage included: (a) front end analysis was carried out by interviewing chemistry teachers to find and determine the basic problems faced by teachers and students in learning chemistry; (b) student analysis was carried out by distributing questionnaires to students to identify student characteristics that are relevant to the design and development of learning tools; (c) task analysis was carried out by analyzing Basic Competence (KD) 3.9 and 4.9 to obtain learning indicators on chemical equilibrium lesson; (d) concept analysis was carried out by analyzing the main concepts discussed in the chemical equilibrium material to design a concept map; (e) the formulation of learning objectives was carried out by changing the results of task analysis and concept analysis into learning objectives.

The design stage aims to design teaching materials that relevant to design the results of the analysis at the define stage. This stage includes: (a) the preparation of tests was

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carried out by arranging questions based on the learning objectives that have been formulated; (b) media selection was done by selecting relevant learning media on equilibrium lessson, it was teaching materials in the form of guided discovery-based e-modules; (c) format selection was done by choosing the e-module writing format, namely according to the guidelines for developing teaching materials; (d) the initial design was done by designing an e-module based on the e-module writing format and guided discovery learning syntax. The development stage aimed to produce a guided discovery-based chemical balance e-module that is valid and practical for use in the learning process of high school students. This stage included: (a) a validity test was carried out to reveal the level of validity of the e-module being developed; (b) revision was done by improving the e-module according to the validator's suggestion; (c) product testing was carried out to determine the level of practicality of the e-modules produced. The research was limited only to the develop stage due to time and cost limitations. The research data collection instruments used were a validity questionnaire (addressed to chemistry lecturers of FMIPA UNP) and a practicality questionnaire (consisting of teacher and student response questionnaires). The validity questionnaire was used to assess the quality of the content validity and the construct validity of the e-module being developed. Practicality questionnaires were used to determine the level of practicality of using e-modules developed for teachers and students.

B. Data Analysis and Synthesizing

Data collecting technique were disseminated the questionnaire and the analysis of the result were done using Kappa Cohen formula:

$$moment\ kappa\ (k) = \frac{P_o - P_e}{1 - P_e}$$

information :
k (kappa moment)
ρ_0 (The division between the value given by the validator and the maximum value)
ρ_e (the maximum value is reduced by the value given by the validator and divided by the maximum value)

TABLE 1.
Categories Of Decisions Based On Kappa Moments

Interval	Kategori
0,81-1,00	Sangat Tinggi
0,61-0,80	Tinggi
0,41-0,60	Sedang
0,21-0,40	Rendah
0,00-0,20	Sangat Rendah
<0,00	Tidak Valid

IV. RESULT AND DISCUSSIONS

A. Define Stage (Definition)

1) *Front-End Analysis:* Based on interviews with several chemistry teachers in the pesisir selatan districts, it was obtained the following data: (1) the level of students' understanding of chemistry learning especially in the chemical equilibrium lesson is still low; (2) teaching materials used in learning process in the form of textbooks and worksheets

2) *Student Analysis*: The results of student analysis through distributing questionnaires obtained the following data: (1) 60% of students think thermochemistry is difficult; (2) the teaching materials used in the learning process has not presented experimental activities; (3) students like learning styles 50% visual, 50% audio, and 90% kinesthetic.

3) Task Analysis:

TABLE 2:- SYLLABUS ANALYSIS OF CHEMICAL BALANCE MATERIAL

Basic competencies (KI 3)	**Basic competencies (KI 4)**
3.9 To analyze the factors that influence the shift in the direction of equilibrium and its application in the industry.	4.9 Designing, conducting, and concluding and presenting the experimental results of the factors that influence the shift in the direction of equilibrium
Indicators of Competence Achievement	**Indicators of Competence Achievement**
3.9.1 To analyze the effect of increasing the concentration on the shift in the direction of chemical equilibrium 3.9.2 To analyze the effect of temperature on the shift in the direction of chemical equilibrium. 3.9.3 To analyze the effect of pressure and volume on the shift in the direction of chemical equilibrium.	4.9.1 Describe the optimum conditions for producing industrial chemicals based on equilibrium reactions

4) Concept Analysis: The main concepts of chemical equilibrium lesson include the concept of reversible reactions and irreversible reactions, dynamic equilibrium, chemical equilibrium, temperature, pressure, volume, and concentration.

5) Formulation of Learning Objectives: Based on the Competency Achievement Indicators (GPA), the learning objectives of this material were formulated as "Through the guided discovery learning model by extracting information from various learning sources, simple investigations and information processing". It is expected that students are actively involved during the teaching and learning process, have a curious attitude. , be careful in making observations and be responsible in expressing opinions, answering questions, giving suggestions and

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criticism, and being able to explain the concept of the effect of increasing concentration, temperature, pressure and volume on the direction of shifting chemical equilibrium.

B. Designing Stage (Design)

The E-Module based on guided discovery chemistry is structured to contain the following components: (1) cover page; (2) instructions for using the e-module; (3) competencies achieved; (4) concept map; (5) activity sheet; (6) worksheets; (7) evaluation sheet; and (8) key evaluation sheet. These e-module components are the components which have been modified so that the components are more complete. The E-Module contains guided discovery learning syntax which consists of (1) motivation and problem presentation; (2) data collection; (3) data processing; (4) verification and (5) closure.

C. Developing Stage (Development)

1) *Validity test:* Validation was carried out by the three chemistry lecturers at Padang State University and two chemistry subject teachers at SMA Negeri 1 Airpura.. The results of the validation are used to reveal the feasibility of the content, language components, presentation components, and graphics components of the developed module. The results obtained can be seen in Figure 1.

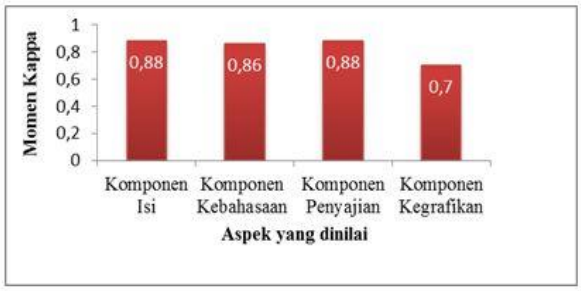

Fig 1. Results of the Validator Data Analysis

The results of the expert validation from the four components were 0.88; 0.86; 0.88; and 0.70 so that the average Kappa moment of e-module validity is 0.86. These results indicate that the resulting e-module has a very high validity category. The validation results obtained from the validator then made several revisions to the e-module design which was developed based on the suggestions of the validator.

2) *Revision:* Revisions were made to correct the incorrect part of the e-module based on suggestions and advise from the validator before testing the product.
3) *Product Trial (Practicality Test):* The practicality of the guided discovery-based equilibrium e-module can be seen from the use of the product from limited trials in the field regarding the practicality and feasibility of the product being developed. Practicality data were obtained from teacher and student response questionnaires. The results of the analysis of the e-module practicality assessment data from teachers and students can be seen in Figure 2.

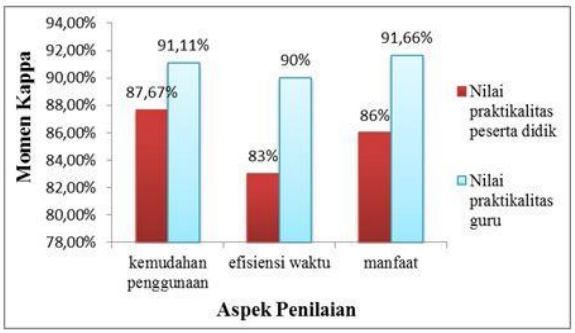

Fig 2. Results of e-module Practicality Analysis of Teacher and Student Responses

Based on the graph above, the results of the practicality of the electronic module which was assessed by teachers and students exhibited the value 0,91 and 0,87 respectively with the very high practicality category.

V. CONCLUSION

Based on the study that has been carried out, it can be concluded as follows.

1) Guided discovery based chemical equilibrium e-Module for second grade of SMA / MA students have been created using the 4-D development model.
2) The e-Module has a very high validity category
3) The e-Module has a very high practicality category.

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