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Article

Development of Chemical Equilibrium E-Learning Content Based on Guided Discovery Blended Learning for Senior High School

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Abstract— The Covid-19 pandemic suddenly hit Indonesia so the situation was out of control, including in the world of education. The government through the Ministry of Education and Culture, the education office, educators and education staff, students, and the public are confused because they must carry out distance learning online, offline, and a combination. In this study, the development of E-learning on chemical equilibrium material based on guided discovery learning was carried out using the Plomp development model. Three high school chemistry teachers validated E-learning. The practicality test carried out in class XI SMAN Mapat Tunggul Selatan. This study aims to help the learning process in the era of the covid-19 pandemic. Content and construct validation obtained scores of 0.86 and 0.88. Based on the practicality test, this e-learning was declared valid and feasible with the support of the Aiken's test of 0.83. The result of e-learning can be used in teaching and learning activities. E-learning can also be accessed easily anytime, anywhere, and with anyone with full use of internet access.

Keywords— **Elearning, Discovery Guided Learning, Blended Learning, Chemical Equilibrium**

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I. INTRODUCTION

Education is the main pillar in advancing the nation. In order to achieve quality education, the learning process carried out must be maximized so that the nation's successors can compete globally in the future. To obtain maximum results, one of the government's efforts is to develop a 2013 curriculum. This curriculum embraces affective, cognitive and psychomotor aspects simultaneously. The purpose of the 2013 curriculum is to form a generation that has knowledge and abilities that are qualified and characterized [1]. To implement the 2013 curriculum, normal conditions are needed, as was the case when this curriculum was initiated. However,

The COVID-19 pandemic appeared suddenly, so neither party was prepared to deal with this situation. One sector that has experienced significant changes is the education sector. The learning process is usually done face-to-face, so it turns into a virtual face-to-face. To deal with this situation, the government issued a new circular through the minister of education No. 4 of 2020 which stated that during the Covid-19 emergency period distance learning (PJJ) was carried out, either online, offline or a combination of both.[2].

Distance learning and combination requires teachers to update their abilities, especially in the field of information technology. One of the learning media used is e-Learning. E-learning is a learning process that utilizes a computer that contains all the materials needed for learning [3]. Teachers and students can access anytime, anywhere and with anyone with the condition that they must be connected to the internet network. Teachers can access e-learning to upload teaching materials and student assignments. Meanwhile, students can access for learning needs and upload assignments and take quizzes in accordance with the provisions that have been agreed with the teacher.

MOODLE (Modular Object Oriented Dynamic Learning Environment) is an application that is structured based on learning needs that is equipped with many features. MOODLE is designed to assist the implementation of the learning process by using the principles of social constructionist pedagogy and internet networks. Moodle development does not change the teacher's teaching style but supports the development of the teacher's teaching style [4].

Learning and combinations will not be carried out properly if they do not use a learning model. One learning model that is suitable for use in online learning is guided discovery learning (GDL) [5]. The GDL learning model is also recommended for the implementation of the 2013 curriculum, so its implementation is highly recommended. The GDL model consists of six stages, namely Simulation and Problem Statement, Hypothesis, Data Collection, Data Processing, Veryfication and Generalitation.

GDL with the use of eLearning becomes more interesting and better if it is used in the learning process. The combination of GDL with eLearning is also emphasized by Khan (2014) who reveals the impact of using GDL, namely when educators do not use the proposed tools, the failure rate actually increases dramatically. Innovative learning practices if carried out in a structured manner and assisted by eLearning, can improve student learning and reduce the overall failure rate [6].

During the COVID-19 pandemic, there are several new learning models that support the online and combined learning process. One of them is the blended learning model. Blended learning aims to improve the learning process through e-learning and virtual face-to-face. The advantage of blended learning is that it improves student learning outcomes because it has easy access to learning materials [7]. By using blended learning, teachers become more comfortable and calmer in carrying out online and combined learning.

Learning using the guided discovery learning model is combined with using blended learning so it is called guided discovery blended learning (GDBL) [8]. GDBL is a slick collaboration to stimulate students to think critically. Through the GDBL learning model, students can get used to critical thinking independently by applying the concept of rearrangement through online learning media and printed books by involving teachers as mentors [9]. E-learning is a place to familiarize students with critical thinking so that e-learning needs to be developed to be in line with the guided discovery blended learning model. Based on the problems above, the researchers are interested in developinge-learning media uses the Moodle application with the title "Development of Chemical Equilibrium E-Learning Content Based on Guided Discovery Blended Learning for Senior High School ".

II. METHODE

This research method is Educational Design Research which is abbreviated as EDR, with the PLOMP development model Educational Design Research (EDR) research examines the design, development and evaluation of educational interventions (such as programs, learning strategies and materials, products and systems) systematically [10]. The plomp development model consists of three stages, namely (1) preliminary research, prototyping phase/prototyping and assessment phase/trial [11].

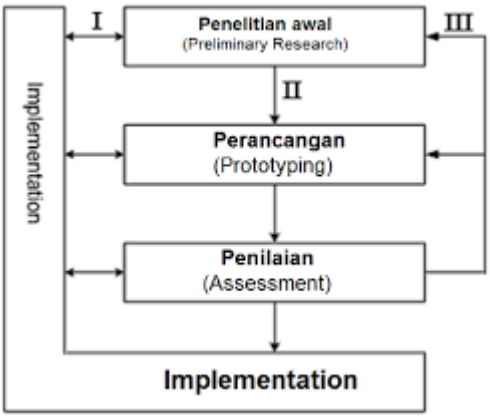

Figure 1. Plomp Development Model Cycle

What was done at the initial stage (preliminary research) was to conduct an investigation aimed at analyzing needs in the development of e-learning material on chemical equilibrium. Investigations can be in the form of interviews, observations or through filling out questionnaires by students and teachers. Curriculum analysis is also carried out at this stage so that researchers know the cognitive level that must be achieved. Next is the literature study and finally the drafting of the concept that will be developed in the form of a chemical equilibrium conceptual framework [12].

The second stage (prototyping phase) is designing chemical equilibrium e-learning using guided discovery blended learning (GDBL) basis. The preparation of the prototype is carried out at this stage where this stage involves an evaluation that begins with an evaluation of yourself/selfevaluation, then from a team of media experts and material experts (expert review). Expert review involves lecturers and teachers with a minimum number of 3 people. Then a one-to-one evaluation was carried out and finally a small group test, where the resulting product was tested on a small scale ([12].

To determine whether e-learning is valid or not, a questionnaire is filled out by validators and students. The results of filling out the questionnaire will be analyzed in the form of descriptive data analysis. This aims to determine the validity and practicality of the developed e-learning. In this study, the Aiken formula was used to analyze the level of e-learning validity.

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

$$S = r - l_o \quad \text{..... (2)}$$

l_o= lowest category of given scale

c = number of categories to choose from

r = the value provided by the validator

n = number of validators

Based on Aiken's V scale the validity asessment criteria can be seen in Table 1

Table 1. Validity Based on Aiken's V Scale

Aiken's V Scale	Validity Category
V≤ 0,4	Less
0,4 ≤ V ≤ 0,8	Are
0,8 < V	Valid

The number V has a value between zero and 1. The better the wide variety of V (close to 1 or equal to 1), the better the validity value of a product, and the smaller the variance V (close to zero or equal to zero) then the value of the validity of a product also increases reduce.

In this study, those who acted as practitioners were 6 students of class XI SMAN Mapat Tunggul Selatan. Practitioners fill out a questionnaire that aims to assess e-learning in terms of benefits, use and time efficiency. The practicality of the questionnaire data is processed using the percentage approach as follows:

$$P = \frac{F}{N} x\ 100\% \text{ ..... (3)}$$

Where,
P = percentage of students' understanding
F = score obtained
N = maximum score

The third stage (assessment phase) is to evaluate and test practicality in field tests [13]. In the practical test, it will be known how the effect of e-learning on the quality of students is.

Table 2. Practicality Category

Practicality Category	Level Practical
0.85 - 1.00	Very practical
0.70 - 0.85	practical
0.50 - 0.70	Less practical
0.01 - 0.50	Not practical

In this study, an assessment instrument was used in the form of interview sheets when the needs analysis and curriculum were addressed to teachers and students, validation questionnaires were addressed to expert reviews, practicality questionnaires were addressed to teachers and students and a check list was addressed to researchers.

III. RESULT AND DISCUSSION

The e-learning developed in this study can help online and combined learning because it is more effective in terms of usage. The development of chemical equilibrium e-learning uses the plomp model which consists of three stages, namely preliminary research, prototype phase and assessment phase [14].

1. Preliminary Research

At this stage, an analysis is carried out that supports this research. Also, the analysis carried out is needs analysis, curriculum and literacy studies.

a. Needs Analysis

The things that are done in the needs analysis are identifying problems regarding chemical equilibrium through distributing questionnaires to students [15]. Students who distribute questionnaires are students of class XII. The results of filling out the questionnaire concluded that students had difficulty participating in the online learning process because the teacher only distributed learning materials through whatsapp groups. In terms of teacher interviews, it is difficult to teach and measure the level of ability of students while online.

b. Curriculum Analysis

This analysis aims to determine the cognitive level that must be achieved according to the provisions in the 2013 curriculum [16]. Since the COVID-19 pandemic, the government through the Ministry of Education and Culture issued a policy through an emergency curriculum. The chemical equilibrium material in the emergency curriculum is the same as the 2013 curriculum, which consists of 2 basic competencies, each cognitive and psychomotor, namely KD. 3.6 and 3.7 and 4.6 and 4.7. At this KD it can be concluded that students reach the analysis stage (C4)[17].

c. Literacy Study

This activity is related to the literature used during research guided by the results of interviews and filling out questionnaires[18]. The GDBL-based E-learning product consists of several components, namely, instructions for use and forewords; learning resources consist of lesson plans, modules, learning videos, ppt, student worksheets; learning activities consist of discussion forums, discussion rooms, resume assignments, worksheets discussion results and evaluation questions; developer profile where the developer is a supervisor and researcher himself.

d. Conceptual analysis

At this stage the activities carried out are determining the material to be developed in e-learning [19]. In chemical equilibrium, the sub-materials studied are reversible and irreversible reactions, dynamic equilibrium, equilibrium constants, factors that affect equilibrium shifts and the application of chemical equilibrium in industry.

2. Prototype Phase

At this stage the activities carried out are designing e-learning which will be used as a product in this research. Each prototype is evaluated, namely selfevaluation, expert review, one to one and the last is a small group test [20].

a. Prototype 1

This activity begins with designing an e-learning design according to the GDL syntax. Starting from simulation and problem statements, hypotheses, data collection, data processing, verification and generalization[21]. Researchers will design a story board that will be developed through e-learning. The designs produced in e-learning are syllabus, lesson plans, teaching

materials/modules, learning videos, powerpoint, worksheets, and evaluation questions[22].

b. Prototype 2

The design produced on prototype 1 is then evaluated through self-evaluation through a check list[23]. This aims to re-check whether it is in accordance with the design that has been compiled on prototype 1. After conducting a self-evaluation, the next step is to revise the product according to the deficiencies recorded on the check list. The following is an e-learning display consisting of: cover, introduction to chemical equilibrium, chemical equilibrium learning resources, chemical equilibrium learning activities and developer profile.

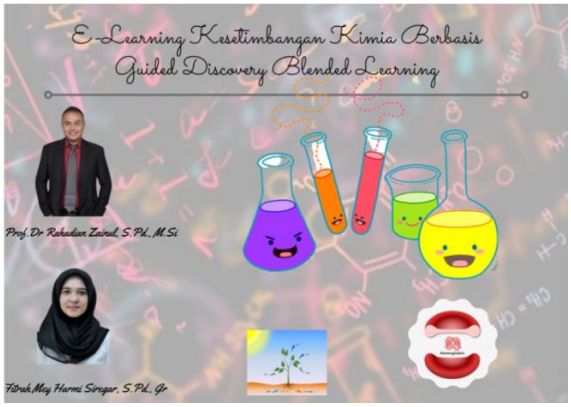

Figure 2. Cover of Elearning Chemical Equilibrium

Figure 3. Introduction of Chemical Equilibrium

The introduction to chemical balance consists of a syllabus, lesson plans, an introduction to chemical equilibrium and a web meeting.

Figure 4. Chemical Equilibrium Learning Resources

The third part of the learning is chemical equilibrium learning resource which consists of several components, namely: powerpoint slides, learning videos, teaching materials and worksheets. In other words, learning resource is a place for material access to understand chemical equilibrium material.

Figure 5. Chemical Equilibrium Learning Activities

The fourth part is learning activities of chemical equilibrium. Where in the section is a forum for discussion and proof that students do the task in accordance with the instructions in the previous component. Learning activities consist of discussion forums, discussion rooms, forums for uploading resume assignments, uploading assignments from worksheet and evaluation questions.

c. Prototype 3

After evaluating through the check list, the next step, the researcher began to design the product starting from the lesson plans, introduction to the material, teaching materials/modules, ppt, learning videos, LKPD and evaluation questions[24]. After e-learning is completed, an evaluation is carried out by:

1) Expert Review

In this study, three high school chemistry teachers played the role of expert reviewers. The evaluation stage was carried out by the expert review 2 times until the product in the form of e-learning reached the feasible stage.

2) One to One Evaluation

Before doing this activity, the researcher first selected 6 students randomly according to their cognitive and psychomotor abilities[25]. Where the selection consists of 1 student with high ability, 2 people with moderate ability and 3 people with low ability. The results of the one to one evaluation will be used as guidelines for revising e-learning. The following is the result of content and construct validation:

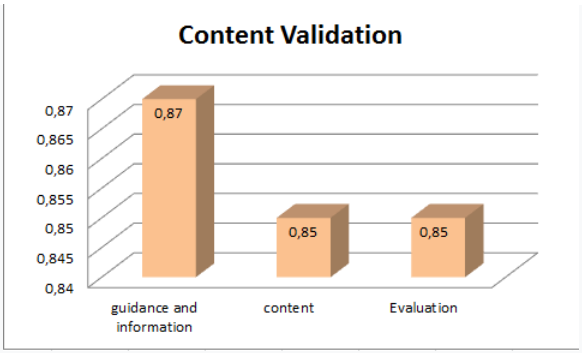

Figure 6. Content Validation Chart

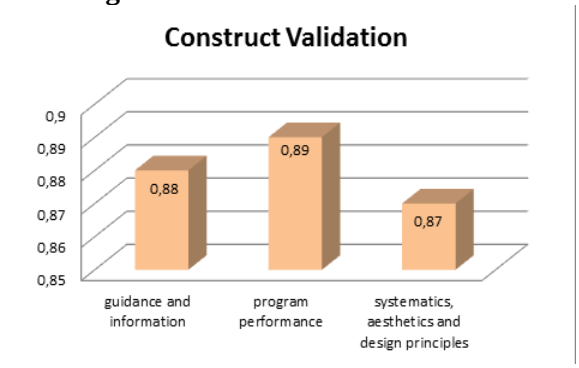

Figure 7. Contruct Validation Chart

From the above validation results obtained a value of 0.86 for the content and 0.88 for the construct.

3) Small Group Test

After conducting a one-to-one evaluation and the product has been revised, the next step is product testing through a small group test[26]. In this case, product trials were carried out to students of class XI MIA SMAN Mapat Tunggul Selatan. The number of students in class XI is 20 people. From the results of filling out the questionnaire, students are comfortable using e-learning because it can be accessed anytime and anywhere with the help of the internet[27]. The weakness of e-learning according to students is that they must have an internet network.

d. Prototype 4

After carrying out various revisions according to selfevaluation, expert review, one to one evaluation and small group, a prototype 4. Practicality test was carried out on prototype 4 through a field test/large group[28]. E-learning of chemical equilibrium material was carried out by practicality tests by chemistry teachers and students of class XI Mapat Tunggul Selatan. From the results of the practicality test, a value of 0.86 was obtained using the Aikens test so that the e-learning material on chemical equilibrium was declared valid and practical. And can be used by teachers and students wherever they are[29].

3. Assessment Phase

The final stage of the plomp development model is the assessment stage. At this stage, it is seen from the practical process. Where at the practical stage, a value of 0.83 was obtained, which means that the chemical equilibrium e-learning product based on guided discovery blended learning was declared valid and could be used as a medium for distance/online learning solutions and combinations[30].

Table 3. Practicality Test Results

No	Question	Practical Value
1	Instructions for using GDBL based e-learning on corrosion topics are clear	0.85
2	The language used in GDBL based E-learning on corrosion topics is easy to understand	0.85
3	Can repeatedly use GDBL E-learning on corrosion topics	0.86
4	Learning time with GDBL based E-learning on the topic of corrosion becomes effective	0.84
5	Learning time with GDBL based E-learning on the topic of corrosion becomes efficient	0.80
6	Thinking skills improve with the use of GDBL based E-learning on the topic of corrosion	0.82
7	The use of GDBL based E-learning on the topic of corrosion can improve memory	0.82
8	Interest in learning through the use of E-learning based on GDBL on the topic of corrosion is increasing	0.83
9	GDBL based E-learning on corrosion topics can make self-study easier	0.81
10	GDBL based e-learning on the topic of corrosion can increase students' learning motivation	0.82

IV. CONCLUSION

E-learning of chemical equilibrium based on guided discovery blended learning is declared valid by being proven through content validation with a score of 0.86 and construct validation with a score of 0.88 for the practicality test to students, a score of 0.83 was obtained, which means that e-learning is stated to be practical both in terms of use and in terms of content. So, the resulting of elearning can be used in a teaching and learning activities. E-learning can also be accessed easily anytime, anywhere and with anyone with full use of internet access.

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