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Article

Development of E-Learning Electrolyte and Nonelectrolyte Solutions based on Rotary Guided Discovery Learning for Senior High School

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Abstract— All activities had to be carried out at home during the Covid-19 epidemic, which affected all nations in the world, including Indonesia. This included learning activities at the elementary, secondary, and higher education levels. This study aims to create e-learning electrolyte and non-electrolyte solutions based on rotary guided discovery learning for high schools. Developed E-Learning Electrolyte and Nonelectrolyte Solutions for Senior High School based on Rotary Guided Discovery Learning to support learning during Covid-19. EDR (Educational Design Research), which employs the PLOMP development model, is the sort of study being conducted. A questionnaire instrument for this study's validity and practicality was used at SMA N 8 Padang. Aiken's V was used to evaluate the validation data, and Kunandar's proposed percentage approach—specifically, the % value—was used to study the practicality data (P). Based on Rotary Guided Discovery Learning, Electrolyte and Nonelectrolyte Solutions for Online Learning In practicality testing, the average value of V for SMA/MA is 0.87, with a valid category, and a percent value (P) of 81, with a very high category. The results of this study indicate that e-learning electrolyte solution based on rotary guided discovery learning has been declared valid, practical and can be utilized in the learning process.

Keywords— **E-Learning, Guided Discovery Learning, Lab Rotation, Electrolyte and Nonelectrolyte Solution**

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I. INTRODUCTION

The success of learning outcomes is a must for every educational unit, both basic education and higher education in accordance with the needs and learning objectives of each subject. In conditions during the Covid-19 pandemic, which hit all countries in the world, including Indonesia, resulting in all activities carried out at home, including learning activities at the primary, secondary and higher education levels. The learning process can take place because there are students, teachers, curriculum, and infrastructure that are interconnected with each other. Students can carry out learning well if the learning infrastructure is adequate, the learning model is supportive, involves active students in the classroom so that an interactive learning process occurs so that students do not feel bored in class [1][2].

At the present time, with learning conditions carried out at home due to the Covid-19 outbreak, the learning model must be improved by teachers or schools in order to improve learning outcomes at least equal to or exceed the learning outcomes carried out directly face to face in class. But the facts in the field of implementing learning models carried out at home with online methods are still many obstacles faced by both students, teachers, and schools, especially the media and learning models used in carrying out online learning. There are still teachers who have dominated learning by only giving structured assignments, there is no interactive learning implementation between students and teachers by utilizing several online media facilities that can be used [3][4].

One of the media used is LMS (Learning Management System). LMS is software designed to create, distribute, and manage delivery of materials that provide learning materials and multimedia resources online. For face-to-face and online learning, various learning management systems (LMS) are provided to develop, manage, and distribute resources digital. LMS involves the interaction between traditional teaching techniques and digital learning resources [5][6][7].

One of the LMS that is widely used is Moodle. Moodle is one of the most popular learning management systems in the world. MOODLE was designed by Martin Douglas at Curtin University, Australia. Moodle is a free software known as a modular object-oriented dynamic learning environment that aims to help students and lecturers achieve quality teaching [8][9]. Moodle is a well-known online learning application that is used by many educational institutions to help students learn faster and improve their educational outcomes. It also helps to improve the quality of the learning process, making it a valuable tool for educators. Moodle-based online learning is very versatile and has all the features needed to help students learn effectively. It also allows you to control the learning process [10].

In the learning process in the classroom, teachers and students are greatly helped by the existence of E-learning based on this Moodle application [11]. The many features contained in the Moodle-based E-learning application can be optimized to increase student interest in learning and learning outcomes during classroom learning [12]. One alternative to improve the quality of learning and train students' higher order thinking skills is to develop learning media in the form of e-learning using the Moodle application [13].

The preparation of E-learning based on guided discovery learning is adjusted to the steps contained in the guided discovery learning model. The syntax of the guided discovery model developed by Carin (1997), Smitha (2012) and Permendikbud No.65 of 2014 has been modified to obtain a new syntax consisting of 6 learning phases, namely "(1) motivation and problem presentation (motivation and problem delivery), (2) data collection (data collection), (3) data processing (data processing), (4) verification (verification), (5) closure (cover) and (6) assessment (assessment)" [14]. This learning model can be collaborated with online learning models. Discovery Learning is a method of understanding concepts, meanings, and relationships, through an intuitive process to finally arrive at a conclusion [15]. Through this model, students are invited to find out for themselves what they have learned and then construct that knowledge by understanding its meaning. This model can be collaborated with online learning models so that learning outcomes will increase and be better in order to prove the Discovery Learning model and online learning models can improve learning outcomes, further research is needed. Another learning model for senior secondary education uses the lab rotation model [16].

The Lab Rotation Blended Learning model is similar to Station Rotation, students have the opportunity to circle the station through a predetermined schedule, only in this model it is carried out using a special computer laboratory that allows flexible scheduling arrangements to meet with teachers [17]. Thus, a computer laboratory is needed to run this model. The initial idea of developing this model was the participation of students in offline activities in a brick-and-mortar (face-to-face) model, which was then transferred to online activities in a computer laboratory. It is basically the same as

the Station Rotation model, but there are slight differences. If the Station Rotation model, offline and online activities can take place in the same class, then the Lab Rotation must have another room, namely a computer laboratory [18].

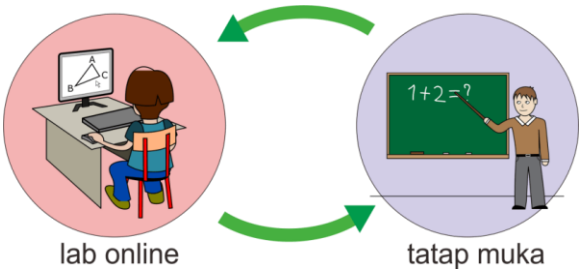

Figure 1. Lab rotation Blended Learning (www.google.com)

The Lab Rotation Model can be run in a way that students spend a part of their learning in a computer lab through an online curriculum at their own individual learning pace. Then students can follow another part of the class with a teacher to reinforce what they learned in the lab. On this occasion students also ask questions or complex concepts. In other words they have learned the basics and developed their understanding as far as they can in online learning, then continued in face-to-face learning where students get the opportunity to ask questions they don't understand or improve the continuation of the learning they have done [19].

When in the computer lab, students can work flexibly at their own pace, spending as much time as they need to understand the material. They can also access learning resources, try various software, and others. So when there is a face-to-face interaction, the teacher provides additional or enrichment activities as needed. A teacher can also group students into small groups according to their level of learning progress or interest in certain topics, and all groups can do something different based on where they are and what level of mastery they have demonstrated [20].

This rotary discovery learning model can be implemented in electrolyte and nonelectrolyte solution subjects that require an understanding of concepts and high-level thinking skills, and are also able to speak in terms of multiple chemical representations [21]. Electrolyte and nonelectrolyte solutions are contextually closely related to the daily lives of students and this subject can be carried out by schools that do not have adequate laboratory facilities [22] [23].

This model prioritizes communication and interaction so as to create an effective and conducive learning atmosphere. The effectiveness of a learning model can be seen from student learning outcomes either directly in class or learning carried out using online or online using distance learning media (PJJ) with online facilities using existing learning models in a collaborative way can be seen from the final results a study using the average score of the test results for each subject held. In the current pandemic situation, in accordance with the government's recommendation for all learning activities, both primary, secondary and higher education levels, the learning process must be carried out at home online or distance learning. The problems discussed, researchers are interested in conducting research. "**Development of E-Learning Electrolyte and Nonelectrolyte Solutions based on Rotary Guided Discovery Learning for Senior High School**"

II. METHODE

The researcher uses the Educational Design Research (EDR) type of research by applying the Plomp model which has 3 stages of development, namely: (a) Initial investigation stage, (b) Prototype formation, (c) assessment [24].

Three teachers of SMA N 8 Padang as the subject of this research. After that, a validation sheet is given in the form of a questionnaire containing content components, presentation components, and linguistic components. The place where this research was conducted is the SMAN 8 Padang.

The validity analysis technique uses the Aiken's V scale, which is a reliable measure of agreement.

$$V = \frac{\sum s}{[n\,(c-1)]}$$

$$\mathbf{s = r - lo}$$

Data analysis using Aiken's V scale is grouped into several categories listed in Table 1.

Table 1. Categories by Aiken's V [25]

Aiken's V Scale	Validity
$V \leq 0,4$	Not enough
$0,4 < V \leq 0,8$	Currently
$0,8 < V$	Valid

The practicality of the questionnaire data is processed using the percentage approach as proposed by Kunandar. This approach is based on the assumption that the practicality of a given question is a percentage of the overall practicality of the questionnaire.

$$\mathbf{P} = \frac{\boldsymbol{F}}{\boldsymbol{N}} \boldsymbol{x}\ \mathbf{100\%}$$

Table 2. Practicality Category

Kriteria praktis	Tingkat kepraktisan
0,85 - 1,00	Very practical
0,70 - 0,85	Practical
0,50 - 0,70	Less practical
0,01 - 0,50	Not practical

III. RESULT AND DISCUSSION

This study aims to create e-learning electrolyte and non-electrolyte solutions based on rotary guided discovery learning for high schools. This study is based on the Plomp development model, which includes three stages: preliminary research, development or prototyping, and assessment [24].

3.1. Initial Investigation Stage

3.1.1. Needs Analysis

The results obtained from the needs analysis are electrolyte and nonelectrolyte solution materials according to Novita et al.,[26] saying "One of the materials that requires a long learning time. This material requires understanding concepts with good memorization and real learning experiences. This material requires an understanding of concepts and higher-order thinking skills, and is also able to discuss in terms of multiple chemical representations. Electrolyte and nonelectrolyte solutions are contextually closely related to the daily lives of students and this subject can be carried out by schools that do not have adequate laboratory facilities. The model that is suitable for the electrolyte and nonelectrolyte solution material based on the 2013 revised 2018 Curriculum is Guided Discovery Learning [14].

Discovery Learning is a method of understanding concepts, meanings, and relationships, through an intuitive process to finally arrive at a conclusion [15]. Through this model, students are invited to find out for themselves what they have learned and then construct that knowledge by understanding its meaning. This model can be collaborated with online learning models so that learning outcomes will increase and be better in order to prove the Discovery Learning model and online learning models can improve learning outcomes, further research is needed [16]. Another learning model for senior secondary education uses the lab rotation model [17].

3.1.2. Curriculum Analysis

In the analysis phase, which is carried out using the 2013 curriculum, it begins by analyzing the syllabus and curriculum by lowering the basic competencies in electrolyte and nonelectrolyte material so as to produce a GPA from the KD. The basic competence of electrolyte and nonelectrolyte solution material is 3.8. Analyze the properties of the solution based on its electrical conductivity and 4.8. Differentiate the conductivity of various solutions through the design and execution of experiments.

3.1.3. Study of literature

The literature study obtained the following results: (1) the preparation of e-learning based on guided discovery learning is effective in following the steps contained in the guided discovery learning model. The syntax of the guided discovery model developed by Carin (1997), Smitha (2012) and Permendikbud No.65 of 2014 has been modified to obtain a new syntax consisting of 6 learning phases, namely "motivation and problem presentation ; data collection; data processing; verification; closure and assessment [14][15][16] "; (2) Plomp model

is a development model used in making e-learning. The Plomp model has three stages, namely the initial investigation stage, the formation of a prototype, and the trial and assessment stage [24].

3.1.4. Conceptual framework

In the conceptual framework, several important concepts will be found in the materials of electrolyte and nonelectrolyte solutions.

3.2 Prototype Formation

3.2.1. Prototype I

At this stage, e-learning is made using the Canva application to style covers, labels and powerpoints within the variety of videos and learning videos. The creation of e-learning is additionally supported by other applications, like MS Word and pdf in making teaching materials and student worksheets (LKPD).

The application utilized in the event is Moodle E-learning by logging in via the link https://elearning.zainulteam.id/. To style e-learning, we first create an account as shown in Figure 2.

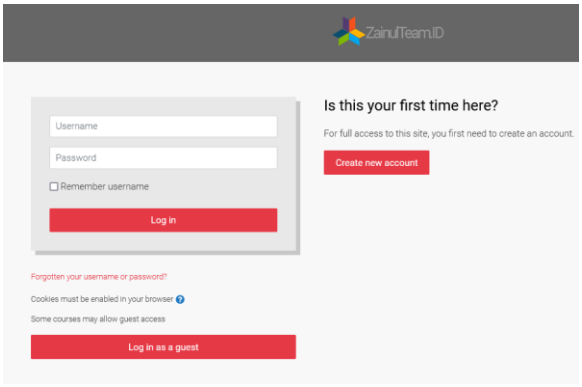

Figure 2. Login page Zainul Team (www.google.com)

After creating an account, you will find the homepage next.

Figure 3. Home E-Learning Electrolyte and Nonelectrolyte Solutions based on Rotary Guided Discovery Learning for Senior High School (www.google.com)

There are three parts to this e-learning, namely an introduction to electrolyte and nonelectrolyte solutions, learning resources for electrolyte and nonelectrolyte solutions and learning activities for electrolyte and nonelectrolyte solutions. introduction to electrolyte and nonelectrolyte solution materials, such as attendance, syllabus, learning implementation design, description of electrolyte and nonelectrolyte solution materials, and web meetings to conduct meetings. As a guide in the implementation of learning, researchers also develop lesson plans and syllabus.

There is interaction between educators and students in this section. This is the orientation stage, during which students are given instructions on how to complete the learning activities. One indicator of the success of learning activities is the clarity of instructions given at this early stage [25].

Figure 4. Introduction to Electrolyte and Nonelectrolyte Solutions (www.google.com)

The second part is Learning Resources Electrolyte and nonelectrolyte solutions. In this section, students can find concepts from teaching materials through sources provided by the teacher, be it books, videos, ppt, and even student worksheets. Worksheets was created with the intention of serving as a mentor for students who are actively participating in their education. It was designed in the best way possible to pique students' interest in their learning activities [26].

Figure 5. Learning Resources of Electrolyte and Nonelectrolyte Solutions (www.google.com)

The third part is learning activities. In this section there are activities that must be followed by students in the learning process. This activity aims to measure student achievement in understanding a learning material. In learning activities on electrolyte and nonelectrolyte solutions, there are discussion forums, discussion chat rooms, video assignments and practicum reports, LKPD discussion results and evaluation questions in the form of quizzes that require students to play an active role. College students are given the freedom to explore which a part of the website online they're interested in, which motivates them to discover because this interest is pushed via their curiosity [26].

Figure 6. Learning Activities of Electrolyte and Nonelectrolyte Solutions (www.google.com)

Then the e-learning is closed with a development profile of e-learning electrolyte and nonelectrolyte solutions based on rotary guided discovery learning for Senior High School.

Figure 7. Electrolyte and Nonelectrolyte Solution E-Learning Development Profile (www.google.com)

3.2.2. Prototype II

Conducting formative evaluation in the form of self-evaluation by means of a check list on important items that must be present in e-learning electrolyte and nonelectrolyte solutions based on rotary guided discovery learning for Senior High School.

3.2.3. Prototype III

Conduct formative evaluation in the form of one-on-one trials and expert assessment of prototype II.In the evaluation, the assessment is carried out by providing assessments and suggestions for products developed scientifically by expert reviewers as many as 3 people by paying attention to four aspects, namely aspects of content components, presentation components, linguistic components, and graphic components.

Based on the results of the analysis of the validity of all aspects of prototype II, it was found that prototype II had an average validator agreement index, V = 0.87, which was valid. The results of the e-learning validity test of electrolyte and nonelectrolyte solutions based on rotary guided discovery learning for Senior High School can be seen in Figure 8.

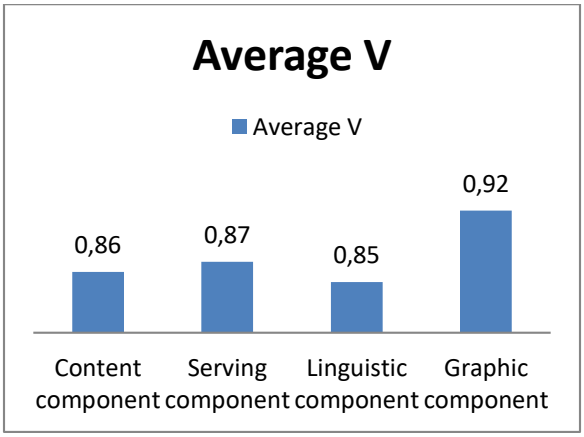

Figure 8. E-Learning Validity Test Results of Electrolyte and Nonelectrolyte Solutions Based on Rotary Guided Discovery Learning for Senior High School

One-on-one test on class XI high college students. Statistics received from the results of filling out a questionnaire to three college students. College students who become check topics one-on-one fill out a questionnaire via a questionnaire after the usage of prototype II.

Based on the results of filling out questionnaires by students, the results of a one-on-one test were obtained, namely, the display contained in E-learning is clear and easy to understand, the language used in the teaching materials is clear and easy to understand, the instructions given in the system are easy to understand, the model given in have generally been helpful in answering key questions.

3.2.4. Prototype IV

After E-learning is declared valid, then a usability test or practicality test of e-learning is carried out in small groups. This test was conducted on 10 chemistry students. The practicality of e-leaening is seen from the aspect of ease of use, time efficiency and benefits. The results of the practical evaluation of small groups can be seen in Figure 9.

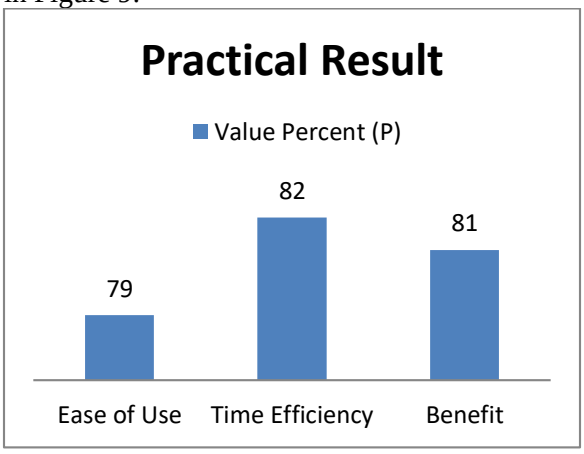

Figure 9. *E-Learning Practicality Test Results of Electrolyte and Nonelectrolyte Solutions Based on Rotary Guided Discovery Learning for Senior High School*

The results based on the analysis of the practicality of all aspects of prototype III, it was found that prototype III had a percentage value (P) of 0.81 with a very high class in practicality and e-learning was declared practical.

3. Assessment Phase

In the assessment phase, field tests are carried out, namely evaluations carried out in actual conditions. This test is also called a field test, which is a test that aims to obtain a final opinion on the practicality of the model and test the effectiveness of the developed model.

IV. CONCLUSION

Based on the consequences of studies and improvement of E-learning Electrolyte and Nonelectrolyte answers based on Rotary Guided Discovery learning for Senior high college, it changed into observed that E-learning of Electrolyte and Nonelectrolyte solutions based on Rotary Guided Discovery learning for Senior high faculty received a mean fee of V of 0.87 with valid class and the percentage price (P) is 81 with a very high class in practicality trying out.

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