

Article

Practicality Study of E-Learning Development on Electrolyte and Non-Electrolyte Solution Using the Flipped Classroom-Project Based Learning Approach in Senior High School

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Abstract— E-learning of the electrolyte and non-electrolyte solutions based on project-based learning used the flipped classroom approach have been developed and analyzed for their validity and practicality assist the learning process of students. This research belongs to research and development with Plomp model. E-learning is validated by three media expert validators and by twenty students to test its practicality. The research instrument used was validity and practicality questionnaire. Populations in this research are students from Senior High School in West Sumatera, Indonesia. There are 20 students of SMA N 8 Padang, in X class level as respondents for developing this product. Data were analyzed using Aiken V and percent of student's understanding. The results of the content and construct validity test obtained an average value of V of 0,86. the result of practicality obtained a percent of student's understanding obtained an average value of 0,83. these data indicate that e-learning that has been developed is valid and practical. The results of the study stated that e-learning developed was valid and practical so that its effectiveness could be tested

Keywords— E-learning., Project Based Learning., Electrolyte and Non- Electrolyte

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I. INTRODUCTION

The Covid-19 flare-up that arose in Indonesia immensely affected all sides of human existence, remembering for the instruction site. This can be seen from the instructions issued by the government, where at this time learning that is usually carried out in schools has now shifted to being carried out at home of preventing the spread of the Covid-19 virus was used as the reason. Adapting in the end definitely happens at homes, yet not with the appearance of the educator to show understudy's home yet with online media[1]. Activities at school are forced to be closed

by the system, with the study system-based learning from home to avoid the spread of this virus. Starting from giving daily assignments, attendance, until examinations are carried out online [2].

The public authority carried out an approach called "Work from Home" (WFH). This arrangement is work that applies to the local area, and its objective is to finished all work in the home. Instruction in Indonesia is likewise one of the spaces influenced by the Covid-19 pandemic. Because of cooperation limitations, the Indonesian Ministry of Education likewise gave a strategy to disintegrate schools and

supplant the instructing clearer, so that it is quickly understood by students. The media is also able to deal with the problem of limited space and time[4].

and learning measure (KBM) with an online framework[3].

Learning technique that uses electronic data innovation that can be gotten to in all spots is called e-learning. E-learning is not constrained by distance and time within certain hours but can still be done anytime and anywhere [4]. One of the characteristics that appear in E-learning is independent learning. Understudies are needed to have the option to deal with the whole learning process themselves, including managing their own environment, motivating, increase knowledge independently, proactively and considerably [5].

E-learning is an innovation in the world of education that provides a big role and function for the world of education. With the existence of e-learning, the shortcomings and weaknesses of conventional learning can be overcome, including the limitations of space as well as with limitations time in the conventional education process [4].

Moodle represents Modular Object-Oriented Dynamic Learning Environment, which is a powerful learning place utilizing an item arranged model. The Moodle application was first evolved by Martin Dougiamas in August 2002 with adaptation 1.0 of Moodle. Perhaps the most notable open source learning the board frameworks on the planet. LMS is a product bundle used to give web-based learning materials and online media assets. Moodle is a web-based learning application that is generally utilized in instructive organizations, both fully intent on speeding up getting the hang of, further developing learning results, working on the nature of the learning interaction and overseeing learning. Moodle-based web-based learning has total capacities and is entirely adaptable, so that nearly all and requires of clients should be possible in this e-learning. Counting orchestrating it's anything but a method of overseeing learning[6]

Basically, it is called E-learning if it uses a separate device system that is devoted to distance learning, but currently it seems that the understanding has begun to shift a lot, currently E-learning also uses a lot of social media, such as WhatsApp, Facebook, YouTube, zoom, and other social media applications[1]. As is E-learning, it is hoped in the learning process that it can help students, so that students can communicate directly or indirectly, whether in classroom learning or outside of the classroom[7].

E-learning has benefits for educational institutions to attract more students than conventional learning methods [5]. E-learning and traditional learning have their differences, that the class is "traditional", the teacher is considered a person who knows everything and is assigned to transmit knowledge to her students. Understudies are free at specific occasions and answerable for their learning in light of the fact that in the e-learning the center is understudies. With the e-learning, understudies to assume more dynamic part in their learning, make plans and search for material with their own endeavors, and drives [8].

To urge understudies to utilize instructive and positive media innovation, educators assume an extremely critical part in working with their learning exercises to utilize media innovation as a learning asset. Media innovation, if appropriately used, will be a truly important apparatus, particularly on the off chance that it is incorporated into an educational plan pertinent to the 21st century[9]. In advanced education in Indonesia, most understudies are instructed in a learning climate that will in general zero in on course books, which eventually makes instructing and learning exercises ugly and understudies will in general be latent in learning exercises. Showing members ordinarily have brief period to communicate with their companions and with educators both inside and outside the homeroom[10][11].

Conventional learning methods are often applied by teachers in practicing thinking skills critical learners are no longer a solution in th century 21, this is because the challenge of this century require the use of technology in every learning process [12]. With the e-learning, understudies to assume more dynamic part in their learning, make plans and search for material with their own endeavors, and drives [13]. So that along with the times, the learning model needs to be modified to adapt to the 21st century digitalization era, namely the use of technology. One way is to combine face to face learning with online learning [14].

Interaction can occur effectively in project-based learning which is a learning approach by utilizing the inquiry process by directing students to develop products that are applicable and related to everydaylife [5]. One of learning models is a Project based learning (PjBL) that can construct student's knowledge and skills through laboratory activities that needed to increase student's creativity and motivation, just as give freedoms to instructors to

oversee study hall learning by including project work [15].

In light of this issue, the scientist needs to apply a learning model that can give direct insight to understudies to get a learning experience that can profit themselves as well as other people. One learning model that is appropriate for learning dissemination of instructive advancement is the Project Based Learning (PjBL) learning model with an external investigation techniques room.

The task based learning model is the utilization of the undertaking as a learning model[16]. Project based learning emphasizes student-centered teaching with project assignments, it can improve concept understanding, critical thinking skills, work actively and collaboratively [17].

Project based learning steps (syntax); (1) ask students essential questions, (2) designing project plans, (3) drawing up schedules of activities, (4) monitoring student activities, (5) assess student success, and (6) evaluate student experience students [18]. Ask questions or problems presented to arrange and start activities is a key component of project-based learning that emphasize to a few projects until the result is obtained in the form of products as a derives of communication activities individuals or various task results that answer questions [19].

All things considered; Project Based Learning is described as an endeavor-based learning. The task of getting understudies to move from activities to better shows activity and experience is especially huge for the learning cycle. From a sociocultural perspective, this definition is especially critical in building understudy understanding. Teacher undertakings, gadgets and materials, and very depictions. Undertaking based learning involves an endeavor based system whereby understudies ought to independently handle specific issues viably applied in specific spaces, issues went up against regarding their lives[20].

One of the latest digital based learning methods today that uses teaching videos as a medium of learning outside the classroom method. This method led students to learn independently through a teaching video before coming to class and activities in the classroom are more focused on discussion activities, no longer focus on teacher's long talk [21][22].

As per the discoveries of different investigations, partners would profit if considering cooperation modules in the stages. For instance, mechanical stages ought to permit the enunciation of correspondence and coordinated effort between

understudies, subsequently impacting use and students' fulfillment. Substance ought to be retrievable, helpful, reasonable, intriguing, and solid. Foundations should plan different methods of self-appraisal through tests, tests, and alternate methods of testing information. Subsequently, suppliers would expand in general achievement level by putting resources into the substance of the course[23].

Quite possibly the most famous LMS these days is LMS Moodle which can uphold exceptionally in every day instructing. LMS bases on supporting ICT-based tutoring. This plan is influenced by the appearance hypothesis and the substance plan of each subject. Before long, these electronic tutoring things base more on the personality of the understudy. The most appropriate technique is to examinations its properties to choose the advantages and weaknesses of LMS using. Consequently, they decided to use imperative SWOT assessment to present this finding as characteristics and weaknesses outside factors impacting the structure concerning expected results and risks[24].

In the flipped study hall, the instructor helps the understudies rather than only conveying data, while the understudies become answerable for their own learning cycle and should administer their own learning pace. Since homeroom time isn't utilized to communicate information to understudies through addresses, the instructor can draw in with understudies through other learning exercises like conversation, taking care of issues proposed by the understudies, active exercises, and direction. Today, the idea of the flipped homeroom has been executed in various orders (math, sociologies, humanities, and so forth), and in schools and colleges all throughout the planet[25].

The 'flipped study hall' is an instructive model where a customary learning climate and its exercises are transformed, or if nothing else improved. For instance, in a Western college setting the typical talk and follow-up learning activities might be switched, with educational talk material conveyed online preceding class time, and in-class time utilized for more dynamic gathering learning task than those embraced in a customary talk. Similarly as with every new educational program, the reasoning for flipped approaches is improved understudies' learning, yet in these perplexed occasions the guarantee of more productive utilization of assets is likewise prone to be conjured, alongside the possible profit with abusing new innovation[26].

The flipped study hall is an informative methodology that inverts the customary educating strategy. Generally, understudies study the talk together in the homeroom and finish tasks outside of study hall. With flipped homeroom approach, understudies learn with informative recordings or different assets outside of study hall at their own speed and take care of tasks[27]. Flipped study halls supplant educator drove in-class directions with singular schoolwork or gathering exercises and intelligent exercises in the homeroom [28].

Business learning models in European countries are applied in 5 BL models: 1) flipped homeroom procedures, starting with passing on material before very close; 2) blended online courses, showing materials, and assessments online yet coordinated in the examination corridor; 3) online starter packs, apply units or online modules to confined classes; 4) self-governing advance up, free classes absolute with materials and tests; and 5) online store, giving appearance materials as material additional items[29].

The flipped homeroom is an inventive and fruitful appearance approach which adjusts the course content taught by the teacher to before the class through the usage of intuitive media and engages understudies to control their own learning progress. Also, during the class time, instructors have more opportunities to guide understudies to think, apply their knowledge, deal with issues, analyze, and to give analysis and thoughts as demonstrated by their individual necessities[30].

This is in line with the advantages of this flipped classroom model, these are 1) students are more independent in learning lesson materials at home, 2) students learn lesson materials in situations and conditions that are comfortable for learners, 3) when students have difficulty in working on problem exercise in the classroom, educators can give maximum attention to help students, and 4) students can learn a variety of learning content from a video, book, or website [31].

II. METHOD

This research is classified as a research and development (R&D) by the type Plomp model. The research stages using the Plomp model consist of preliminary research, prototyping stage, assessment stage[32]. Primer exploration is brought out through requirements and setting examination, writing survey, and theoretical structure improvement. The prototyping stage is carried out through product design, which produced four prototypes. For each

prototype produced, a formative evaluation and revision of the prototype were carried out.

The formative evaluation is conducted based on a formative evaluation proposed by Tessmer, namely self-evaluation for prototype I, one to one evaluation and expert review for prototype II, small group evaluation for prototype III, and field test for prototype IV [32].



Figure 1. Layer of formative evaluation

The assessment stage is a stage an assessment of product carried out with semi-summative evaluation through field test. In this study, it was carried out until the practicality stage which resulted in a valid and practical e-learning.

The e-learning of electrolyte and non-electrolyte solutions developed was validates by three media expert validators. The media expert validator consisted of three postgraduate’s chemistry education students state university of Padang. The instruments used in this study were content validation sheets, construct validations, and practicality. The existence of this instrument, e-learning the electrolyte and non-electrolyte solutions developed can be assessed for their feasibility both in terms of content and construct, and practical for use.

The quantitative information and subjective information are the kinds of information are utilized in this exploration. Quantitative data were obtained from the results of filling out the validation questionnaire and practically meanwhile for quantitative data obtained from suggestions from the validator. The validity of the e-learning developed is obtained through assessment results data provided by the validator on the content validation sheet, and construct validation.

Data from questionnaires validation is processed using the techniques Aiken’s V data analysis

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

$$S = r - I_o \dots\dots\dots(2)$$

Description

I_0 = the least score of legitimacy evaluation

c = the most noteworthy score of legitimacy evaluation

r = the score given by the validator

n = number of validators

The validity category according to Aiken is presented in Table 1.

Table 1. Validity category based on *Aiken's V* [33].

<i>Aiken's V</i> scale	Validity
$V \leq 0,4$	Less valid
$0,4 \geq V \leq 0,8$	Current valid
$0,8 <$	Valid

Data from questionnaires practicality is processed using the percentage approach as suggested by Kunandar as follows:

$$P = \frac{F}{N} \times 100\% \dots\dots\dots (3)$$

Where, P = percentage of student's understanding

F = score gained

N = maximum value [34].

III. RESULTS AND DISCUSSION

3.1 Preliminary Research

3.1.1. Needs Analysis

With the use of technology, learning is expected to be efficient and effective. The covid-19 pandemic which affects all aspects of life, especially in the field of education, causes the government to issue a study at home policy. The implementation of the study at home policy in the era of the industrial revolution 4.0 also require a device electronic based learning such as e-learning.

Project based learning using e-learning is a unique approach to improving learning that can motivate students through the opportunity to gain experience in filtering and sorting data, working together and using critical thinking skills, all of which aim to solve real problems. Students who take project-based learning using the e-learning application can become individuals who are able to solve problems on their own and are responsible for their learning individually as well [5].

In view of this investigation, showing materials as e-learning dependent on project-based learning were created which could be proper and get one of them choices to fulfill the needs of the 2013 modification educational program, one of which is the electrolyte and non-electrolyte arrangement material.

3.1.2. Context Analysis

This can be realized by applying a project based learning model and using learning media in the form of e-learning in the implementation of learning. The analysis of the syllabus in the 2013 revised 2018 curriculum that has been carried out is in the form of a basic competency analysis of electrolyte and non-electrolyte solution material which is translated into indicators competence (KD) in electrolyte and non-electrolyte solution material is KD 3.8. Analyzing the properties of solution based on its electrical conductivity and KD 4.8. Distinguishing the conductivity of various solutions through experimental design and implementation.

3.1.3. Literature Review

Based on the literature review conducted, it was found that e-learning developed was arranged based on guidelines for the preparation of e-learning Padang State of University in 2021. Guideline for the preparation of e-learning for Padang State of University in 2021 is a reference in determine the components that must be in e-learning.

As for the content or material on e-learning referenced from college textbooks and internet sources. The content or material is adjusted to the predetermined competency achievement indicators. The use of college textbooks is intended for this purpose material or content on e-learning is referenced from college textbooks and sources are clear and correct, while internet sources are used to obtain videos animations that support material on e-learning.

3.1.4. Framework Development Conceptual

Based on the concept analysis that has been carried out, the results show that the main concepts that must be mastered by students include definition of solutions, properties, types of chemical bonds, and the role of electrolyte and non-electrolyte solutions in everyday life.

3.2. Prototype Stage

This stage resulted four prototypes where each prototype was subjected to a formative evaluation.

3.2.1. Prototype I

Prototype I is a prototype resulting from the design and realization of preliminary research. The resulting prototype in the form of e-learning electrolyte and non-electrolyte solutions based on project-based learning with flipped classroom approach has e-learning components and is equipped with a project-based learning syntax.

The design of prototype I is in the form e-learning. The type of writing used varies with the size

that is adjusted. Selection of color variations for prototype I, it is adjusted according to the need to make it look attractive, which is dominated by blue.

3.2.2. Prototype II

Prototype II was generated after conducting a formative evaluation in the form of self-evaluation of prototype I. Based on the results of the self-evaluation, it was found the prototype I needed to be revised. Revisions made to prototype I in the form of adding an e-learning component, namely adding a list of attendees in the introduction section.

3.2.3. Prototype III

Prototype III produced after formative evaluation and revision of prototype II were carried out. The formative evaluation conducted is an expert review. Expert review is conducted by three validators. There are two types of validity tests, namely content validity and construct validity. Legitimacy is an appraisal of the plan of an item. An instrument is supposed to be substantial when it can gauge what ought to be estimated[35].

The questionnaire for the validation of e-learning content contains three aspects of assessment, namely aspects of guidance and information on e-learning (aspect I) contains 4 statements, aspects of e-learning content/material (aspect II) contain 12 statements and the evaluation aspect (aspect III) contains 7 statements.

The results of the validation of all aspects of content validity, e-learning obtained an average value of V of 0,86 in the valid category. This means that e-learning is valid.

The results of content validation data analysis for all aspects of e-learning can be seen in Figure 2.

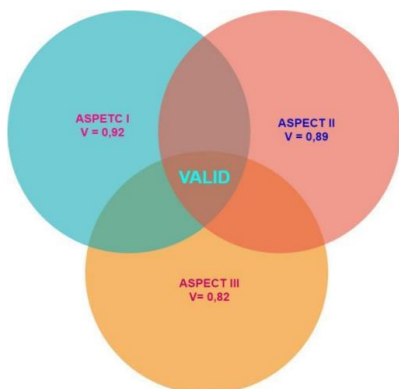


Figure 2. The results of validity of the e-learning content by the validator

The next validity test is construct validity. The construct validation questionnaire contains three aspects consisting of aspects of guidance and information, navigation, and program operation. The results of data processing validity of the e-learning constructs can be seen in Figure 3.

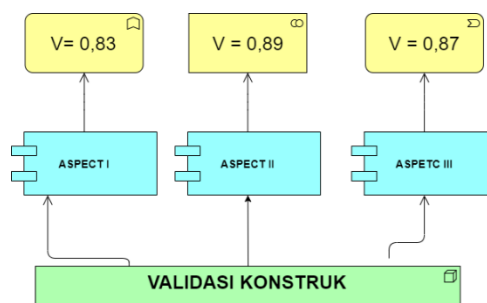


Figure 3. Results of the validity of the e-learning constructs by the validator.

The results of practicality test on twenty students with ten statements can be seen in picture 4.

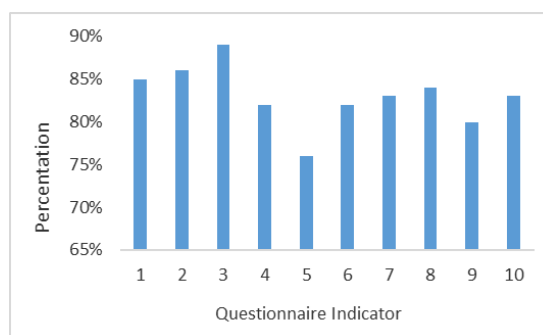


Figure 4. The results of practicality of the e-learning content by the students.

The results of the practicality of all aspects e-learning obtained an average value of 0,83 in the practical category. This means that e-learning is practical. The indicator of the questionnaire of practicality is shown in Table 2.

Table 2. Questionnaire indicator of practicality of the e-learning content

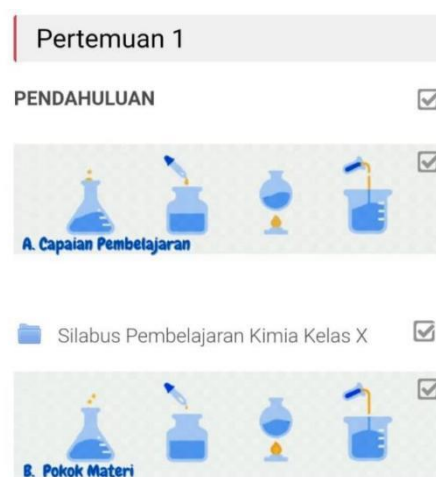
No.	Question
1	The PjBL based e-learning using the moodle application has clear instructions for use
2	The language used in PjBL based e-learning using the moodle application is easy to understand
3	PjBL based e-learning using the moodle application can be used repeatedly
4	Learning with PjBL based e-learning using the moodle application makes learning time effective
5	Learning with PjBL based e-learning using the moodle application makes learning time efficient
6	PjBL based e-learning using the moodle application helps improve thinking skills
7	PjBL based e-learning using the moodle application helps improve memory
8	PjBL based e-learning with the flipped classroom approach that can increase student interest in learning
9	PjBL based e-learning with the flipped classroom approach, it can make it easier to learn independently
10	PjBL based e-learning with the flipped classroom approach, it can increase the learning motivation of students

The front page of e-learning is the first page that will appear when we enter e-learning. there will be several class choices in it, according to the material we will study.

**Figure 6.** Display of e-learning of electrolyte and non- electrolyte solutions

Display e-learning contains any subject matter that will be taught. for example, such as the definition, the properties, types of chemical bonds, and the role of electrolyte and non-electrolyte solutions.

This chemistry learning e-learning is equipped with a guide to using E-learning, learning syllabus, concept maps, lesson plans, learning videos, textbooks and student worksheets, as well as a discussion forum that functions to make it easier for students to follow and understand learning on the covid-19 period.

**Figure 5.** The E-learning Front Page**Figure 7.** E- learning Content

In the e-learning content there are materials that will support the learning process at each meeting, for example, such as a learning syllabus, concept maps, lesson plans, learning videos, textbooks and student worksheets, as well as a discussion forum that functions to make it easier for students to follow and understand learning.

Learning activities is the movement of students in the learning cycle that is utilized to see the degree to which understudies can comprehend a learning material. In this investigation action, understudies are given the opportunity to investigate what parts of the site they are keen on and roused to know since this investigation movement is driven by their interest[36].

**PANDUAN PENGGUNAAN E-LEARNING
MATERI LARUTAN ELEKTROLIT DAN NON ELEKTROLIT**



Figure 8. E-learning Guideline

This guide contains various kinds of instructions of all the features that exist in the electrolyte and non-electrolyte e-learning system in the form of uploading files, making assignments, online quizzes and so on with the hope that students can use them as an alternative to technology-based learning.

IV. CONCLUSION

Based on the research conducted, the development of e-learning for electrolyte and non-electrolyte solutions based on project-based learning with the flipped classroom approach has been valid and practical. The research has content and construct validity levels of 0.86 respectively with extremely high categories and a level of practicality accounting to 0.83 in the extremely high category. So that further the effectiveness test can be carried out from the development of e-learning for electrolyte and non-electrolyte solutions based on project-based learning with the flipped classroom approach.

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