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Article

Prototype Validity Of Content Learning System (CLS) on Atomic Structure Material Based on Project Based Learning (PjBL) Using Flipped Classroom With Moodle For High School Students In Indonesia

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Abstract—When the Covid-19 epidemic hit Indonesia, one of the learning systems that was suitable for use was learning using e-learning and the use of the blended learning model using the flipped classroom method. This research has been carried out until the validity stage by producing e-learning based on Project Based Learning (PjBL) on Atomic Structure material by applying the flipped classroom approach in the learning process. The type of research is R&D (Research and Development), with a 4-D model consisting of: (1) Define, (2) design, (3) develop, and (4) disseminate. Populations in this research are students from Senior High Shcool in West Sumatera, Indonesia. There are 10 students of SMAN 1 Rambatan, in class X level respondents for developing this product. This products products from the study were validated by 2 chemistry teachers at SMAN 1 Rambatan, The continued at the revision stage based on input from the validator and continued with practicality tests by teachers and students of SMAN 1 Rambatan. Analysis The validity test was carried out using the Cohen kappa formula. Then obtained the kappa value of content validity 0.852 and construct validity 0.737 and from the practicality of teachers and students of 0.709 and 0.742 with very high categories for both very high and high categories. Based on this, it has produced valid and parctical e-learning to be used in the learning process.

Keywords—**E-Learning, *Project Based Learning*, Atomic Structure Material, Flipped Classroom**

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I. INTRODUCTION

In the current era of globalization, development of science and technology is highly demanded. At the same time, the government is also making various efforts to improve the quality of education in Indonesia. This is in accordance with the National Education Vision, the Ministry of National Education aims to produce intelligent and competitive Indonesian people by 2025, so education is very important in the survival of the nation.[1] Therefore, an increase in the quality of education in Indonesia greatly affects the sustainability and welfare of the nation[2].

Along with the rapid development of technology as it is today, of course we are familiar with internet technology. Where, the internet can be used as a container as a container for existing learning media or the internet itself can be modified in such a way as to become a

learning medium that can support a learning process. One of them is e-learning based learning media. [3] [4]

The learning model needs to be modified to adapt to the digitalization era of the 21st century, namely the use of technology. One way to use this is to combine face-to-face learning and online learning [5]. Based on this, one of the learning models that combines face-to-face learning and online learning is the project based learning (PjBL) learning model[6][7][8] .In project-based learning, students are required to build their thinking and communication skills. Project-based learning is a learning method that provides opportunities for teachers to manage learning in the classroom by involving project work [9][10].

The steps in Project Based Learning consist of 6 stages, namely: starting with essential questions, designing project plans, making schedules, monitoring students and project progress, assessing results and evaluating experience. Project-Based Learning can help students in group study, develop skills and projects they work on so as to provide personal experiences to students and in addition to achieving a student-centered learning process.Thus the teacher no longer acts as a learning resource but only as a facilitator, meaning that the teacher helps more students to learn, the teacher also monitors student activities in the learning process (student centered) [11].

To support the learning process it is assisted by the use of the Flipped Classroom. Flipped classroom in Indonesian can be translated as "reverse class" is a learning strategy that is currently becoming a trend and has become a novelty issue in variousreputable international journals[12][13]. The use of Flipped Classroom technology can support learning materials that can be accessed anytime and anywhere, while from learning time in class students can work together with project partners, train and develop skills, and receive feedback on what they [14][15].

The flipped classroom model provides what is generally done in class and what is generally done as homework which is then reversed or exchanged [16]. Students read materials, listen to instructional videos before they come to class and they begin to discuss, exchange knowledge, solve problems, with the help of other students and teachers, train students to develop procedural fluency, if needed, inspire and help them with challenging projects by provides greater learning control [17][18]. This model can be implemented using various student-centered approaches to activate students' critical and creative thinking skills in accordance with the characteristics of the scientific approach suggested in the implementation of the 2013 Curriculum. One suitable approach is the Problem Based Learning approach[19].

The PBL learning model in the 2013 Curriculum has student orientation stages, organizing groups, developing and presenting work, and analyzing and evaluating the problem-solving process [20]. With these stages, students can not only develop cognitive abilities but also develop soft skills and social and spiritual values [21].

The use of e-learning in the learning process has four benefits, namely getting a personal learning experience, reducing costs, being easy to obtain and increasing the ability to be responsible [22]. In addition to preparing students, the use of IT during learning also prepares educators to face the era of the industrial revolution 4.0 [23]. In the learning media there are also pictures that can be inserted so that it can reduce student boredom while studying [24]. In addition, the use of e-learning media can increase student motivation[25]. Project Based Learning-based e-learning media are categorized

as valid and practical learning tools with high levels of validity and practicality [26].

Based on the material chosen, namely the atomic structure, as it is known that the concept of the atom, especially the atomic structure, is a basic concept that must be mastered in learning to understand further chemical concepts. Atomic structure is one of the materials in chemistry given in class X Senior High School in the early semester[27]. This material has several characteristics as follows: (1) it is abstract (invisible), namely about electrons, protons, neutrons, isotopes, isobars, isotons, and atomic models, (2) understanding the concept, namely the configuration rules and atomic theory, (3) application of the concept, namely configuring the electrons of several atoms [28].

Based on these problems, researchers are interested in conducting research to develop e-learning media content with the title "Prototype Validity Of Content Learning System (CLS) in Atomic Structure Material Based on Project Based Learning (PjBL) Using Flipped Classroom With Moodle For High School Students In Indonesia"

II. METHODE

This type of research is Research and Development (R&D). in the form of Prototype Content Learning System (CLS) in Atomic Structure Material Development Based on Project Based Learning (PjBL) with Flipped Classroom Approach in Senior High School. The research model used is the 4-D model with the stages of define, design, develop and disseminate [27].However, this research is limited to the develop stage, namely the validity test. The subjects in this study were 2 chemistry teachers at SMAN 1 Rambatan.

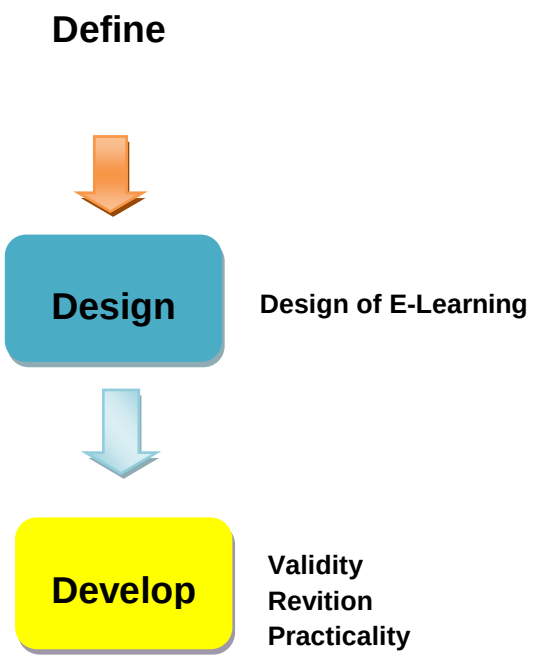


Figure 1. Stages of the 4-D development model

The define stage is carried out to analyze the difficulties and constraints experienced in learning, based on the front end analysis stages, student analysis, task analysis, concept analysis, and formulation of learning objectives[29].

At the design stage, it aims to design the e-learning content of the atomic structure material. The stages include: making e-learning guides, creating teaching material content (PPT, summary, e-module, animation, learning videos, LKPD), quizzes, class discussions. In learning resources, e-modules are used which have been tested for their validity and practicality and have resulted in a very high level of validity and practicality of e-modules [30][31].

The develop stage aims to produce and test the validity and practicality of a product that has been designed. At this stage, three processes are carried out, namely, product validity testing, product revision of validation results.

Use Cohen's kappa formula to analyze the data obtained by categories in Table 1.

$$kappa\ Cohens's\ (k) = \frac{\rho_o - \rho_e}{1 - \rho_o}$$

Keterangan :
k = value of kappa moment
ρ_o = realized proportion
ρe = unrealized proportions

Table 1. Categories of Decisions based on Kappa Moments (k)

Interval	Katagori
< 0.00	Invalid
0.00 – 0.20	Very low
0.21 – 0.40	low
0.41 – 0.60	medium
0.61 – 0.80	high
0.81 – 1.00	Very high

III. RESULT AND DISCUSSION

3.1 Definition stage

3.1.1 Front and analysis

The front and analysis data came from interviews with chemistry teachers. Based on the results of interviews with the chemistry teacher at SMAN 1 Rambatan, the following results were obtained: (1) the learning model that is usually used is discovery learning (2) the teaching materials provided by the school are printed books, worksheets, PPT and videos (3) Lack of student understanding.

3.2.1 Student Analysis

The student analysis phase was carried out by interviewing the chemistry teacher and class X students. The data generated was the student's interest so that they were motivated to learn when using IT-based media. This is based on the theory of cognitive development of high school students, namely the age range of 15 to 18 years, including the formal operational stage. This stage is characterized by the ability to think randomly, think logically, and be able to conclude the available information.

3.3.1 Task Analysis

Based on the 2013 revision of the 2018 curriculum, electrolyte and non-electrolyte solutions are found in KD 3.2 and 4.2. From basic competency 3.2, the competency achievement index is obtained as follows: (1) Determining the basic particles that make up the atom, (2) Showing the atomic number and mass number, (3) Classifying several elements into isotopes, isobars and isotons. The competency attainment index in KD 4.2 is as follows: Using atomic models to explain natural phenomena or experimental results

3.4.1 Analysis of Learning Objectives

Determine learning objectives based on the GPA obtained. The purpose of learning this material is by compiling e-learning content with independent learning strategies based on computers and devices. Students are expected to be able to observe the particles that make up the atom and determine the atomic number and mass number of an element as well as isotopes, isobars, isotons through designing and implementing experiments, analyzing the number of protons, electrons, and neutrons of an element to determine isotopes, isobars and isotons, and concluded that the groups and periods of an element are determined by the atomic number and electron configuration.

3.2 Design Stage

The activities carried out in this step are designing the e-learning arrangement of the atomic structure that will be developed. The e-learning arrangement was made using Microsoft Powert point 2007 and the logo maker. The following are some of the views on E-learning developed in Figure 2 and Figure 3.

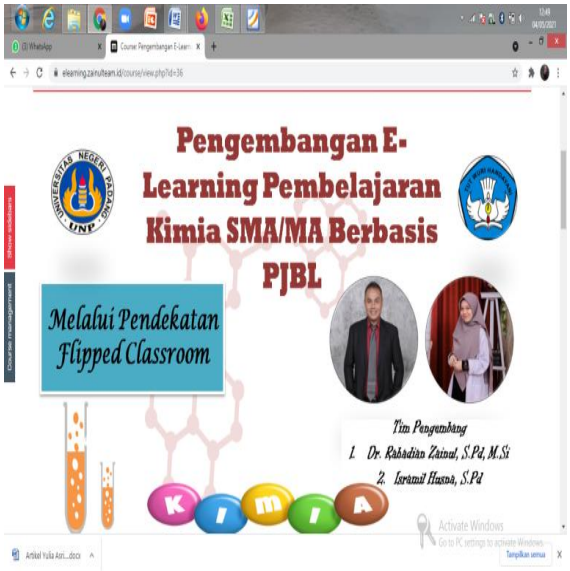
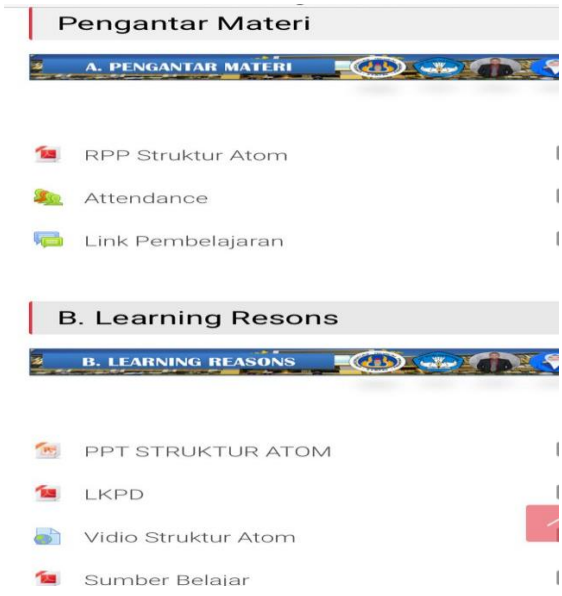


Figure 2. E-learning startup view



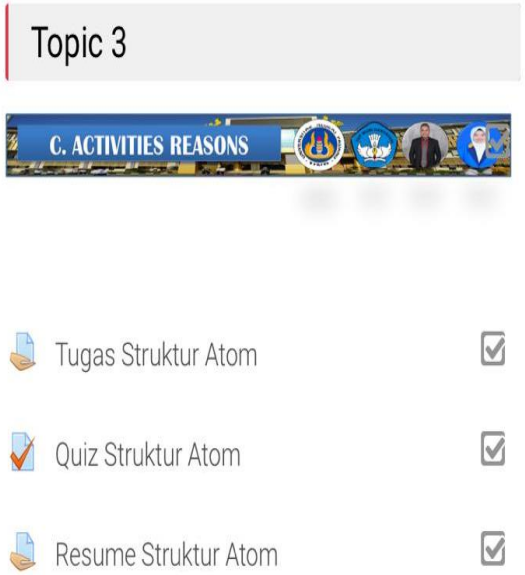


Figure 3. Display of E-Learning Content

3.3 Development Stage

3.3.1 Validation test

The validity test is intended to be able to assess a product. There are two types of validation tests, namely the content validity test and the construct validity. The validation was carried out by 2 chemistry teachers. The content validity consists of a guide and information component, content / material on e-learning and evaluation. Construct validity also consists of three components, namely guidelines and information, program performance and systematics, aesthetics and design principles. The designed e-learning content was assessed by 2 validators. The assessment is based on the statement that testing the validation can be used by expert opinion (judgment experts), which number three people [32][33]. The results obtained can be seen in Figure 4 and Figure 5.

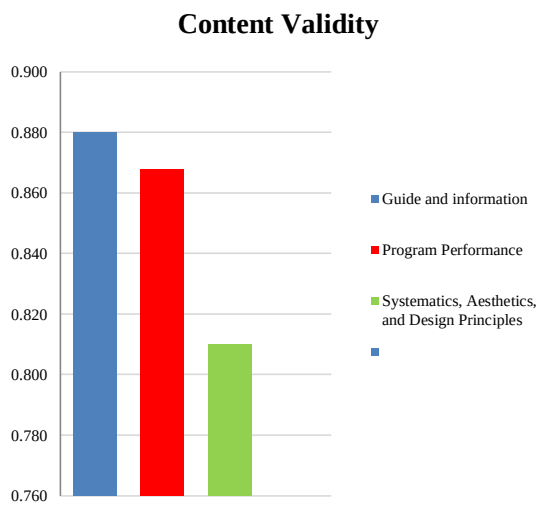


Figure 4. Graph of content validation results rated by the validator

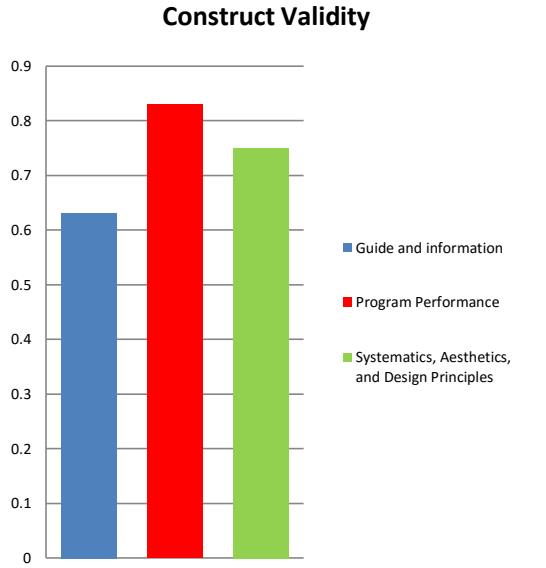


Figure 5. Graph of content validation results rated by the validator

Overall, the content validity and construction of e-learning learning content for the atomic structure material developed for each component have very high and high categories, respectively, 0.852 and 0.737. The results of the validation data show that the content of e-learning for atomic structure material is declared valid and in accordance with the component of validity assessment [34].

The guide and information components on content validation have an average k value of 0.880, including the very high category.This proves that the guidelines and information on e-learning have met the requirements for clarity and ease of understanding e-learning.

The content / material component in e-learning has an average k value of 0.868, including the high category. This value proves that the content on e-learning developed is in accordance with the demands of KD according to the 2013revision of the 2018 curriculum. The aspect of content feasibility includes the suitability of the material contained in content with KI, KD and the learning objectives provided depend on students' abilities [35].

The average k value of the evaluation section is 0.810 in the high category. In general, evaluation is a systematic process, which determines the value of something based on certain criteria through evaluation [36]. With this average value, it shows that the evaluation on e-learning can measure the abilities of students.

Next is construct validation. The assessment was carried out by 2 chemistry teachers. The first component construct validation is a guide and information. The mean value of k is 0.631, including the high category. This value proves that e-learning has conveyed information that is clear and easy to understand.

The k average score of the program performance component is 0.830, including the high category. This section covers program installation, user-friendliness and consistency in e-learning.

The last component is systematics, aesthetics and design principles with an average k value of 0.750, including the high validity category. E-

learning that is made interesting can motivate students to read learning material [37][38].

The results obtained from the validator assessment were then made to several revisions to the e-learning content developed based on the suggestions of the validator.

3.3.2 Revision

The revision stage is intended to increase the section on e-learning content for the developed atomic structure material which is considered inappropriate before being tested. After the revision is made, then it is given to the validator to be discussed again. The revision is complete if the e-learning content for atomic structure material has been declared valid by the validator. Several components in e-learning learning content suggested to be revised by the validator: 1) improve GPA, 2) develop teaching materials, 3) improve color selection,4) improve content appearance.

3.3.3 Practicality

The practicality of the developed e-learning can be seen in the use of the product based on limited test results in the field. The practicality test was carried out on 1 chemistry teacher at SMAN 1 Rambatan and 10 students. E-learning that is made must also have high learning flexibility (can be used repeatedly) to meet student needs [39][40]. The learning process with e-learning can condition students to learn independently and students can access online anywhere and anytime [41][42]. Information can be seen in Figure 6

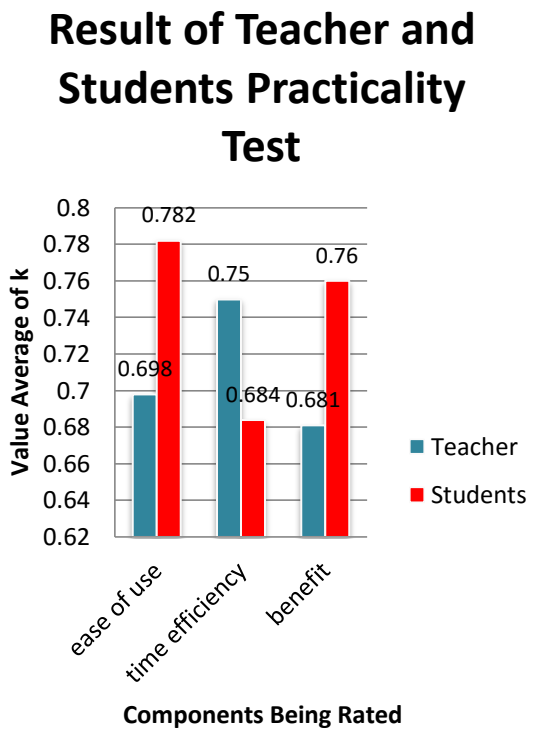


Figure 6. Graph of Teacher Practicality test and student

Based on the graph above the practicality testresults from the teacher and students are illustrated for each assessment component. The teacher practicality average value was 0.709 in the high practicality category, and the student's score was 0.742 in the high category. This shows that e-development is practical for use in learning.

IV. CONCLUSION

E-learning content based on Project Based Learning on Atomic Structure Material for Class X using the Moodle application produced in this development research has content and construct validity levels of 0.852 and 0.737 with very high and high categories, respectively. The practicality test results from the teacher and students was 0.709 with the high practicality category, and the student's score was 0.742 with the high category.

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