

*Article***Development Of Content Learning System (E-Learning) Based on Project Based Learning on Quantum Number Material Using The Flipped Classroom Approach in 1<sup>st</sup> Grade of Senior High School**

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*Abstract*— This study is aims to produce an e-learning to help students understand chemistry lesson eventough they can't study in class or study in a normal condition. This research is focused development of content learning system e-learning on quantum number topic based on project-based learning model using flipped classroom approach. The e-learning is run using Moodle. This study is a research and development (R&D) using the Borg and Gall model method to produce a particular product, and test the effectiveness of the product. The data collection techniques used is questionnaire of product evaluation. The e-learning product validation conducted by 2 postgraduate students of educational chemistry, one from Universitas Negeri Padang and another from Universitas Negeri Yogyakarta. The validation analysis was carried out using Kappa Cohen formula. The validation of 3 aspects of content validity shows that the average k value are 0.78 for information and guide that classified as high category, 0.86 for content aspect and classified as very hight category, and the last is evaluation with 0.80 k value as high category. For the construct validity the average k value for information and guidance is 0.78 and classified as high category. K value for program performance is 0.84 and categorized as high, and the last aspect is e-learning design that classified to very high category with 0.82 k value. This result conclude that the e-learning product is valid, and can be use for learning process in Senior High School.

*Keywords*— **Content Learning System; Project Based Learning; Moodle; Quantum Number**

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**I. INTRODUCTION**

This research is motivated by a lack of innovation in chemistry learning which results in

students being less active in carrying out learning so that students are unable to understand the material well and reduce student learning

outcomes [1][2]. Educational Chemistry in its study requires 3 levels of representation known as the triagle, namely macroscopic, submicroscopic and symbols. Generally, chemistry material is abstract, so that students learn it easier, this material needs to be concrete [3][4][5].

One of the efforts that can be done is to determine the media and learning resources that make students more active in searching. However, to fulfill this, students still have low motivation to work independently. The lack of creative ideas and student creative products means that the existing media and learning resources have not been able to fully explore students' abilities [6].

Quantum number are chemistry subject matter for 1st class of Senior High School listed in the syllabus. To increase students' understanding in learning, innovation and transformation are needed [7]. Content Learning System is a combination of direct learning systems and digital technology, for example using "MOODLE (Modular Object Oriented Dynamic Learning Environment)" [8][9].

The Content Learning System Model Flipped Classroom is a "reverse" learning innovation that will make students more active in teaching and learning activities and can be run using MOODLE [10][11]. Education that uses digital technology in the learning process is the influence of the industrial revolution 4.0. One of the skills of the era 4.0 is the ability to think creatively and critically, which is the goal of the higher order thinking skills learning system [12].

The use of information and communication technologies (ICT) and therefore e-learning is becoming an ever more frequently used teaching and learning technique at all levels of education [13]. There are many learning model that can be used in learning process, one learning model that can be used is the project base learning model [14][15].

Content Laerning System (CLS) represents a multi-user learning environment where developers can design, store, reuse, organize, and transmit digital learning content from central object storage [16]. Content refers to information that is managed in text, graphics, images, video, animation, and other formats [17].

This information needs to be managed to facilitate the process of creating, updating, distributing, searching, analyzing, and increasing the flexibility of converting to other forms [18]. Collaboration is also something that supports the teaching and learning process using the Content Learning System [19]. Whether it is low-level ability students, intermediate-level abilities or high-level abilities, learners can benefit from the collaborative teaching and learning process [20].

The development of the CLS Flipped Classroom model is carried out using the MOODLE (Modular Object-Oriented Dynamic Learning Environment) application as a Learning Management System [21][22]. Moodle can be used freely as an open source product (open source). How to install moodle on a computer is quite easy on the operating system, can run with PHP and supports SQL databases [23].

Moodle has various advantages that make it widely used. Moodle is a simple, efficient and lightweight application that is compatible with many browsers. Very easy installation with support for multiple languages, including Indonesian [23]. In addition, the availability of site management for overall site settings, module changes, and so on, as well as good user management and course management [24][25].

Ease of installation to compile an e-learning is one of the considerations for researchers to choose Moodle as the basis for e-learning that will be developed [26]. The Project Based Learning learning model has very important and beneficial advantages for students. However, the Project Based Learning model is rarely used by

teachers, because in practice it requires sufficient preparation and takes a long time to work [27].

## II. METODE

The researcher use research and development (R & D) method to produce a particular product, and test the effectiveness of the product [28]. Subjects in this study E-learning based moodle used by postgraduate students of Chemistry Education at Padang State University. The materials learning refers to the 2013 national curriculum. Procedures that researcher used is based on Borg and Gall model with the consideration that this refers to real conditions and needs, develops systematically and is based on the theoretical foundation of learning design [29].

The stages of research consist of 9 steps proposed by Borg and Gall. There are: conduct literature study, make a plan, develop a product preliminary form with validation conducted on content expert, media expert, revision and outcome/result.

The e-learning is produced by using moodle and combined additional application. Additional application that used in this study are Microsoft power point, Microsoft word, Corel Draw, and Youtube [30]. The data collection techniques used is questionnaire of product evaluation. Questionnaires are used to assess product development by some experts that has been choosed.

The questionnaire for the assessment of the validity and practicality tests used was arranged based on Likert scale [31]. And the data that obtained will be analyzed using Kappa Cohen formula [32].

The step of this method will be conclude in the figure below, there are 9 steps that include in the Borg and Gall model of R&D development methods.



**Figure 1.** Stages of Borg and Gall design

The questionnaire for the assessment of the validity and practicality tests used was arranged based on Likert scale as in Table 1.

**Table 1.** Likert scale

Likert scale	Assessment
1	Very disagree
2	Disagree
3	Neutral
4	Agree
5	Very agree

The data that obtained will be analyzed using Kappa Cohen formula below

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

k = value of kappa moment

$P_o$  = realized proportion

$P_e$  = unrealized proportion

The k value that obtained, will be categorize based on Kappa Cohen as in Table 2.

**Table 2.** Categories of Kappa Value (k)

Intervals	Category
0,81 – 1,00	Very high
0,61 – 0,80	High
0,41 – 0,60	Moderate
0,21 – 0,40	Low
0,01 – 0,20	Very Low
< 0,00	Very Low

### III. RESULT AND DISCUSSION

This research was conducted using R&D method using Borg and Gall model. The e-learning product that has been produced was valid from the validity trial. The overall stage of the research will be discussed below.

#### 3.1 Preliminary

This study was started in the preliminary stage. In this initial stage, data collected through questionnaire to determine the problems experienced by teachers and students in learning chemistry, especially in quantum number topic. Some questions is about the use of e-learning in learning chemistry.

Based on the questionnaire answers by the teachers and students, the results show that many students didn't attracted to chemistry learning because of the lesson that difficult to understand. Especially in quantum number topics, the students sometime gets bored with that topic. The way the teacher teach the lesson is affected to the student's ability to understand that

lesson. And then, some students still did not get into e-learning and haven't used it before.

#### 3.2 Planning and Development

At this stage, the display and content of e-learning products was designed that will be used in learning activity. The design have to be fun and nice in visual, so it will attract students to study. In this stage, contents of e-learning was add based on 2013 national curriculum. The e-learning product have to show guidance and information about how to use the e-learning. This guidance and information must be understand by students and teachers.

The aim of the lesson, learning source, learning activity like task and practice, it can be add with animation video and other fun thing to make students study happily. The color and font of the content must be eye-catching and clear. The picture that shown in e-learning must be clear too. The final design e-learning is illustrated below.

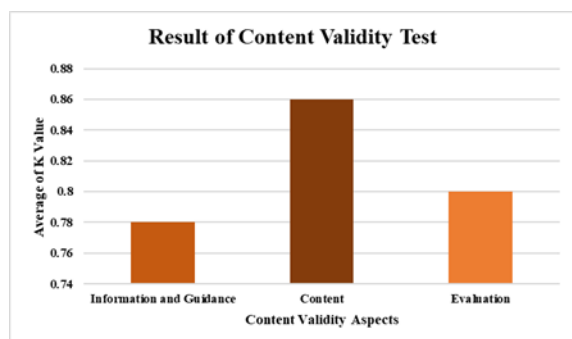
#### 3.3 Evaluation and Revision

Validity and Practicallity trial was conduct in this stage. Validity result was obtained using Kappa Cohen technique. The result is served in 2 value, construct validity and content validity.

The calculation of kappa value of content validity shown in table 3. The result are 0.78 for information and guide and classified as high category. The second aspect is content with 0.86 k value and classified as very high category. The last aspect is evaluation with 0.80 k value as high category.

**Table 3.** Content Validity Result

Two of the aspects are categorized high k value, and for content is very high. The graph of k value for these 3 aspect shown in figure 2.



**Figure 2.** Content validity result graphic

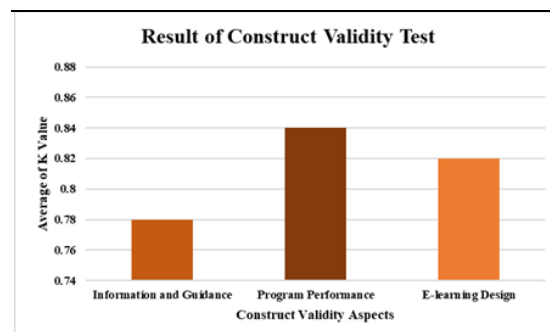
The result for kappa value of construct validity show below in table 4. The construct validity is contain of 3 aspects. The first aspect is information and guidance, for this aspect the k value is 0.78 and classified as high category. The next aspect is program performance with 0.84 k value and categorized as high k value. The last aspect is e-learning design that classified to very high category with 0.82 k value. Two of the aspects are categorized high k value, and for content is very high.

**Table 4.** Construct Validity Result

Aspect	K value	Category
Information and Guidance	0.78	High
Program Performance	0.84	Very High
E-learning Design	0.82	Very High

These information and guidance, program performance, and e-learning design aspect shows as a graphic of in figure 3 as a graph, the graphs consist the k value comparison of these 3 aspect for the construct validity.

Aspect	K value	Category
Information and Guidance	0.78	High
Content	0.86	Very High
Evaluation	0.80	High



**Figure 3.** Construct validity result graphic

### 3.4 Implementation

At this stage, researchers are conduct to applied the e-learning product to the students as a trial and effectivity test. Based on the e-learning that has been produce, the display of the e-learning can be accessed in <https://elearning.zainulteam.id/enrol/index.php?id=32> as shown in figure 4.

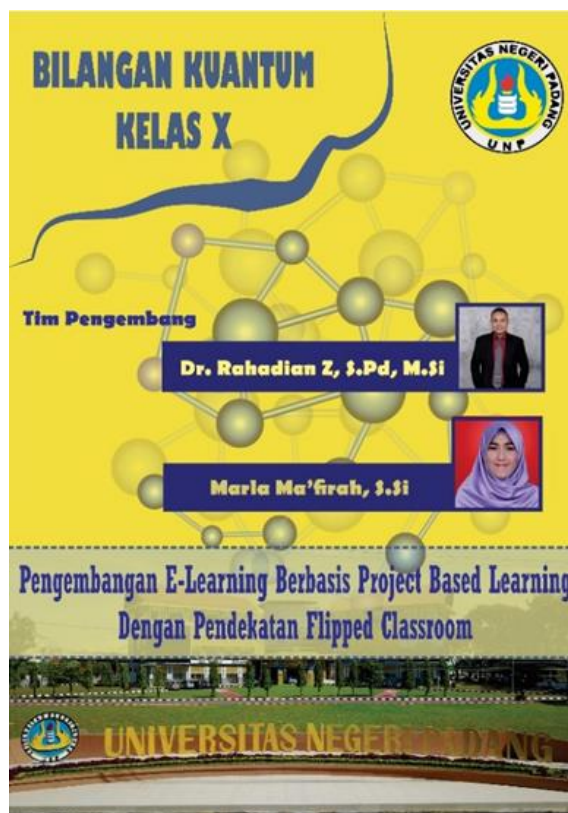


Figure 4. E-learning display

The e-learning is composed in LMS moodle on Zainulteam.id webpage. The page was made by uses several software such as Mic. Word, Mic. Power Point, Video from Youtube, Coreldraw, and manymore. The e-learning consists cover, user guidance, attendance, learning achievements, learning video, learning activity, exercise sheets and evaluation sheets. The e-learning are designed based on project based learning model. The elearning content display can be seen in the following figure.

The content in this e-learning start with guidance and information. Guidance and informations are provided for students and teachers. This guidances are served to help students and teachers to understand how to use e-learning. In this section students can check their attendance too. The display of information and guidance section shows below.



Figure 5. Information and guidance

The primary content of the e-learning include learning achievement, learning source, learning activity and learning evaluation. The learning achievement was served to make students more concern about their study and know what to achieve. So, they can prepare everything that they need to understand the lesson. On the other hand, they can figure out what topic they will focus to study to reach the goal.

The other thing that must include in this section is lesson plan. A lesson plan show the students about directions for class activity for each meeting. So, they can prepare themselves before the meeting time. And then, the lesson plan include some task that they must done, so they can prepare for the task earlier. This lesson plan is add in form of an pdf paper, so the students can download it by themselves. The display of learning achievement section shows in figure 6.



Figure 6. Display of learning achievement content

The next section in this e-learning is learning source that shows in figure 7. This section must be served various learning resources, to made students understand however



they have different learning styles. E-learning designer must consider about this things, because every students have different style in study. The different style of study in each students can be like their ability to understand the lesson. Some students will be understand the lesson that gave in a colorfull visual, or in a fun lesson video, and the others more like to study with a strong audio. In this learning source section, there are a power point slides, textbook, and learning video of the lesson.



**Figure 7.** Display of learning source content

Learning activity was served for student's discussion with their classmates or their teacher. This would make students easier to connected with their classmate and teacher although they are far each other. This served student's workbook too, it will help students to upgrade their skills. The display of learning activity section shows in figure 8.



**Figure 8.** Display of learning activity content

The last component of thi e-learning is learning evaluation, there are some question about all topics that has been learned, and students will answer it to get the poin and know how far they understand the topic. The display shows in figure 9.



**Figure 9.** Display of learning evaluation content This research was conducted using R&D

#### IV. CONCLUSION

E-Learning using Content Learning System (CLS) Flipped Classroom Model Based on Project Base Learning on Quantum Number in 1st Class (X) has been produced. K value of content validity is categorized high for information & guidance and evaluation, meanwhile for content component are very high. K value of construct validity is categorized high for information and guidance, meanwhile for program performance and e-learning design are very high. The result conclude that the products have high validity and can be used for Senior High School Students.method using Borg and Gall model. The e-learning product that has been produced was valid from the validity trial. The overall stage of the research will be discussed below.

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