Article

Development of E-Learning Chemistry Learning in SMA/MA Project Based Learning on Salt Hydrolysis Material Using the Flipped Classroom Approach in Class XI Senior High School

Lutfiah Azmi[1*], Nurbaiti[2], Rosena Putri Nabila[3], Novi Indriani[4], Ayu Wahyuni[5]

[1]Chemistry Departmen, Universitas Negeri Padang, Jl. Prof. Dr. Hamka, Air Tawar Barat, Padang Utara, Sumatera Barat, Indonesia 25171
[2]Chemistry Departmen, Universitas Riau, Kampus Bina Widya KM. 12,5, Simpang Baru, Kec. Tampan, Kota Pekanbaru, Riau 28293
[3]Chemistry Departmen, Universitas Andalas, Limau Manis, Kec. Pauh, Kota Padang, Sumatera Barat 25175
[4]Chemistry Departmen, Universitas Islam Negeri Sultan Syarif Kasim, Jalan HR. Soebrantas Panam Km. 15 No. 155, Tuah Madani, Kec. Tampan, Kabupaten Kampar, Riau 28293
[5]Chemistry Departmen, Universitas Negeri Malang, Jl. Semarang No.5, Sumbersari, Kec. Lowokwaru, Kota Malang, Jawa Timur 65145

*luthfiahazmi6@gmail.com

Abstract— This study aims to produce an elearning of salt hydrolysis based on a project-based learning model with the Flipped Classroom approach. This type of research is research and development (R&D), the technique used on this studies is a improvement version the usage of a 4-D design. The stages taken are defining, designing, developing, and disseminating. This research is limited to the development stage, validity and practicality tests. The data collection instrument was in the form of an observation questionnaire, validity and practicality. Elearning was validated by 2 experts, consisting of UNP chemistry education graduate students while the test was conducted by students. The data show that e-learning based on project based learning on salt hydrolysis material through flipped classroom for the results of the analysis of the validity sheet with Aikens's V obtained an average value of 0.90 (for content validity) and 0.89 (for construct validity). The results of the analysis of the practicum sheet with an average score of 0.87 (for student practice). Therefore, It may be concluded that e-learning based on project-based learning on salt hydrolysis using flipped classrooms is valid and practical. Based on this, valid and parctical e-learning has been produced to be used in the learning process.

I. INTRODUCTION

The spread of COVID-19 as a global pandemic based on the 2020 World Health Organization (WHO) press release has affected various aspects of human life, one of which is in the field of education. Based on the Ministry of Education and Culture circular letter number 4 of 2020 on the kemendikbud.go.id website, the learning process is carried out online / remotely at each student's home. Learning in the end inevitably takes place at home, but not with the arrival of the teacher to teach at students' homes but with online media [1]. Activities in schools are focused on being closed by the system, with a learning-based learning system from home to avoid the spread of this virus. Starting from giving daily assignments, attendance, to examinations carried out online [2].

Based on this, innovation withinside the subject of training is wanted to aid the scholar getting to know process. The innovation that can be done is by improving the teaching materials used, one of which is the development of teaching materials in electronic form such as electronic or elearning modules. Elearning which includes audio, video, animation and navigation is a form of implementation of student learning resources independently so that it can improve student competence and understanding which is displayed in electronic format [3]. Elearning can encourage students to increase self-confidence to take an active role, as well as be brave and confident in expressing opinions in the learning process [4].

E-learning is studying that makes use of technological media including the internet, interactive tv, audio videotape, CDROM to ship studying substances everywhere and whenever [5]. E-learning is a gadget this is predicted to now no longer most effective update traditional studying techniques and substances however can upload new progressive techniques and techniques withinside the contemporary studying system. The utility of e-learning is a brand new medium which could triumph over passive attitudes, growth enthusiasm for studying, permit direct interaction, and permit college students to study independently [6].

E-learning innovation is a brand new studying version in training that offers a massive position and characteristic for the arena of training. This is to reply the shortcomings and weaknesses of traditional training which include the constraints of area and time withinside the traditional training system [7]. This studying is taken into consideration to have a excessive performance fee due to the fact it is able to be accessed whenever and everywhere and offers new reports to enhance capabilities in using technology [8]. The coaching and studying system the use of e-studying primarily based totally at the Moodle utility makes it smooth for college kids and instructors who train withinside the studying system withinside the classroom [9]

The 2013 curriculum needs that the studying procedure be finished with a systematic technique and is scholar centered. One studying version this is according with the needs of the 2013 Curriculum is a undertaking primarily based totally studying version, that is a studying version that emphasizes complicated studying wherein college students play the primary position of changing the instructor in fixing issues and finishing a given undertaking. Project Based Learning can boom scholar motivation to learn, boom scholar activity, enhance scholar talents, broaden and exercise communique talents in cooperative operating groups, offer possibilities for college students to arrange projects. The use of this studying version consists of the crowning glory of a undertaking via way of means of college students whose stop end result is a product [10].

Based on the results of observations, it was obtained that: 1) students were not accustomed to using teaching materials in electronic form, 2) the difficulties experienced by students in the salt hydrolysis material were in understanding the concept and still learning by memorizing, 3) the teaching materials used were still not attractive to them. students, 4) unable to carry out practicum activities during online learning.

Based on the rationale above, the authors are inquisitive about developing project-based learning with the Flipped Classroom approach on salt hydrolysis. The developed teaching materials are expected to be able to make students learn independently so that they are able to support the learning process both face-to-face and distance / online.

II.   METHODE

This examine makes use of a improvement studies type. The development model used in this study is the 4-D (four-D) development model which consists of 4 stages, namely the define stage, the design stage, the develop stage and the dissemination stage [11] . The 4-D stages can be seen in Figure 1
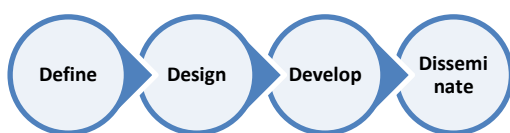
Figure 1. 4-D stages

The studies topics consisted of postgraduate college students of Chemistry Education at Padang State University. The defining stage is composed of a series of steps including front-end analysis, student analysis, task analysis, concept analysis and analysis of learning objectives. This stage aims to determine and define the conditions that must be met in learning based on Basic Competence (KD) in the revised 2013 Curriculum. The design stage aims to design

teaching substances in the form of project-based learning based on elearning materials and learning objectives that have been defined at the define stage. At this stage, elearning is designed based on the syntax in the project based learning model and is in accordance with the module components based on a combination of the Ministry of National Education [12] and Prastowo [13]. The development stage is carried out to determine the validity and practicality of the product so that a valid and practical product is produced through validity and practicality testing. The validity test is carried out by experts. display design. Elearning that has been given an assessment by the validator is then revised according to the validator's suggestions so that a valid e learning is produced and is ready to be tested in practicality testing. The practicality test was carried out by graduate students of chemistry education and high school students. The develop stage aims to produce valid and practical e-learning. The dissemination stage was not implemented due to time and cost limitations. The data obtained were analyzed using the validity index proposed by Aiken [14]. The questionnaire for the assessment of the validity and practicality tests used was arranged based on a Likert scale as in Table 1.

Table 1.Likert Scale

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

The data obtained from the validity and practicality test results were analyzed by means of the Aiken's V (V) index item validity and formulated as follows:

$$V = \frac{\Sigma s}{n(c-l)}$$

$$S = r - lo$$

Information:

V = Rater agreement index

l0 = The lowest number of validity assessments (in this case = 1)

c = the highest number of validity assessments (in this case = 5)

r = number given by an assessor n = number of raters

Table 2. Decisions Based on Index
Aiken's V (V)

Interval	Category
≤ 0.4	Less
$0.4 < V \leq 0.8$	Moderate
$0.8 < V$	Valid

The variety of numbers V that may be received is among zero to 1. The better the quantity V (near 1 or identical to 1), the better the validity fee of an object / object will be, and the decrease the quantity V (near zero or identical to zero) then the fee the validity of an object / object is likewise getting decrease [15]

III.   RESULT AND DISCUSSION
3. 1 Definition Stage (Define)
At the define stage, 5 data are obtained in the form of

3.1.1 Front End Analysis

The front stop evaluation became completed to decide the troubles skilled through instructors and college students in studying chemistry, specifically concerning the coaching substances used and the salt hydrolysis cloth. Based at the consequences of the evaluation of the questionnaire given to instructors and college students, it became discovered that a number of the troubles skilled through instructors and college students had been the coaching substances used had been nevertheless now no longer interesting, the salt hydrolysis cloth became nevertheless taken into consideration tough through college students, college students

had issue know-how the idea and college students had been nevertheless studying through memorizing.

3.1.2 Student Analysis

Student analysis is carried out to determine and understand the characteristics of students in the learning process. Based on the results of the student analysis, it is known that the project based learning model can be applied into e-modules to help students find concepts. In addition, students tend to like teaching materials that contain animation, images, video and audio and with an attractive appearance.

3.1.3 Task Analysis

Task analysis was carried out to determine Competency Achievement Indicators (GPA) by analyzing Basic Competency (KD) 3.11 class XI in the 2013 revised curriculum.

3.1.4 Concept Analysis

Concept analysis is carried out to determine the main concepts needed in the salt hydrolysis material by identifying the main concepts being taught and arranging them in the form of a concept map.

3.1.5 Learning Objectives Analysis

Based on the results of basic competency analysis (KD) and competency achievement indicators (GPA), mastering targets may be formulated to be accomplished throughout the mastering process.

3.2 Design Stage (Design)
At the design stage, an elearning presentation of salt hydrolysis based on project-based learning was carried out based on the results of the analysis at the define stage. Elearning is composed of elearning components consisting of: cover, instructions for use, competencies to be achieved, activity sheets, worksheets, evaluation sheets, and bibliography, e-modules are designed based on the project-based learning cycle. The elearning design uses several software

including: Microsoft Word 2010, Microsoft PowerPoint 2010, LMS Moodle, Youtube Video. Zainulteam.id LMS software is an elearninge based on project based learning materials for salt hydrolysis. The Microsoft Word 2010 application was used to compile an initial draft of the composing components of the e-learning which was later converted into a pdf format. Microsoft Power Point 2010 application is used to display material on the LMS. Youtube videos are used to display stimulus videos which when clicked are directly linked to YouTube. The software developed based on the learning process contains two activities, namely classroom activities and laboratory activities. Research on developing software-based learning on the subject of buffer solutions shows that the resulting software has good quality based on the validator and student assessments [16].

The elearning design display can be visible withinside the following Figure.
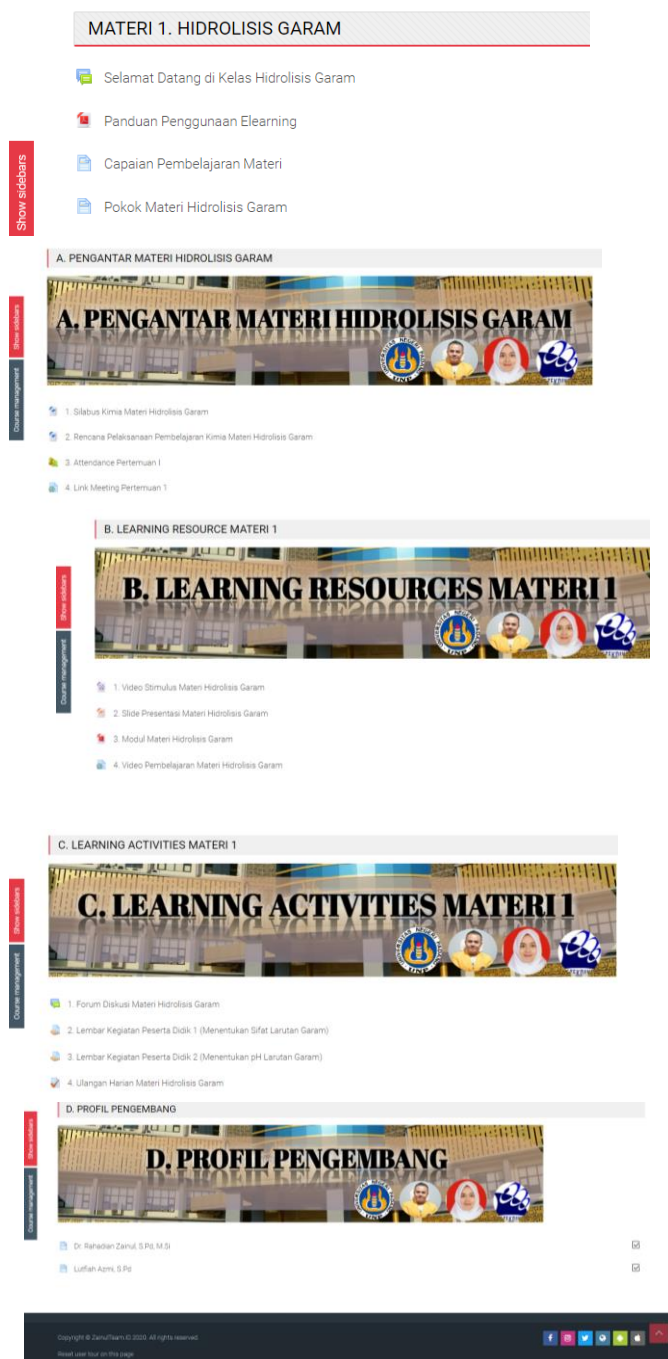

Figure 2. E-Learning Homepage

Figure 3. E-learning content

3.3 Development Stage (Develop)

3.3.1 Validity test

Validity testing is intended to be able to assess a product that has been designed. The validity of this elearning is determined using an assessment

questionnaire sheet that has been validated by two validators. The validation test in this study is divided into two, namely the content validity test and the construct validity. Content validity consists of a guideline and information component, elearning material and evaluation. Construct validity consists of three components, namely guidelines and information, program performance and systematics, aesthetics, and design principles. Overall, the validity of project-based learning with the flipped classroom approach was developed for the respective components of content validity and construct validity in very high categories, namely 0.89 and 0.90.

The results of the validation data show that e-learning based on project-based learning on salt hydrolysis through the flipped classroom approach is declared valid and follows the component of validity assessment [17]. The guideline components and content validation information have an average value of 0.93. Based on these scores, it can be concluded that the e-learning guidelines and information have met the requirements for clarity and ease of understanding of e-learning. This follows the principles of learning using e-learning which can provide assistance and convenience for students to understand learning material and provide assistance in carrying out tasks according to clear directions [18].

Furthermore, the content component in e-learning has an average value of 0.88 which is included in the very high category. This value proves that the content in e-learning developed follows the demands of KD 2013 curriculum revision 2018. Aspects of content feasibility include the suitability of the material contained in content with KI, KD and the learning objectives given depend on student abilities [19]. This follows the provisions of the facilities that e-learning must have, which must be able to build

new insights and techniques related to learning objectives and also follow the rules of making e-learning, namely subject matter that is delivered systematically and accordingly. for generally accepted standards [20,21].

The average score of the evaluation section was 0.87 in the high category. In general, evaluation is a systematic process, which determines the value of something based on certain criteria through evaluation [22]. With this average value, it shows that evaluation on e-learning can measure students' abilities. This follows the principles of making e-learning where there must be a tool used to determine the success of learning, namely by conducting an evaluation as feedback from students [23].

Next is construct validation. The first component in construct validation is guidance and information. The average value of 0.92 is in the very high category. This value proves that e-learning has conveyed information that is clear and easy to understand. This follows the features that must be owned by e-learning, one of which can provide information about the teaching and learning process, such as objectives, syllabus, and others [24]. The average score for the program performance components is 0, 90 which falls into the very high category. This section covers program installation, ease of use, and consistency in e-learning. To produce e-learning that attracts students' attention, e-learning must be simple. Simple means that it makes it easier for students to use technology and the menu system, with the convenience of the panels provided so that student learning time becomes more efficient. E-learning that is made must also have a service system, responsiveness, and high learning flexibility (can be used repeatedly) to handle student needs [25].

The last component is systematics, aesthetics, and design principles with an average score of 0.87, including the very high validity category. E-

learning that is made interesting can motivate students to read learning material [26]. The number of features contained in e-learning can be optimized to increase student interest in learning and student learning outcomes while studying in class [27]. The results of the content and construct validity analysis can be seen in Figure 4 and Figure 5.
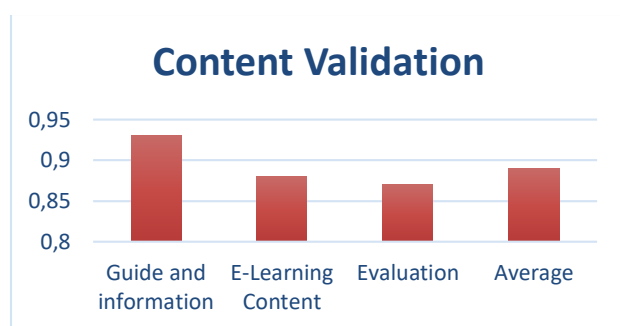
Content Validation

Figure 4. Graph of Content Validation Results
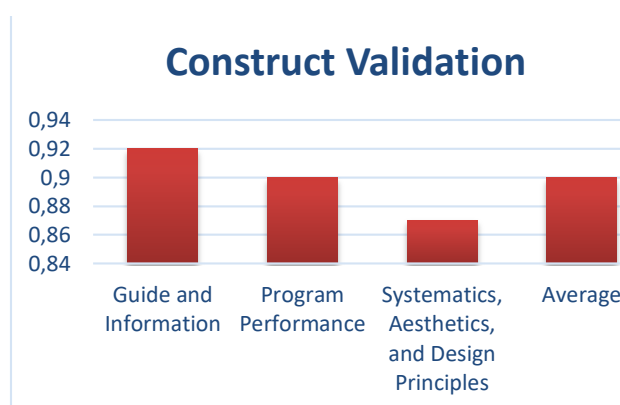
Construct Validation

Figure 5. Graph of Construct Validation Results

Elearning that has been validated by the validator is then made some improvements based on suggestions from the validator to support elearning perfection.

Revision

Revision stagecarried out to improve the elearning part of salt hydrolysis based on guided inquiry integrated virtual laboratory which is considered still need to be improved by the validator before elearning is tested at the practicality test stage Some of the points of improvement of the e-module by the validator are: 1) improving questions with questions that are easier to understand, 2) improving information at a more relevant stimulus stage, 3) improving the appearance of e-learning such as background color and letter size in chemical equations, 4) add questions to the evaluation sheet.

Practicality Test

The practicality test was carried out on 20 students at public high schools in Pekanbaru City. The practicality data of students who get an average score of 0.87 are included in the very high category. The practicality assessment by students as a whole is an indication of the use of e-learning that is delivered, language that is easy to understand, the storyline that is presented is easy to understand, can be used repeatedly, learning time is more efficient and effective, can increase memory, increase learning desire and make it easier students to study independently on salt hydrolysis. Pictures and experiments can help students understand the concept through the questions in the evaluation questions. E-learning that is made must also have high learning flexibility (can be used repeatedly) to handle student needs [28].

The learning process with elearning can improve student learning outcomes, increase student learning motivation, and have a high level of validity and practicality [29]. The results of the student practicality analysis can be seen in Figure 6.
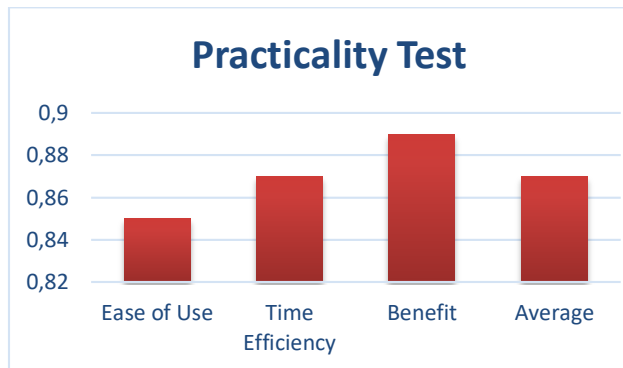
Practicality Test

Figure 6. Graph of Practicality Test Results

IV.   CONCLUSION

Based at the studies that has been done, it is able to be concluded that the elearning of salt hydrolysis based on project-based learning with Flipped Classroom for class XI SMA / MA with the resulting 4-D development model is valid and practical. The content and construct validity levels were 0.89 and 0.90 respectively with very high categories and practicality levels. amounting to 0.85 in the very high category. As well as the product produced in this study in the form of e-learning content for learning material based on project-based learning salt hydrolysis with a Flipped Classroom perspective that can be used by SMA / MA schools.

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