Problem Based Learning (PBL) Chemistry E-Module Development for Class X High School Students

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Abstract. This study aims to develop and determine the feasibility of the Problem Based Learning (PBL) Chemistry E-Module for Class X. The method in this study uses Research and Development (R&D) with the ADDIE model (Analyze, Design, Development, Implementation, Evaluation). The instrument used in this research is the BSNP standard validation sheet which has been modified according to the needs of module development. Validation was carried out by 2 material experts, 2 media experts, and 3 chemistry teachers. Based on the validation results obtained from the lecturer validator subject matter expert and chemistry subject teacher, an average yield of 82.7% was obtained which met the criteria of "very feasible", and from media experts. Obtained an average yield of 93.12% which meets the criteria of "very feasible". So that overall the Problem Based Learning (PBL) Chemistry E-Module for Class X is feasible to use in the learning process.

Keywords: Development, E-Module, Problem Based Learning (PBL), BSNP, Chemistry

1 Introduction

Education is the stage of developing students to reach maturity in life. In the era of the 4.0 revolution, there were changes in the needs of education, so the government implemented the revised 2013 curriculum to meet educational needs in the 21st century in accordance with the times and the characteristics of students. In its implementation, the revised 2013 curriculum requires teachers to develop learning by integrating four important things, namely strengthening character education, literacy, 21st century skills and Higher Order Thinking Skills which require teacher creativity in concocting them [1]. The implementation of the 2013 curriculum is supported by teacher independence which can create active, creative, effective and enjoyable learning that is no longer teacher centered but student centered which requires students to become the subject of the learning.

Chemistry is a subject that is part of natural science which contains facts, theories, principles, and laws from scientific work processes. In the chemistry learning process there are 3 main

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aspects that must be considered, namely product, process, and scientific attitude. However, students still often experience difficulties in understanding chemical material because it is abstract. As a result, students do not understand chemical concepts well, even though abstract facts are part of the explanation of concrete facts and concepts. One of the chemistry materials studied in class X is electrolyte and non-electrolyte solutions[2]. Based on the characteristics of the material for electrolyte and non-electrolyte solutions which contain factual, conceptual and procedural knowledge, the results of research conducted by [2] show that some students still have difficulty understanding the material for electrolyte and non-electrolyte solutions. One learning model that can build students' analysis and thinking processes is Problem Based Learning (PBL).

Problem-based learning called PBL is a learning approach that supports students to think about finding problems from a real event by gathering information independently through methods that have been developed to solve problems and then the work will be presented cooperatively[3]. Problem-based learning facilitates the creation of habits of analysis and habits of critical thinking for problem solving, problem-based learning usually consists of 5 stages starting with student orientation to problems, organizing students for learning, guiding individual and group investigations, developing and presenting work and analyzing and evaluate the problem-solving process[4]. In an effort to implement the PBL model in the learning process, teaching materials are needed as learning resources that can support the achievement of learning objectives set by the curriculum through competency arrangements. One form of teaching materials is a module[5].

The module is a book written with the aim that students can learn independently without or with the guidance of the teacher, so that the module contains several mandatory components including the opening, core and final sections which are tailored to the interests, abilities, characteristics and needs of students. The development of information technology in the 4.0 era demands the provision of teaching materials not only in printed form but interactive teaching materials that contain text, images, visuals, audio and can be used by students independently with electronic assistance, for example the development of teaching materials in the form of electronic modules (E- module) [6].

The electronic module (e-module) is Kvisoft Flipbook Maker. Kvisoft Flipbook Maker software by converting writing in PDF form into an electronic book. In Kvisoft Flipbook Maker there is a file editing menu that functions to add hyperlinks, audio, video, images, and multimedia objects to electronic books that can be read as valid as original books. Apart from that, there is also a design menu which functions to set the background (background) with certain themes so that it is interesting to read[7]. Student skills in problem solving can be trained through e-books with the application, with the addition of videos, and flash made e-books can develop into communicative for users. Video can train observing, classifying, asking, and formulating hypotheses, while flash can be used to help users train questions, formulate hypotheses, and communicate skills [8].

2.Method

The research method that will be implemented in this study is Research and Development. Researchers developed a product in the form of a PBL-based electronic module for class X

SMA students in semester II by utilizing the Kvisoft Flipbook Maker application. The research will be carried out using the ADDIE development model, which stands for Analyze, Design, Develop, Implement, and Evaluate. Following these development stages is expected to produce products that can be applied directly and facilitate the learning process. Of the five stages of the ADDIE model, only 3 stages are adapted in this study, namely Analyst, Design and Development. A more complete procedure in this study is presented in Figure 1.

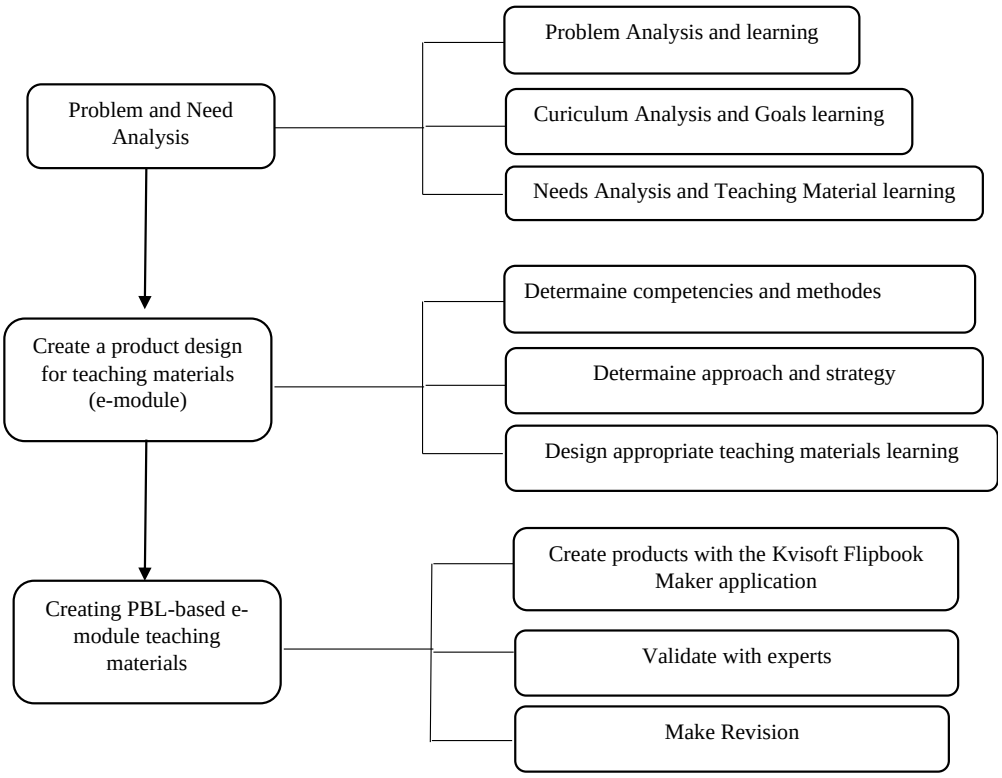


Figure 1. Prosedur Penelitian

The data collection instrument used in this study was a validation questionnaire sheet based on eligibility standards according to the National Education Standards Agency (BSNP). Questionnaires were given to expert lecturers in the fields of material and media as well as chemistry teachers. The scale used in the eligibility of the Interactive E-Module based on Prolem Based Learning is a Likert scale with a range of 1-4 where the answers given strongly disagree to strongly agree. The data analysis technique used is a quantitative descriptive analysis technique and a qualitative descriptive analysis technique. Interpreting the feasibility category of the Interactive E-Module based on Prolem Based Learning, can be seen in Table 1.

Table 1. Criteria for Validity of Average Value Analysis

No	P Value Intervals	Eligibility level

1	3.26 - 4.00	Very Worth It
2	2.51 – 3.25	Worthy
3	1.76 – 2.50	Not Worth It
4	1.00 – 1.75	Not feasible

3 Results and Discussion

This research is a Research and Development (R&D). This development research process uses the ADDIE model which consists of Analyze, Design, Development.

3.1 Analyze

The E-module product development stage begins with the analysis stage, at this stage an analysis of the needs and curriculum used by the school is carried out. Needs analysis was carried out by means of observation and interviews with teachers and students at SMA Muhammadiyah 01 Medan. Observations and interviews were conducted to find out how the learning process took place at school, the characteristics of students, and the sources of teaching materials used in the learning process. Furthermore, a curriculum analysis was carried out, namely an analysis of the teacher's and student's handbook which was used as a reference for learning by the teacher in the classroom. Then review the learning model recommended by the curriculum, analyze the KI and KD in the material.

3.1.1 Analysis of Syllabus, KI and KD

The results of the analysis of the syllabus for class X of the MIPA Specialization group contained 4 main materials for the even semester, namely Reduction and Oxidation Reactions, Nomenclature of compounds, Basic laws and chemical calculations, Electrolyte and non-electrolyte solutions which were broken down into 6 Basic Competences.

3.1.2 Needs Analysis

Based on the results of the needs analysis obtained from teacher and student interviews, it was found that students need teaching materials that are practical and interactive which can motivate students to learn. The teaching materials used are only in the form of textbooks and the obstacles faced by the teacher in the learning process are students who tend to be passive and not eager to learn due to monotonous learning because they only use the lecture method, do not use the method or model recommended by the curriculum. So there is a need for innovation in teaching materials that are more interactive so that students participate actively in the learning process. This is evident from the results of observations which show that students tend to be passive in the learning process.

3.1.3 Analysis of Teaching Materials

Analysis of the teaching materials used by schools uses an assessment instrument in the form of a BSNP questionnaire. The results of the feasibility analysis of chemistry teaching materials for Class X MIA high school students can be seen in table 4.1. For the teaching materials used, namely the book Concept and Application of Chemistry for Class X High School / MA.

Table 2. Preliminary analysis of the feasibility of teaching materials based on BSNP

Aspects Examined	Average Score	Percentage
Eligibility of content	3.08	77%
Language eligibility	3.26	81,6%
Feasibility of presentation	2.55	63,7%
Graphic Eligibility	3.00	75%
Total	2.9	74,3%

Design

At the design stage, PBL-based interactive e-modules are made according to the results of curriculum analysis, needs analysis, and teaching materials used previously. The material used to develop the e-module is taken from chemistry reference books and university books. The design of the module content material follows the PBL syntax, which consists of (1) Orientation of students, (2) Organizing students for learning, (3) Guiding individual and group investigations, (4) Developing and presenting results, (5) Analyzing and evaluating processes problem solving. These sections are integrated in the module and packaged using professional flip PDF software and will continue to be uploaded online with the help of a flipbook maker. The appearance of the e-book is made as interactive as possible including pictures, learning videos, quizzes and evaluation questions that students can work on directly, and students can see firsthand the results of working on the questions and their corrections. The initial appearance of the e-module design is shown in Figure 2.

Figure 2. Preliminary Module Design

Development

At the development stage, the e-module that has been designed is developed. PBL-based interactive e-modules were validated by expert lecturers, namely 2 material expert lecturers and 2 media expert lecturers, the material was also validated by chemistry study teachers, namely 3 teachers. A feasibility test was carried out to determine the feasibility percentage of the module developed by validity test. Based on the validity test conducted by the expert, there are several notes of improvement to perfect the PBL-based interactive e-module. The average percentage results of the validity test by the material expert validator can be seen in table 3 and table 4. The average percentage of due diligence by Media expert validators on problem-based learning-based interactive e-modules of 3.72, namely 93.12% in the proper category but there are several notes that can improve the e-module.

Table 3 Expert Lecturer Validator Results

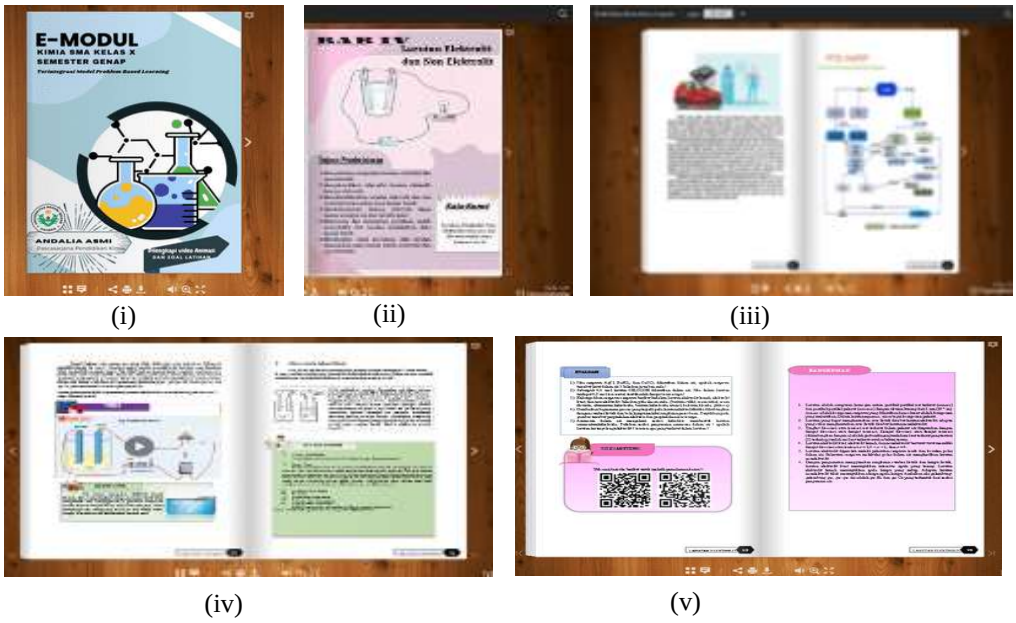
No.	Assessment Components	Average	Percentage	Criteria
1.	Content Eligibility	3,27	81.75%	Worthy
2.	Language Eligibility	3,21	80.25%	Worthy
3.	Feasibility of Presentation	3,47	86.75%	Worthy
	Average	**3,31**	**82.75%**	**Worthy**

Table 4. Results of Study Field Teacher Validators

No.	Assessment Components	Average	Percentage	Criteria
1.	Content Eligibility	3.49	87.25%	Worthy

2.	Language Eligibility	3.35	83.75%	Worthy
3.	Feasibility of Presentation	3.53	88.25%	Worthy
	Average	**3.45**	**86.25%**	**Worthy**

After making improvements based on the suggestions and notes provided by the validator, the results of the PBL-based interactive e-module can be seen in Figure 3.



(i) (ii) (iii)

(iv) (v)

Figure 3. Display of the PBL interactive e-module (i) Cover; (ii) Beginning of Chapter; (iii) Initial introduction; (iv) animated videos; (v) chapter closing

4 Conclusion

Based on the results of observations and interviews that have been carried out, it was found that students need interesting and interactive teaching materials, so that students are actively involved in learning, learning is more fun and not monotonous, after being developed and carrying out feasibility tests, Based on the validation results obtained from the lecturer validator subject matter expert and chemistry subject teacher, an average yield of 82.7% was obtained which met the criteria of "very feasible", and from media experts Obtained an average yield of 93.12% which meets the criteria of "very feasible". So that overall the Problem Based Learning (PBL) Chemistry E-Module for Class X is feasible to use in the learning process.

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