E-Module Development Based on Problem Based Learning (PBL) on Material Class X High School Chemistry Association

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A R T I C L E   I N F O

ABSTRACT (9 PT)

This study aims to obtain: (1) PBL-based E-modules that have met the criteria for content eligibility, language eligibility, presentation eligibility, and graphic eligibility according to the National Education Standards Agency; (2) Students' responses to aspects of the appearance, material and benefits of PBL-based e-modules on chemical bonding materials. The type of research used is Research and Development (R&D) which has been modified as needed. This research was carried out in several stages, namely syllabus analysis according to the current curriculum, module analysis by researchers, module design and development, validation of e-modules by lecturers and teachers, and then evaluation of e-modules developed by students. The average result of validation by lecturers is 3, 53 which means it is valid and does not need to be revised and the average teacher validation is 3.86 which means it is valid and does not need to be revised. The average percentage of student satisfaction with PBL-based e-modules that have been developed is 77.87%. So it can be concluded that the E-module based on Problem Based Learning (PBL) in the chemical bonding material for class X SMA is valid and does not need to be revised. Based on the high student response, it means that students feel interested in the e-module.

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1. INTRODUCTION

Education is a means to create quality human resources. According to Paulo Freire, an educational leader from Brazil, education aims to liberate and raise everyone's critical awareness. Education has role urgent in progress something nation. Various business has conducted every country to improve the quality of education. Based on Law No. 20 of 2003, concerning the National Education System, education aims to educate the nation's life. One of Indonesia's efforts to improve the quality of education is the implementation of the 2013 Curriculum. In the 2013 curriculum, the learning process requires students to be more active, critical and more responsive to everyday social conditions (Komara, 2010).

In process learning like teacher, student and environment could affect the achievement of learning objectives. The purpose of education will be achieved if the quality of education is

achieved, and one of the ways to improve the quality of education is to improve the quality of learning in schools (Zainul, 2019).

The 2013 curriculum is a curriculum that focuses students on 3 competency achievements namely, attitudes, knowledge, and skills (affective, cognitive, and psychomotor). The achievement of learning outcomes from cognitive, affective, and psychomotor competencies illustrates quality which balanced Among achievement hard skills and soft skills (Kusuma, 2013). The 2013 curriculum system uses a scientific learning approach system with four model learning that is discovery, inquiries, problembased learning (PBL) and projectbased learning (PJBL). The approach and learning model in the 2013 curriculum want students to be able to learn independently and the learning process is no longer teacher center but student center. Therefore, students are expected to play an active role during the learning process (Sariono, 2013).

PBL is a learning strategy in which students work on authentic problems with a view to constructing their own knowledge and skills think level more, develop independence and believe self. PBL focuses on challenges that make students think. Research conducted by Trihatmo et al. (2012) shows that the application of the PBL model is effective in improving learning outcomes student. Chemistry is branch knowledge physical which learn characteristic, structure, Theory, and change. Chemistry is one of the subjects in high school that is considered difficult by some students, this is because chemistry subjects include abstract, memorizing and calculating things that use certain formulas so that they are difficult to understand. by students. Most students find it difficult to understand the structures in learning During learning chemistry wrong the only one on Theory bond chemistry.

Based on research which conducted by ananda, et al (2016), Bond chemistry is wrong one material that is difficult for students to understand. This statement is reinforced by the results of interviews with class X chemistry teachers. The students' learning difficulties can be seen from the low scores of students' daily tests. Of the 4 classes, students who have not reached the KKM (80) get a percentage of about 55.7% while students who complete 44.3%. Chemistry learning at school can be linked to the surrounding environment so that students are accustomed to solving problems in everyday life. One of the learning models that connects chemistry learning with life daily and could practice Skills think creative student is model PBL (Budiariawan, 2019).

The success of a learning is determined by two important components, namely the model and the media used. These two components are interconnected and cannot be separated. Election and use something model certain have consequence for also determine the appropriate media. One model that is considered as the right strategy in creating more interesting chemistry learning is PBL. This is supported by research conducted by Abdurrozak (2016), the PBL model is proven to improve student learning outcomes, including: students experience an increase in creative thinking abilities, there is an increase in student learning outcomes, students' thinking skills are better by using the PBL model compared to the conventional model (Abdurrozak, 2016).

The module is one of the teaching materials that can be developed using the PBL model. The module is a teaching material that is designed systematically, attractively, and refers to clear and measurable learning objectives so that students can learn independently. The learning module includes material content, methods and evaluations that can be used by students to achieve the expected competencies. The use of this module is successful and proven to be able to create an interesting and effective learning process and is able to increase the level of student understanding. This is supported by the results of the module development research conducted by Febriana, et al., (2014) which suggests that the PBL-based chemistry module is effective for improving student's cognitive aspect of learning achievement. Based on research conducted by Dhamas Mega (2013) suggests that the average student learning outcomes are higher after learning using problem-based teaching materials than before learning using problem-based teaching materials (Effendi, 2018).

Technology is one of the important aspects that can be used to create interesting teaching materials for students. Based on the analysis of the Teacher's Book and Student's Book that has been carried out, the 21st century skill competencies that are important for mastered participant educate not yet fully raised. Book Student in form Print also has limitations in presenting the material.

The limitations of print media open up opportunities for the integration of an innovation in teaching materials with information technology to support the achievement of 21st century skills. The teaching materials developed should be able to use by independent and easy accessed by participant educate. E-Module could become one of the forms of teaching materials developed because the module has five main characteristics which Becomes the advantages that is self-instructional, self-contained, stand-alone, adaptive, and use friendly (Febyarni, 2019).

Media based on technology could make student adapt with current developments in the IT field. Students who are accustomed to using IT-based media indirectly also develop their abilities in these fields and can develop the quality of their human resources. Government Regulation No. 17 of 2010 articles 48 and 59 hints at the development of an education information system based on technology and information. One technology-based learning media that can be used as an existing support is a module packaged in the form of e-learning (Masykuri, 2017).

Electronic module (E-module) is a teaching material in the form of a displayed module in format electronic which expected could increase interest and students' learning motivation. The use of e-modules is as a substitute for books or modules print without reduce the essence as source information or source study (Nadia, 2019).

Use ingredient teach in the form of E-module used as replacement book or print module (hardcopy) without reducing its function as a source of information. The use of e -modules can also be used outside the classroom or inside the classroom (Handayani, 2020).

Progress technology multimedia learning allow student learn chemistry in form module electronic. Ingredient teach in the form of module electronic, have a number of advantages, including making it easier for students to get information by using electronic devices owned by these students, whether in the form of PC computers, laptops, ipads, or mobile phones. anywhere and anytime, thus enabling students to gain complete mastery of the subject matter (Nurhayati, 2021).

The selection of this electronic module is not without reason because according to data on smartphone users in Indonesia in 2016 it reached 65.2 million. Based on the observations of researchers, almost 100% of students have smart phones so that researchers judge it is appropriate to make electronic modules (Databoks, 2016).

Based on the above background, researchers are motivated to develop more innovative teaching materials based on PBL for SMA/MA in Chemical Bonds. So that this research is entitled "Development of Problem Based Learning (PBL) E Modules in Class X High School Chemical Bonding Materials".

2. RESEARCH METHOD

This research uses research and development (R&D) methods. The design of this study uses a 4D model. 4D models are used to develop learning tools. The 4D model was developed by S. Thiagarajan, Dorothy S. Semmel, and Melvyn I. Semmel in 1974. As the name implies, the 4D model consists of 4 that is Define, Design, Develop, and Disseminate.

Subject from study this are 3 lecturers Department of Chemistry, State University of Medan and 3 Chemistry teachers at SMA Negeri 1 Sumbul. Object from study this is -based teaching materials problem that will developed on the material bond high school chemistry class X and will responded by 20 students class X SMA Negeri 1 Sumbul. Instruments used _ in study this is in the form of BSNP questionnaire and Questionnaire response student to developed teaching materials.On data analysis for analysis validation based on BSNP can see like in table following :

Table 1. Category BSNP Eligibility

No	Achievement level	Qualification	Information
1	3.26-4.00	Very good	Very worth it, no need revised
2	2.51-3.25	Well	Worth it, no need revised
3	1.76-2.50	Enough good	Not worth it, need revision
4	1.00-1.75	Not good	Not worth it, need revision

Analysis response student, result percentage questionnaire response could see in the following table:

Table 2. Category Response Results Student

No	Achievement rate (%)	Qualification
1	84 - 100	Very high
2	68 - 83	Tall
3	52 - 67	Currently
4	36 - 51	Low
5	20 - 35	Very Low

3. RESULTS AND DISCUSSIONS

This research was carried out in several stages, namely: (a) syllabus analysis according to the current curriculum, (b) module analysis by researchers, (c) module design and draft, (d) standardization or validation of teaching materials by expert lecturers and the teacher, (e) assessing or asking for student responses to the developed module. Based on the research that has been done by the researcher, the following research results are presented.The syllabus is an elaboration of competency standards and basic competencies into learning materials, learning activities, and indicators of competency achievement for assessment. The syllabus used is a syllabus that is in accordance with the current 2013 curriculum. This syllabus analysis stage aims to find out the material and sub-materials that will be discussed in the module. The material and sub materials obtained from the syllabus are: (1) Ion Stability, (2) Lewis Structure, (3) Ionic Bonds, (3) Covalent Bonds, (4) Covalent Covalent Bonds, (5) Polar and Nonpolar Covalent Compounds.By referring to the 2013 curriculum syllabus, the next step in this research is to analyze the current 4 class X high school chemical bond material modules. Module I (author Marie Kurniawan, et al in 2017), Module II (author Bayu Pranata in 2021), Module III (Chemistry of love), Module IV (author Diantoro, Spd). The following are the reasons for selecting the module that has been analyzed by the researcher.

Table 3. Analysis results module by Researcher

Module	Average Of Material Compatibility Standards				Average
	Eligibility Of Contents	Language Eligibility	Service Eligibility	Graphic Eligibility	
Module I	3.21	3.18	3	3	3.09
Module Ii	3.05	3.18	2.62	2.54	2.84
Module Iii	2.89	3	2.31	2.36	2.64
Module Iv	2.42	3	1.93	2	2.33

Based on the data above, it can be seen that the results of the analysis of the four modules give different results, both in terms of material coverage and with the BSNP instrument. Where each has advantages and disadvantages both in terms of content feasibility, language feasibility, presentation feasibility, and graphic feasibility. After analyzing the module, the next step is to make a design and draft of the module. This design is based on the results of the 2013 curriculum syllabus analysis and the results of the module analysis that has been carried out, so that the material components that will be proposed are in accordance with the standards. At the design stage, the module was developed from the results of the analysis of the four existing modules. Then the results of the analysis of the module are used as a reference.After the module design has been completed, the next step is to validate the module using a modified BSNP instrument, covering aspects of content feasibility, language feasibility, presentation feasibility, and graphic feasibility.

Table 4. Results of Validation of Teaching Materials by Lecturers of Chemistry Department

No	Assessment Components	Evaluation			Average Score	Feasibility Criteria
		D1	D2	D3		
1	Eligibility Of Contents	3.041	3.666	3.875	3.527333333	Valid And Does Not Need To Be

No	Assessment Components	Evaluation			Average Score	Feasibility Criteria
		D1	D2	D3		
2	Language Eligibility	3	3,733	3.866	3.533	Revised Valid And Does Not Need To Be Revised
3	Service Eligibility	3	3.5	3.9	3.466666667	Valid And Does Not Need To Be Revised
4	Graphic Eligibility	3	4	3.83	3.61	Valid And Does Not Need To Be Revised
Average		3.01025	3.72475	3.86775	3.53425	Valid And Does Not Need To Be Revised

The modules that have been compiled have been validated based on the BSNP instrument which consists of several components such as content feasibility, language feasibility, presentation feasibility, and graphic feasibility. The average result of the analysis of teaching materials that have been developed is 3.53, which means that the teaching materials are valid and do not need to be revised. With the average translation of the validation results, the feasibility of content is 3.52, the feasibility of language is 3.53, the feasibility of presentation is 3.46, and the feasibility of graphics is 3.61.

Table 5. Results of the Validation of Teaching Materials by Chemistry Teachers

No	Assessment Components	Evaluation			Average Score	Feasibility Criteria
		G1	G2	G3		
1	Eligibility Of Contents	3.875	3,708	3,708	3.763666667	Valid And Does Not Need To Be Revised
2	Language Eligibility	4	4	4	4	Valid And Does Not Need To Be Revised
3	Service Eligibility	3.95	3.9	3.7	3.85	Valid And Does Not Need To Be Revised
4	Graphic Eligibility	4	3.83	3.66	3.83	Valid And Does Not Need To Be Revised
	Average	3.95625	3.8595	3,767	3.86091667	Valid And Does Not Need To Be Revised

The average score of the validation results carried out by the chemistry teacher at SMA Negeri 1 Sumbul was 3,767. With the elaboration of the average content feasibility score of 3.763, language eligibility 4, presentation feasibility 3.85, and graphic feasibility 3.83. Based on the criteria for the validity of the analysis of the average value of the teaching materials used, this module is valid and does not need to be revised. In this study, 20 students of SMA Negeri 1 Sumbul were used as respondents in the problem-based module assessment on the chemical bonding material. Previously, problem-based modules were distributed directly to students, then students were asked to read, understand the module from the aspect of appearance, material and benefits.

Table 6. Percentage of Satisfaction and Response Level Student to Teaching Material

No	Evaluation	Percentage Response Student
1	Aspect Appearance	75.90%
2	Aspect Theory	78.50%
3	Aspect Benefit	79.20%
Average		77.87%

Based on the results of the questionnaire on student responses to E-modules based on Problem Based Learning (PBL) in Chemical Bonding, the average percentage was 77.87%. With the description of the average percentage of the display aspect is 75.90%, the material aspect is

78.50%, and the benefit aspect is 79.20%. Based on the criteria for the level of student response to the E-module, students gave a high response where students felt interested in using PBL-based E-modules to study Chemical Bonding material.
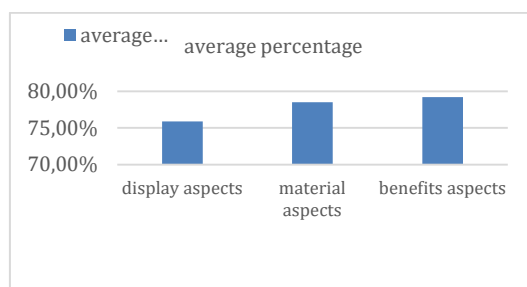

Figure 1. Percentage Of Student Response Results To E-Modules

After conducted validation to expert validators so obtained that e- module is said to be valid and not need revised. Beside that with response all student show student interested with e - module it and can made as teaching materials in learning chemistry as well as reference reading for students

4. CONCLUSION

Based on research conducted _ so obtained teaching materials in the form of e - modules PBL based on material Bond class X high school chemistry already fulfil BSNP eligibility and worthy used in accordance with level interest tall student with the teaching materials.

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