

**DEVELOPMENT OF PROBLEM BASED LEARNING MODULE ON
BUFFER SOLUTION AT ELEVEN GRADE ON PUBLIC HIGH SCHOOL
IN PONTIANAK**

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Abstract : The research aims to produce problem based learning module on buffer solution of eleven grade that is appropriate as teaching materials. The method used is a Research and Development recommended by Borg & Gall. The sample in this research was determined by disproportionate stratified random sampling and purposive sampling technique. Based on the results of data analysis on the questionnaire obtained: (1) evaluation of the expert judgment in terms of the feasibility of content, feasibility of presentation, feasibility of linguistic and feasibility of graph are respectively 89,74% (very high), 89,27% (very high), 92,5% (very high), and 85,23% (very high); (2) The readability test on initial field trials teacher response is 68,75% (high) and students response is 78,43% (high); and (3) The readability test on major field trials teacher response is 82,49% (very high) and students response is 85,14% (very high). It can be concluded that the module developed feasible used as teaching materials and has a high readability based on the responses of teachers and students.

Keywords: *problem based learning modules, buffer solution*

A 21st century education is related to the new problems that exist in the real world. This requires human resources to be able to understand the problems that developed in the society as well as solving the problem through the thought process more complex. Problem based learning can be the right choice in order to realize the man who is knowledgeable and has a good thinking skills. Problem based learning is able to offer individual learning by using intelligence in problem solving meaningful, relevant, and contextual so the ability of thinking students really optimized (Rusman, 2013). The development of thinking skills through problem solving has become the development potential given the skilled person to solve the problem is believed to be able to race with the necessities of life, be a productive individual and to understand complex issues relating to the global community.

Problem based learning model is a way of presenting the learning material exposes students to the problem to be solved to achieve learning objectives. According Killey (2005) problem based learning has advantages for helping to develop critical thinking skills, oral and written communication and develop teamwork skill. Bilgin (2009: 153) states that problem based learning is proven to improve learning achievement, and students knowledge, discuss about precise definition, and have positioned themselves as researchers.

The effectiveness of learning can be seen through students' ability to solve problems. Students' ability to solve this problem is obtained through a preliminary analysis by the problem-based questions. Following is pre-research of data related to the result of completion on problem-based questions given to students in eleven grade at three high schools in Pontianak. Based on the data pre-research it can be seen that most students have difficulty in interpreting the application into a concept. It can be seen from the low percentage of problem solving applicative given to students.

The implementation of problem based learning is focused on the problems to be solved students with reference to various sources or learning materials to development of thought processes as well as support in solving these problems. According Belawati (2003), the role of teaching materials for teachers is effective time to teaching, changing the role of teachers becomes a facilitator, enhancing the learning process becomes more effective and interactive. As for the role of teaching materials for students is can learn without a teacher or friend other, students can learn anytime and anywhere he wants, students can learn to pace themselves, students can learn according to the rules of his own choosing, and to help potential students to become independent learners.

Based on the results of field observations, obtained information that the teaching materials act as the main support in the learning process. An important role of teaching materials can be seen from the exposure concepts and the process to develop the knowledge of students through the exercises, all referring to students' reference. This suggests that the textbook used in the learning process is highly influential on student learning outcomes.

Based on the analysis of learning materials used in the learning process, it is available are still not touching aspects of the development thinking skills of learners. Existing learning material are generally limited to presenting the

material, not contains lessons that guide students in understanding and not developing the to thinking skill. Additionally, based on the results of field observations show in the learning process, students still depends on teachers in the process of thinking skill, students are doesn't to study learning material in the book. That is an impact on students's understanding and thinking processes are relatively low. The existence of these limitations would encourage the necessity of learning material with activity based not content based as supporting the implementation of the curriculum as well as the initial step in the development of thinking skills of learners. It is can be done by applying a learning material designed to systematically based on specific curriculum and packed in the smallest learning unit. One of the teaching materials with specific characteristics is learning module.

Module is a learning material that can be used as an alternative source of good learning. This is supported by the results of interviews with teachers of chemistry in Public High School in Pontianak, that High School 1 Pontianak and High School 8 Pontianak are two schools ever apply learning modules on one of the subject matter grade X. The learning module can improve of student learning outcomes in the learning material because the learning materials contained in the module is adapted to the student's ability and ease to understanding learning materials.

Study of learning materials chemistry mostly contains concepts and algorithmic is complex. This makes the chemistry became one of the subjects that are considered difficult by students. Based on the results of student responses, it can be seen that most students considered buffer solution is one that is considered difficult subject matter. The characteristics of the material buffer solution include: an abstract (acid-base reactions), the concept (characteristic of buffer solution), real and applicable (the role of buffer solution) so in the learning process requires the real teaching through problem based learning. This relates to one of the basic competencies that must be achieved by students that description about buffer solution and the role of buffer solution in living organisms.

Modules that developed is an integrated problem based learning (PBL) where students can develop critical thinking skills to solve problems related to everyday life. Problem based learning modules develop will improve students' critical thinking skills to solve problems because the principle of problem based learning is learning that begins with any problems and question that make students want to solve it (Duch, et al.2000).

Based on the theories and facts related to the condition of students often have difficulty understanding the concept and implementation of algorithmic on buffer solution, encourage researchers to develop a teaching material in the form of problem based modules that study of learning is oriented problem on buffer solution of grade XI. This is done as an effort to improve learning outcomes by strengthening the concepts and algorithmic through problems. Expectations on the development of this research can be obtained a product of teaching materials in the problem based learning module that can be used as learning material for development concepts and thinking skill on buffer solution.

METHOD

The method used in this research is the research and development. The procedure recommended by Borg & Gall in Puslitjaknov (2008) which includes five steps: (1) analysis of the product to be developed; (2) develop the initial product; (3) experts judgment and revision; (4) initial field trials and revision of the product; (5) main field trials and the final product.

Data collection techniques in this research using a questionnaire feasibility and legibility questionnaire with likert scale. Feasibility questionnaire was given to the experts for validation modules that developed. Feasibility test consists content, presentation, linguistic, and graphic to be undertaken by experts. Legibility questionnaire aims to determine the level of ease or difficulty of teachers and students understand the content and representation of modules are developed. This questionnaire given to teachers and learners in initial field trials and main field trial.

The initial field trials have been two schools, high and low categories. Each school selected 1 teachers of chemistry subject and 4 student that have high ability in the subjects of chemistry so that the samples at initial field trial are two teachers and eight students. The main field trials have been 4 school consist of 1 high school of high category and medium category, and 2 high school of low category. Each school selected 1 teachers of chemistry subject and 12 students of class XI consisting of each 4 students of high ability, 4 students of medium ability, and 4 ability students is low ability, so the sample of field trials test is four chemistry teachers and 48 students.

Analysis of textbook consists of feasibility and legibility test as follows:

1. Feasibility Test

- a. Calculate score frequency per item
- b. Calculate total score per item
- c. Percentage scores of module feasibility calculated using the formula:

$$P = \frac{\sum X}{\sum Xi} \times 100\%$$

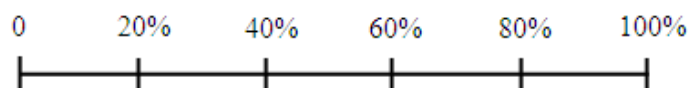
P = percentage of score
 $\sum X$ = total score per item
 $\sum Xi$ = maximum total score

- d. Average of module feasibility is calculated using the formula :

$$X = \frac{\sum X}{n}$$

X = average of validity
 $\sum X$ = amount of average score per aspect
n = amount of aspects assessed

- e. Determining feasibility criteria (FC) of module with the following interpretation criteria :



- 0% < FC ≤ 20% : Very Low
- 20% < FC ≤ 40 % : Low
- 40% < FC ≤ 60 % : Moderate
- 60% < FC ≤ 80% : High
- 80% < FC ≤ 100% : Very High (Riduwan, 2008).

2. Readability Test

- a. Calculate respondents frequency that choose very agree, agree, disagree, very disagree of positive item and negative item.
- b. Calculate total score per item with following criteria :

Table 1 Score of Likert Scale on Module

Categories	Positive Item	Negative Item
Very Agree	4	1
Agree	3	2
Disagree	2	3
Very Disagree	1	4

Sources : Riduwan, 2008

- c. Percentage scores of module readability calculated using the formula :

$$P = \frac{\sum X}{\sum Xi} \times 100\%$$

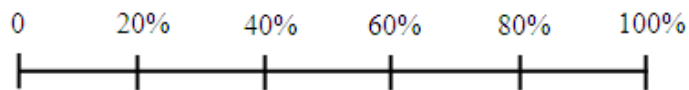
- P = percentage of score
- $\sum X$ = total score per item
- $\sum Xi$ = maximum total score

- d. Calculate total score of response using formula :

$$V = \frac{\sum P}{n}$$

- V = average percentage of validity
- $\sum P$ = amount of average score per aspect
- n = amount of aspects assessed

- f. Determining responses criteria (RC) of module with the following interpretation criteria :



- 0% < RC ≤ 20% : Very Low
- 20% < RC ≤ 40 % : Low
- 40% < RC ≤ 60 % : Moderate
- 60% < RC ≤ 80% : High
- 80% < RC ≤ 100% : Very High (Riduwan, 2008).

RESULT AND DISCUSSION

The development of problem based learning module aims to enhance students' thinking skills through the problem related teaching materials. In the learning process, students are given the opportunity to think systematically through the problem by the stages of problem based learning to understand the concept. Problem-based learning module is applied on buffer solution at eleven grade high school.

The initial phase before the development problem based learning module that is necessary to analyze the concept of related buffer solution will be presented in the module. At this phase, the analysis of buffer solution tailored to the indicator and learning objectives. Analysis is done for the concept of the depth and breadth of the material on buffer solution in accordance with the demands of content standards and competency standards contained in the Curriculum 2013.

A. Description Product Component

On the module developed, explanation buffer solution concepts are presented through a problem based learning approach. Characteristic of problem-based learning in this module can be seen from learning process through steps of problem based learning. The steps of problem based learning consist of (1) analysis of the product to be developed; (2) develop the initial product; (3) experts judgment and revision; (4) initial field trials and revision of the product; (5) main field trials and the final product.

B. Result of Expert Judgment

Expert judgement conducted with experts respondents. Chemist who will assess the feasibility of content and presentation, linguists who will assess the feasibility of language and media experts who will assess the feasibility graphic. This activity is conducted to review the feasibility of initial product, as well as provide input for improvement. The following recapitulation of the expert judgement of the learning module for each aspect assessed presented in diagram 1.

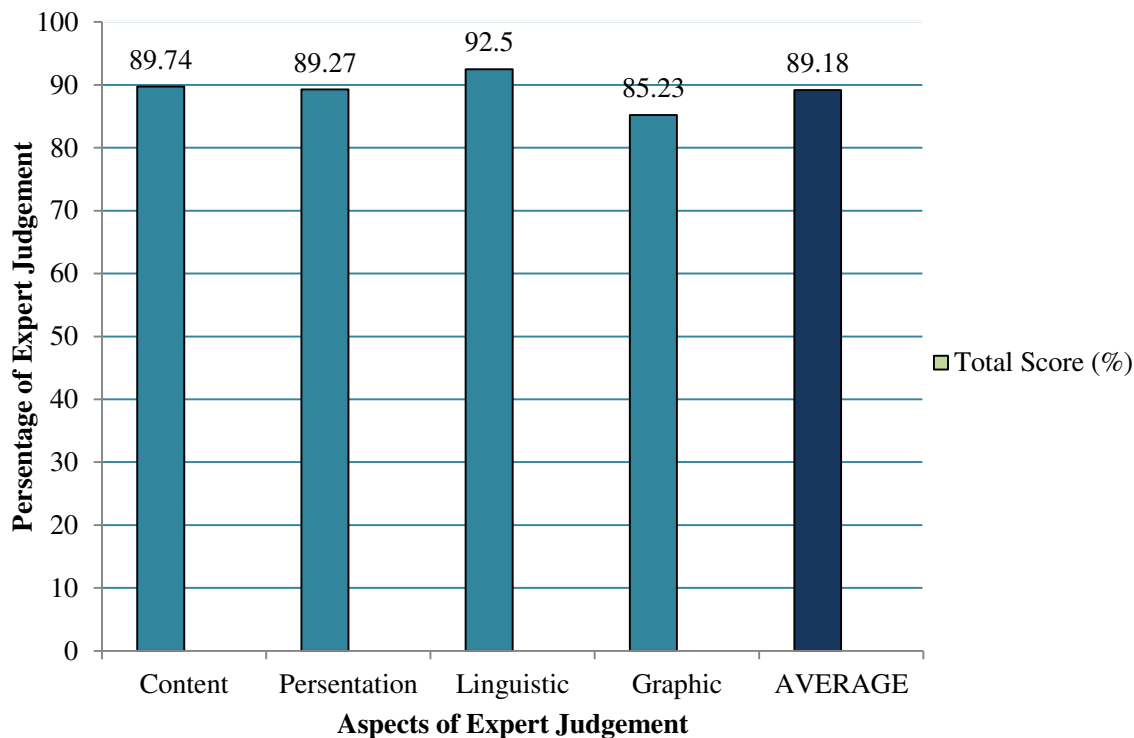
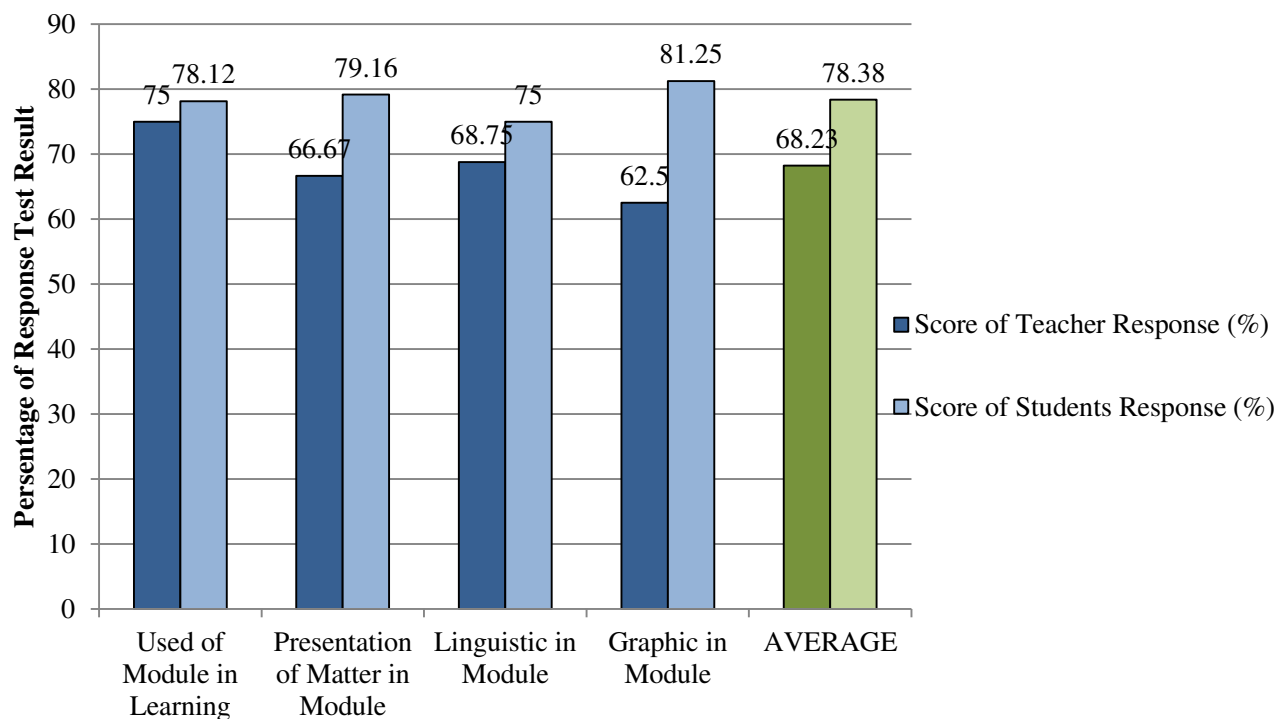


Diagram 1 Recapitulation results for Expert Judgement of Problem Based Chemistry Module

The results of feasibility studies by experts on the problem based learning module known the average percentage for each aspect of the assessment is based on an expert judgement questionnaire to the learning modules is 89.18% with a very high eligibility criteria. Thus, viewed from the aspect of content, presentation, linguistic, and graphic, problem based learning module is very fit for use as teaching material in the learning process.

C. Initial Field Test

Initial field test aim to determine readability of problem based learning module. Initial field test conducted against teachers and students. At initial field test, selected high ability students in two high schools in the Pontianak classified as high and low categories, namely high school of 1 Pontianak and high school of 8 Pontianak. The following recapitulation of the questionnaire responses of teachers and students of the developed problem based learning module is presented in diagram 2.



Response Assessment Aspect of Teachers and Students

Diagram 2 Summary of Results of Teacher and Student Response to Problem Based Learning Module on Initial Field Test

D. Main Field Test

The main field test aims to determine the response of the use of problem based learning module with the students more. Students in main field test have heterogeneous capabilities, the ability of high, medium and low. The main field test on 4 high schools in the Pontianak, each school classified of high, medium, and low at high school of 1 Pontianak, high school of 4 Pontianak, high school of 7 Pontianak and high school of 8 Pontianak with the total of students as much as 48. The problem based learning module that is used on the main field test have been revised based on suggestions and comments from the initial field test. The following recapitulation of the questionnaire responses of teachers and students of the developed module is presented in diagram 3.

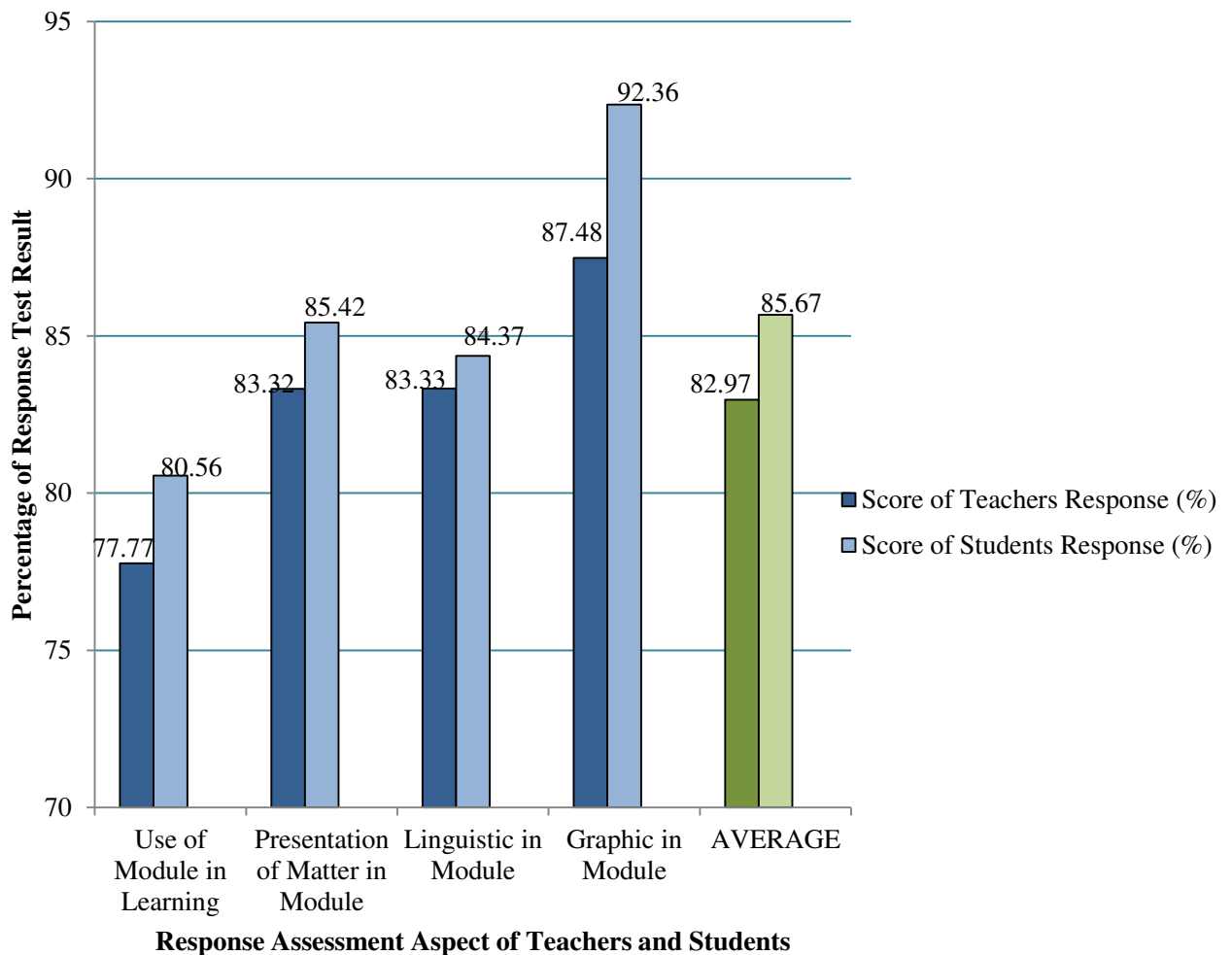


Diagram 3 Summary of Results of Teachers and Students Response to Problem Based Learning Module on Main Field Test

Based on data of teachers and students response, it can be concluded that the developed modules fit for use as learning material in the learning ability of students with diverse characteristics with the average percentage of teachers and students' responses, respectively is 82.97% (very high) and 85.67 (very high). Results of response assessment of teachers and students to problem based learning modules in main field test to obtain a very good assessment. It shows teachers and students agreed that the problems based learning module on buffer solution at eleven grade that developed, feasible to use for teaching and learning based on the instructional criteria and presentation criteria in terms of uses modules in learning, presentation of teaching materials, the use of language and graphic of problem based learning module.

CONCLUSION AND RECOMMENDATION

Conclusion

Based on the research that has been done, it can be concluded that (1) the problem based learning module on buffer solution at eleven grade high school very decent used as teaching materials with an average of feasibility is 88.90% in terms of feasibility of contents, presentation, linguistic, and graphic are respectively 89.74% (very high), 89.27% (very high), 92.5% (very high), and 85.23% (very high), and (2) the problem based learning module on buffer solution at eleven grade high school received a high response of teachers and students with an average response of teachers and students at the initial field test is 68.75% (high) and 78.43% (high). The average response of teachers and students at the main field test is 82.49% (very high) and 85.14% (very high).

Recommendation

Based on the research and development that has been done, it is necessary to further research on the effectiveness of use of problem based learning module on buffer solution that has been developed, as well as the need to research the development of problems based learning module on the other materials.

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