

Development of Electrolyte and Nonelectrolyte solution Module Based on Science Approach to Science Prompting Probing Technology Class X SMA / MA

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Abstract - This study aims to produce electrolyte and nonelectrolyte solution modules based on a scientific approach with probing prompting techniques and determine the level of validity, practicality and effectiveness of the module. This research includes development research using the Plomp development model which has three stages, namely the initial investigation phase (preliminary research phase), the prototype phase (prototyping phase) and the assessment phase. At the prototyping stage, self-evaluation is carried out, expert review, one-to-one evaluation, small group evaluation, while the assessment phase is carried out through field tests. in 2 schools namely SMAN 1 Shadow and SMAN 1 Koto XI Tarusan. The research instrument used was a questionnaire in the form of validity and practicality sheets and a matter of objective forms. The results of practicality by students in small groups and in the field test are very high and the level of practicality by the teacher is also very high. Hypothesis test results showed a significant difference between the learning outcomes of the experimental and control classes in schools with high student ability, while there were no significant differences in schools with low student ability.

Keywords - Modules, Electrolyte and No-Electrolyte Solutions, Probing Prompting, Scientific Approach.

I. INTRODUCTION

The scientific approach is known as the scientific approach (scientific approach). The scientific approach uses five learning experiences for students to observe, ask questions, gather information, reason, and communicate. The application of a scientific approach to the learning process in class can be supported by the use of a learning model and technique. One learning technique that is suitable with the application of a scientific approach is probing prompting. According to Julius (2012) in learning there are two questioning techniques that can improve student activity so that it helps students understand concepts, namely probing techniques and prompting questions.

Probing prompting is learning by means of the teacher presenting a series of questions that are probing and guiding so that a thought process occurs that links each student's knowledge and experience with new knowledge that is being

studied. Probing prompting learning techniques as well as learning that refers to students' thinking power, encourage to think more actively, develop student skills in expressing opinions and provide extensive knowledge to students (Shoimin, 2014). One of the chemicals studied in class X is electrolyte and non-electrolyte solutions. Based on the material characteristics of electrolyte and non-electrolyte solutions containing factual, conceptual and procedural knowledge, probing prompting techniques can be applied in the development of modules for electrolyte and non-electrolyte solution materials because they are in accordance with the contents of Permendikbud No. 59 of 2014 which states that probing prompting techniques can be selected for material that has dimensions of factual, conceptual and procedural knowledge.

Based on observations and interviews with chemistry teachers and students of SMA Negeri 1 Bayang, SMA Negeri 2 Bayang and SMA Negeri 2 Painan, information is obtained

that some students still have difficulty understanding electrolyte and non-electrolyte solution materials, especially in grouping solutions into strong electrolytes, electrolytes weak or non-electrolyte as well as in writing the ionization reaction equation. Generally, electrolyte and non-electrolyte solution materials are taught by experimental methods and group discussions using teaching materials in the form of textbooks provided by schools and practical worksheets made by teachers. The textbook used has not been revised edition 2016, where in the book the material electrolyte and non-electrolyte solution is still combined with the material concept of reduction and oxidation.

In the learning process of course teaching materials are needed. The selection of teaching materials with appropriate learning models or methods can support the success of the learning process (Isworini, 2015). Appropriate teaching materials can support the achievement of learning objectives or certain competencies by attracting students' interests, stimulating students and motivating students to be more active and active in learning through the material provided. One example of teaching material is a module. The module is a complete unit that consists of a series of learning activities arranged to help students achieve a number of goals that have been formulated. The purpose of using modules is that learning objectives are achieved effectively and efficiently, students can learn in their own way. (Nasution, 2008).

One of the modules that can be developed is a scientific-based module with probing prompting technique on electrolyte and non-electrolyte solution material. Teaching materials in the form of scientific-based modules with probing prompting techniques on electrolyte and non-electrolyte solution materials are not yet available in schools. The scientific-based module with probing prompting technique is expected that students will be able to learn independently and discover their own concepts from the subject matter of electrolyte and non-electrolyte solutions through problem analysis provided at the beginning of learning so that students' critical thinking skills can be trained and improved.

Based on the description above, the authors consider the need for research development of teaching materials to improve the competence of students in learning chemistry in the form of learning modules in accordance with 2013 curriculum requirements under the heading "Development of Electrolyte and Non-Electrolyte Solutions Module Based on Scientific Approaches with Class X Probing Prompting Techniques SMA / MA".

II. RESEARCH METHODS

This type of research is research and development. The development model used in this study uses the Plomp design model which consists of 3 stages, namely preliminary research, preliminary development or prototyping (development or prototyping phase) and assessment phase (Plomp, 2013). The study was conducted to test the validity and practicality of the modules developed. The research subjects were chemistry lecturers, chemistry teachers and students of class X SMAN 1 Shadow and SMAN 1 Koto IX Tarusan.

The preliminary research stage is carried out by analyzing the needs, curriculum, students and concepts to design the Electrolyte and Non-Electrolyte Solution Module Based on the Scientific Approach with Class X SMA / MA Probing Prompting Techniques.

Prototyping stage consists of prototype I, prototype II, prototype III, and prototype IV. Based on the initial research stage (Preliminary research) prototype I was produced. Then a self-evaluation of prototype I was carried out using a checklist of the components contained in the module. If there are still deficiencies in the components of the module, a revision is carried out to produce prototype II. Furthermore, an expert review was carried out on 5 experts. After an expert assessment, a one to one evaluation is conducted by interviewing 3 students about prototype II so that prototype III is produced. Then a small group trial was conducted by giving a practicality questionnaire to 6 students to produce prototype IV.

The assessment phase is carried out in a field test to get the practicality level of prototype IV. At this stage a practicality test is carried out on teachers and students by giving a practicality questionnaire. The instrument used was a questionnaire of validity and practicality. Data obtained from the validity and practicality questionnaire were then analyzed using the Cohen kappa formula below.

$$\text{momen kappa } (\kappa) = \frac{\rho_o - \rho_e}{1 - \rho_e}$$

Information:

K = kappa moment which shows the product validity

Po = proportion realized

Pe = unrealized proportion

Assessments that have been analyzed using the Cohen kappa formula can be decided based on the kappa moment as shown in Table 1.

Table 1. Assessments that have been analyzed using the Cohen Kappa formula can be decided based on the kappa moment

Interval	Category
0.81 - 1.00	Very high
0.61 - 0.80	Height
0.41 - 0.60	Medium
0.21 - 0.40	Low
0.01 - 0.20	Very low
≤ 0.00	Invalid

III. RESULTS AND DISCUSSION

A. Results

The study was conducted through 3 stages, namely the initial investigation stage (preliminary research), the prototype phase (prototyping phase) and the assessment phase (assessment phase).

1. Preliminary Research Phase

a. Requirements Analysis

Based on interviews with chemistry teachers, it is known that the application of techniques in the learning process is still not commonly done in schools, especially using the probing prompting technique. In general, the content or material of teaching materials in schools is complete, but 5M activities have not been described in accordance with curriculum requirements and there are no activities that guide students to think critically in solving problems related to learning materials.

b. Curriculum Analysis

This analysis aims to formulate indicators and learning objectives on the material electrolyte and non-electrolyte solutions. Based on the 2013 revised 2017. Syllabus chemistry syllabus, Basic Competencies, Competency Achievement Indicators (GPA) in electrolyte and non-electrolyte solution materials are as follows; 3.8 Analyzing the nature of electrolyte solutions and non-electrolyte solutions based on their electrical conductivity (C4) 4.8 Designing (C5), conducting (C3), and concluding (C4) and presenting the results of experiments to determine the nature of electrolyte solutions and non-electrolyte solutions. Indicators of Competency Achievement (GPA): 1. Detailing the properties of electrolyte and non-electrolyte solutions, 2. Inferring the degree of ionisation / dissociation of electrolyte and non-electrolyte solutions, 3. Testing the solution based on its electrical conductivity, 4. Finding the relationship

between the type of bond with the electrolyte properties of the solution.

c. Concept Analysis

The main concepts in electrolyte and non-electrolyte solution materials are the concepts of solution and ionization, electrical conductivity experiments, the properties of electrolyte solutions and the degree of ionization.

d. Student Analysis

The questionnaire given to 60 students in the form of an open questionnaire consisting of nine questions resulted in 95% of the difficulties faced by students in the material electrolyte and non-electrolyte solution was the solution of questions that required a lot of understanding of concepts and reaction equations, 88% of students were interested in approach-based learning Scientists use probing prompting techniques and students like teaching materials that are illustrated and colored and students like the color blue. These results serve as guidelines for designing and making electrolyte and nonelectrolyte solution modules based on a scientific approach using probing prompting techniques that suit students' needs.

2. Prototyping Phase

a. Prototype I

Prototype I is a prototype resulting from the design and realization of the initial investigation phase. The components of the module that are designed are cover, preface, table of contents, list of drawings, module usage instructions, competencies, indicators and learning objectives, concept maps, activity sheets, worksheets, evaluation questions, answer keys and references.

b. Prototype II

Prototype II results from self-evaluation of prototype I. This self-evaluation focuses on apparent errors or obvious errors such as mistakes in using images, typing errors in letters and module completeness.

c. Prototype III

Prototype III results from expert reviews and one-to-one evaluations of prototype II. The module design was validated by five validators, consisting of three chemistry lecturers from FMIPA UNP, two chemistry teachers from SMAN 1 Shadow and SMAN I Koto IX Tarusan. There are four components that are assessed by the validator, namely the content component, the construct component, the linguistic component and the graphic component. Each component has

a statement item that is filled in by the validator. Based on the analysis of the four components, it was obtained 0.84 with a very high category.

Table 2. Results of validity analysis by the validator

Component And Result	
1.	Ease of Use 0.73 High
2.	Efficiency of Usage Time 0.50 Moderate
3	Benefits of 0.79 High
4	Average 0.67 Very High

One-to-one evaluation is done through interviews with three students of class X MIPA SMAN 1 Shadow with low, medium and high ability. There are three aspects evaluated at this stage, namely clarity, appeal and obvious errors.

Based on the results of the interviews it was found that the module's instructions for use can be well understood by students, the presentation of the material in clear, the language used in the module is easy to understand and students can understand the steps of learning to use the module and still find typing errors in the number of pages written as many twice.

d. Prototype IV

Prototype IV was obtained from the results of small group evaluations of prototype III. This small group evaluation was carried out by teaching electrolyte and non-electrolyte solution material to 9 students of SMAN 1 Shadow Class X Mathematics and Natural Sciences, where each student got 1 module design (prototype III). The results of student practicality at the small group evaluation stage can be seen in Table 3.

Table 3. Small group evaluation results

No	Component	Result K	Category
1	Ease of use	0,73	High
2	Efficiency of Usage Time	0,50	Medium
3	Benefits	0,79	High
Rata-rata		0,67	Very High

Overall, the results of the student practicality questionnaire obtained a kappa moment of 0.67 with a high level of module practicality. Next, a small group evaluation is carried out and a prototype IV is obtained which is tested on a large group (field test).

Table 5. Results of Teacher Practices

Component And Result
1 Ease of Use 0.93 Very High
2 Use Time Efficiency 0.67 High
3 Benefits of 0.88 Very High
Average 0.83 Very High

3. The Assessment Phase

This assessment phase aims to see the practicality and effectiveness of the modules that are tested on large groups (field tests). Practicality data obtained from giving questionnaires to students (student questionnaire responses) and chemistry teachers (teacher questionnaire responses) can be seen in the table

Table 4. Student Practicality Results (Field Test)

Component And Result
1 Ease of Use 0.89 Very High
2 High Efficiency of Usage Time 0.83
3 Benefits 0.83 Very High
Average 0.85 Very High

Very high practicality. That is, the probing prompting module for electrolyte solutions is easy for students to use. Time efficiency is 0.83 very high and benefits are 0.83 with high criteria too. This shows that the electrolyte and non-electrolyte modules with probing prompting techniques are effectively used in learning and the benefits are felt by students. The average acquisition of kappa moments for practicality from the teacher's questionnaire responses was 0.83 with a very high level of practicality, meaning that the Electrolyte and Non-Electrolyte Solution modules with scientific approaches developed were practically used in the learning process by teachers.

The effectiveness of the module can be seen from the learning outcomes (cognitive aspects), the tests were

conducted at two schools with high and low student abilities. The acquisition of sample class learning outcomes test can be seen in Table 6.

Table 6. Sample Class Learning Outcomes

School	K	N	$\bar{X}$	S
SMAN 1 Bayang	Eksperimen 1	33	88,24	9,80
	Kontrol 1	34	82,53	10,44
SMA 1 XI Koto Tarusan	Eksperimen 2	30	78,20	14,83
	Kontrol 2	31	73,29	15,41

From table 6 above, the learning outcomes of SMAN 1 Shadow are higher than the learning outcomes of SMAN 1 XI Koto Tarusan for electrolyte and nonelectrolyte material with the help of the probing prompting module. The results of the experimental class are higher than the control class.

B. Discussion

Product quality resulting from development research is assessed based on three aspects, namely validity, practicality and effectiveness (Nieveen, 1999). The validity, practicality and effectiveness of electrolyte and non-electrolyte solution modules based on a scientific approach with probing prompting techniques are explained as follows.

1. Module Validity

Module validity data was obtained at the expert review stage (expert review) using validated instruments. The validation sheet contains 25 aspects of assessment consisting of the content component, the construct component (the presentation component), the linguistic and graphic components (MONE, 2008). The contents of the module module with very high validity. The category of very high kappa moments indicates that the electrolyte and non-electrolyte solution modules with probing prompting techniques with the scientific approach developed are in accordance with the demands of core competencies, basic competencies, indicators, and learning objectives to be achieved.

The validity of the content indicates the product developed in accordance with the curriculum (Rochmad, 2012). The problems given in the module are in accordance with the material being taught. In addition, the questions created can lead students to find concepts. The contents of the module in the form of facts, concepts, principles and procedures in the category are sufficient because it is still lacking and has been fixed at the beginning of each activity. Macroscopic, submicroscopic and symbolic level images are

scientifically correct. This shows that the module was developed based on a strong theoretical rational (Rochmad, 2012).

The construct component of modules with very high validity categories is related to the scientific approach steps (observing, asking questions, gathering information, associating and communicating). The construct validity of a product shows that various components in a product are related to one another and are consistently connected (Plomp, 2013).

Very high module validity. The linguistic component regarding the shape and size of letters can be read by students so that students find it easier to learn the modules, instructions and information conveyed in clear modules. The language used in the module is in accordance with the correct Indonesian rules, easy to understand and clear so it does not cause confusion, according to Hamdani's opinion: 2011 that the sentence used in the module must be simple and easy to understand.

Graphic components with high validity category. Kappa moment categories are sufficient for varying font sizes, because some pages are typed in small sizes and have been fixed. Layout, illustrations, drawings, attractive graphics and overall attractive module design. Good layout can lay out its own attraction to students' learning interests (Hamdani, 2011).

2. Practicality of Modules

Practices assessed consisted of three aspects namely ease of use, efficiency of learning time and module benefits (Sukardi, 2011). The practicality of the electrolyte and non-electrolyte solution modules with a scientific approach was assessed by chemistry teachers and high school students of grade X MIPA. Modules are said to be practical if the teacher and the target user (students) assess that the module can and is easy to use (Plomp, 2013). The instrument used was a

practicality questionnaire given to nine students at the small group evaluation stage, 63 students in the experimental class and two chemistry teachers who accompanied the research at the field test stage.

The ease of use of students in small groups and in field trials obtained a very high level of practicality of the module. This is because in small group learning students still need guidance and direction from the teacher, whereas in large groups students are required to be independent and cooperate with peers. The size of the module is practical so it is easy to carry. Practicality considerations can be seen from the aspect of ease of use (Sukardi, 2011).

The efficiency aspect of learning time obtained by the level of practicality is very high in small group evaluations and in field trials. In its implementation, large group students can work together with peers and the module is able to facilitate interaction between students. Then, students are able to act as a tutorial for their friends with the help of the probing prompting technique module. As a result, learning time becomes more efficient. Students who more quickly complete an activity sheet, can continue to complete another activity sheet. Learning by using modules can make learning time more efficient and students can learn at their own pace (Daryanto, 2014).

For the aspect of module benefits the high level of practicality is obtained in small group evaluations and very high in field trials. Learning with modules can motivate students to find themselves and understand the concepts taught, help students to learn independently, measure understanding with the questions contained in the module. The benefits of modules greatly help students in learning especially in large groups. Students can measure their own level of mastery of the material discussed in the module (Prastowo, 2014). Besides learning with modules can increase interest in learning and cause a sense of pleasure in learning. Colored charts and pictures make the brain more active and increase students' pleasure (Ellizar et al, 2013).

The results of assessing the practicality of teachers at the field trial stage (Table 24) for the aspect of ease of use are very high, for the aspect of high learning time efficiency, for the aspect of module benefits with a very high level of practicality. Learning that has been done in class shows that the material presented in the module is clear, easy to understand, and has practical measurements. Learning with modules can support the teacher's role as a facilitator, reduce the teacher's burden because there is no need to explain the

material over and over again and can measure student understanding and achievement of learning objectives.

The practicality of electrolyte solution modules and non-electrolyte probing prompting techniques with a scientific approach that was developed very high students (field tests) and teachers with a high level of practicality. The module practicality results show that the modules that are designed are practical and can be used by students and teachers in learning. This is in accordance with the opinion of Nieveen (1999), the practical aspect in terms of its use is that it can be used in normal conditions and the product developed can be applied by teachers and students

3. Module Effectiveness

Effectiveness is assessed based on the results of using the product as desired (Plomp, 2013). If the module operationally provides results as expected, the module is said to be effective (Nieveen, 1999). In this study, the effectiveness of the electrolyte solution module and the non-electrolyte probing prompting technique with a scientific approach is seen from student learning outcomes (cognitive aspects), student activities in working on the modules and students' critical thinking skills.

Student learning outcomes are seen after the module has been tested in two schools, namely schools with high and low student abilities. Each school has two sample classes, namely the experimental class and the control class. The final test results of the experimental class are higher than the control class. The difference in value is tested with the hypothesis test to find out whether differences in learning outcomes are influenced by the use of modules or not.

The results of hypothesis testing in schools with high student ability show that the learning outcomes of students who use the electrolyte solution module and the nonelectrolyte probing prompting technique are significantly higher than the learning outcomes of students who do not use modules. The application of probing prompting techniques in learning can improve learning outcomes (Megariati, 2010), because what is given by the teacher can improve the way of learning and improve students' critical thinking skills and can attract students' attention. The probing prompting technique presents a series of questions that are both guiding and probing so that a thought process occurs that links each student's knowledge and experience with new knowledge being learned (Widyastuti, 2014).

IV. CONCLUSION

Based on research that has been done, it can be concluded that the module electrolyte solution and non-electrolyte probing prompting technique with a scientific approach has been produced which has a very high validity and practicality category and the effectiveness of learning outcomes is increased. The Plomp type research and development model produced a final prototype in the form of electrolyte solution and non-electrolyte probing prompting technique with a valid, practical and effective class X SMA / MA scientific approach.

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