Development of teaching material in the chemical solution based on inquiry learning in chemistry education of Faculty of Teacher Trainer and Education of Universitas Sriwijaya

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Abstract. This research aims to develop teaching material in the chemical solution in inquiry learning. This research was conducted by ADDIE design and formative evaluation by the Tessmer method. The validity of teaching material was assessed by three experts; material expert, pedagogic expert, and design expert. The validity of the material is 3.81 which is categorized as very valid, the validity of pedagogical value is 3,30 which is categorized as very valid, and the validity of design is 3.20 which is categorized as valid. The Practicality of teaching material seen from the average score questionnaire in the one-to-one or small group phase. In the one-to-one phase, the practicality score is 3.53 which is categorized as practical and in a small group, the practicality score is 3.85 which is categorized as very practical. The effectiveness of this teaching material could evident from the test study which is implemented at the field test phase. Based on the field test phase, the score gained 0.68 which is moderately categorized. It indicates that the teaching material in the chemical solution based on inquiry is effective to be used.

1. Introduction

Higher Education Curriculum 2017 focuses on improving the relationship between the subject learning outcomes, sub-subject learning, and the learning process. The curriculum contains: (1) Reinforced by integrated character education which is mainly in five characters, namely: religious, nationalist, independent, cooperation, and integrity; (2) Integrating literacy for 21st-century skills which are Creative, Critical thinking, Communicative, and Collaborative which is used to abbreviation by 4C; (3) Integrated Higher Order Thinking Skill (HOTS). For this reason, the learning process which is developed by teachers not only oriented to the student learning activity and a scientific approach but also requires learning materials to be meta-cognitive. Furthermore, HOTS is an analysis needed which means needs ability for think in specifying aspects/elements of a particular context, evaluation ability or making decisions based on facts/information, and creative ability or building idea [1].

Based on the interview with the second-year students of chemical solution class in the chemistry education department of Sriwijaya University, students not only using textbooks and but also worksheet from the lecturer as teaching materials in chemical solution class. However, the worksheet used is not by the higher education curriculum in 2017 and the teaching material that provided is not interesting so that it makes student discourage to learn [2]. In addition, based on the result of

questionnaires that distributed to 49 students (chemical solution class in Studi Program of FKIP Universitas Sriwijaya), it is found that 68.7% of the students feel that teaching materials that they used do not make them understand the concept of problems such as exercises in material subject and 79,1% of the students stated that teaching materials that they used are not related to daily life yet. Based on the interview with the second-year chemistry students in Chemistry Education of FKIP Universitas Sriwijaya, it is obtained that the most difficult material in chemistry in second-year chemistry is the chemical solution because there is a calculation that it makes student hard to understand the material.

Based on the result of the lecturer interview and student questionnaires found that the school needs the development of teaching material. Teaching materials which can be developed are printed teaching materials such as films, audiotapes, videotapes, maps, globes, and charts [3]. Development of teaching materials should be done by strategy learning or model learning [4]. Based on the result of questionnaires that distributed to 49 students (second-year class), it is obtained that 88.1% of students are interested in the chemical solution is given based on the problems that associated with daily life. The learning model which can encourage students to relate the concept of material with phenomena in daily life is Learning Cycle Approach [5].

Also the inquiry learning is a model of student-centered learning. It is called as "The four Cs of 21st Century Skill, that are Critical Thinker (Solving Problem), Communicator (Understanding and Communication Ideas), Collaborator (Working with Other), and Creator (Producing High-Quality Work). The Problem Based Learning a series of activities, there are five steps in inquiry learning model, Orienting students to problems, Organizing students to learn, Help independent inquiry, Develop and present the work, Analyze and evaluate the problem-solving process [6].

The research about inquiry learning has been done by Prasetio & Wijanarko. Based on the result of research [7], there is an increase in the process skill and mastery of students concepts and students were more delighted with laboratory management if it is using problem-based learning model. Also, the result of research [8] showed that by applying the inquiry learning model, it can improve the mastery of the concept student on cognitive aspects of higher level thinking and increase the student's critical thinking skill for each indicator. The result of research in inqui learning model which is done by [9] showed that the application of the inquiry learning model can improve learning outcomes in chemistry subject. The research about teaching material based on inquiry learning model have been done by [10]. Also, research [11] which the comparison studi of chemical learning using Inquiry Based Learning and Problem Based Learning Models, it can increase student motivation in second year class of chemical solution class.

Based on the background, the development of teaching material based on inquiry learning model in a chemical solution in the second-year class of Studi Program of Chemistry Education in FKIP Universitas Sriwijaya is needed. The research question: how to develop teaching materials that are valid, practical, and effective. The purpose of this research is to develop and produce teaching material based on inquiry learning in chemical solution material for the student in the second-year class of Studi Program of Chemistry Education in FKIP Universitas Sriwijaya has valid, practical, and effective criteria.

2. Research Method

This study uses the ADDIE model to develop teaching material chemical solution based on the inquiry learning model. In Addie, there are five steps which are analysis, design, development, implementation, and evaluation [12]. Evaluation is done by using Tessmer formative evaluation. The validator for this development research is design expert, material expert, and pedagogic expert.

In purpose to getting the practicality of teaching material, the teaching material that has been developing will testing to second-year students in the chemistry education department of Sriwijaya University. One to one evaluation phase involved three students of chemical solution class. In the small group evaluation phase, involved nine students of the chemical solution class. For testing the effectiveness of teaching material, involved forty-nine students at the chemistry education department

of Sriwijaya University. The data collection was done by an expert validation test (walk-through) consist of a questionnaire and an achievement test.

3. Results and Discussion

The analysis in this research is the analysis of need and characteristic of students. Based on the interview with the second year chemistry class in Chemistry Education of FKIP Universitas Sriwijaya, it is obtained information that some students have textbooks and lecturer also use the worksheet as teaching material in the classroom. However, the worksheet is used not following curriculum 2017 and teaching material that provided is not interesting so it makes students discourage to learn. Also, students hard to understand chemistry concept such as counting material especially calculation in the chemical solution. Based on the questionnaire of 49 students of the second-year class in Chemistry Education of FKIP Universitas Sriwijaya, it is obtained information that 55.2% of the students like chemical solution, 88.1% of students interested in chemical solution related to daily life, 88.2% of students prefer to work together a group rather than alone, 68.7% of the students feel that teaching materials that they used do not make them understand the concept of problems such as exercises in material subject and 79,1% of the students stated that teaching materials that they used are not related to daily life yet

In the design step, teaching material that arranged was adapted to the learning outcome, namely learning the outcome of courses. Analyzing the characteristic of a chemical solution on the concept of electrical conductivity of solution or pKa of the solution, and learning outcome asking idea about using right indicators to determine the base titration on the conductivity of acid/base. The arrangement of teaching material follow the eligibility standards of content on KKNI is teaching materials described in the chapters that contain study material, student activities, and exercises that are suited to indicators. Teaching material is presented by the inquiry learning model. There are six steps in the inquiry learning model. They are orientation, formulate a problem, formulate of hypothesis, data collection, the test of hypothesis, and draw of conclusion.

In the development step, teaching material is developed with formative evaluation there are four steps of evaluation. They are self-evaluation, the expert review, One to One and small group. In the self-evaluation, we evaluate the products that we have been made. The results of the self-evaluation phase include improving the text, images, sentence structure and punctuation, and overall look of teaching material. Expert review step is to test the validity of the prototype which has been through a phase of self-evaluation. Validators who validate the design of these materials consist of validator design, material and pedagogic.

Table 1. Validation result of pedagogic, material, desain

No	Validation	Score	Category
1.	Pedagogic	3,30	Very valid
2.	Material	3,81	Very valid
3.	Desain	3,20	Valid
	Average	3,45	Very valid

Assessing the feasibility of teaching material based on the inquiry learning model from design aspects include a cover page design, color, writing, images, and view of teaching material. The design expert will give comments and suggestions about the design of the teaching material. First, the cover page of teaching material design, it is obtained average score is 3.25 with a valid category. Second, the color of teaching material, it is obtained average score is 3 with a valid category. Third, the writing of teaching material, it is obtained average score is 3.5 with the very valid category. Fourth, in the image of teaching material, it is obtained the average score is 3.25 with a valid category. Fifth, the views of teaching material, it is obtained an average score is 3 with a valid category. The highest score of design criteria of teaching material is in the writing aspect. The score is 3.5. It can be seen from the accuracy of writing selection, suitability selection of font size, the accuracy of text color selection and

suitability of the design which shown in the writing of teaching material based on the inquiry learning model. Based on the assessment of design expert, it is obtained an overall average score is 3.20 with the valid category.

Assessing the feasibility of teaching material based on the inquiry learning model viewed from the aspects of pedagogic learning competencies. They are components, compliance with the rules writing of Bahasa Indonesia correctly, the use of communicative language, the ability to motivate students, foster curiosity. First, the components of competence, it is obtained average score is 3.5 with the very valid category. Second, in conformity with the rules writing of Bahasa Indonesia, it is obtained the average score is 3 with a valid category. Third, the use of communicative language, it is obtained average score is 3.25 with a valid category. Fourth, the ability to motivate students, it is obtained average score is 3.5 with the very valid category. Fifth, the foster curiosity, it is obtained average score is 3.25 with a valid category. The highest score of pedagogic is components of competence aspect. The score is 3.5. It can be seen from the suitability of the material solution with core competencies, basic competencies, indicators of learning, and the learning objectives in teaching material based on the inquiry learning model. Also, The highest score also of pedagogic criteria of teaching material is the ability to motivate students aspect. The score is 3.5.

From the language aspect, teaching material based on the inquiry learning model use communicative language so it makes students easy to understand the material. The accuracy of using language can help students in understanding the questions in teaching-learning based on the inquiry learning model. Besides that, teaching material based on the inquiry learning model following the Ministry of Education (2004) which explains that the words which are used should use simple language so it makes the reader easy to read. One thing which is needed to improve is in the arrangement of teaching material based on the inquiry learning model. It replaces the right word so it makes the reader can capture thoughts and ideas from the author. The accuracy of the word is a word to evoke the same idea in the reader's imagination, such as something which is thought and felt by the author [13].

The feasibility assessment of teaching material based on the inquiry learning model from the material aspects includes the suitability of curriculum, the truth of material, the accuracy of the material, the recency of material, and suitability with the inquiry learning model. First, on the suitability of the curriculum, it is obtained the average score is 4 with the very valid category. Second, the truth of the material, it is obtained average score is 3.75 with the very valid category. Third, the accuracy of the material, it is obtained average score is 3.75 with the very valid category. Fourth, the recency of material, it is obtained average score is 3.5 with the very valid category. Fifth, suitability with the inquiry learning model, it is obtained average score is 4 with a very valid category.

The highest score of material criteria of teaching material is in the suitability of the curriculum and the inquiry learning model and the recency of material. The score of them is 4. It can be seen from the suitability of the view of the material with the basic competencies, indicators, objectives, and presentation of the material has correct steps in the inquiry learning model. They are orientation, formulate a problem, formulate of hypothesis, data collection, the test of hypothesis, and draw of conclusion. The highest score shows that the material in the chemical solution of teaching material based on the inquiry learning model following the curriculum and the inquiry learning model. Based on the material expert, it is obtained the average score is 3.8 with a very valid category.

Therefore, teaching material based on the inquiry learning model has valid criteria and worthy tested. Furthermore, the one-to-one evaluation. The trial was conducted at three students of the chemical solution class in Study Program of Chemistry Education of FKIP Universitas Sriwijaya. The score of practicality in this step can be seen in Table 2 below.

Table 2. The Practicality score of teaching material in one to one

No.	Aspect	Score
1.	The Cover of teaching material	3,67
2.	Display the contents of teaching material	3,67

3.	The language used	3,16
4.	Can motivate students	3,56
	Final score	3,53 (Very practical)

From the results of the questionnaire practicality, students stated that the teaching material is interesting so it makes students add their interest to read it. Suggestions received are necessary to add the column "do you know" and inventor information and consider neatness of writing and conformance with the rules writing of Bahasa Indonesia correctly. The practicality score of teaching material is 3.53. It shows that the teaching material based on the inquiry learning model is very practical.

The next is a small group evaluation. At this step, the evaluation was done by nine students of the chemical solution class in Study Program of Chemistry Education of FKIP Universitas Sriwijaya. The practicality score can be seen in Table 3.

Table 3. The Practicality score of teaching material in Small Group

No.	Aspect	Score
1.	The Cover of teaching material	3,78
2.	Display the contents of teaching material	3,83
3.	The language used	3,94
4.	Can motivate students	3,85
	Final score	3,85 (Very practical)

From the results of the practicality questionnaire, students stated that the teaching material is interesting and complete. However, there is a student who stated that there is some writing in teaching material is not clear. It also needs to be added to the sample exercises and their answers. This has been corrected to facilitate the students to understand the material in teaching materials. The results of student assessment to the practicality of teaching materials in the amount of 3.85 stated very practically.

Field test step was conducted in chemical solution class in The Study Program of FKIP Universitas Sriwijaya has 49 students and it has done with two meetings. Learning outcomes were measured using a pre-test and post-test. The score of the pre-test is 38.85% and post-test is 81.17%. The value of learning outcomes can be seen in Graph 1 below.

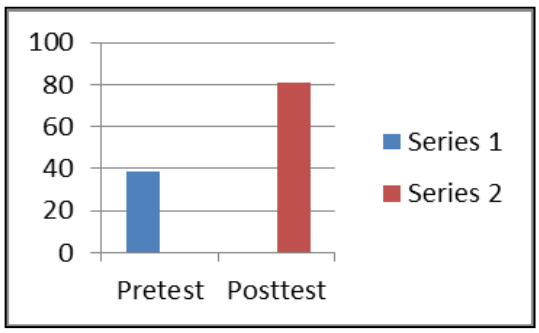

Figure 1. Result of Field Test

The Improvement learning outcomes supported by the teaching material in a chemical solution which can increase student's interest in the materials which they studied, which in turn will help students understand the material. It is related to the statement from Sudjana and Rival [14] which states that teaching material has good quality and worthy life will be able to support the achievement of learning goals.

The n-gain value which is obtained is 0.68 with the medium category. Based on the value of N-Gain known that teaching material based on the inquiry learning model is effective for learning. Therefore, this research shows that by using teaching material based on the inquiry learning model take a good place in chemistry learning. Based on the results of the validation and testing of product, teaching material based on the inquiry learning model has valid, practical, and effective criteria.

Based on the results of research, teaching material which is developed has advantages: (1) the teaching material make student easy to learn and it gives a lot of information related to the concept of material and discuss about the phenomenon in daily life, (2) images in teaching material can attract students to learn it, (3) there are any additional information such as the recent discovery about chemistry, character information which add student knowledge and information about the concept.

After the learning process by using teaching material which is developed in chemical solution material, students give a positive response. They stated that learning by using teaching material is more interesting because it is presented with the view and interesting pictures so it can increase student's comprehension. The use of images can give a visual representation of the material described. The statement is following who wrote that in the arrangement of teaching material and teaching aids can make students easy to understand and with illustrations or pictures that visually can give a real description of the substance which is studied[15].

In addition to the use of teaching material, students are also interested to participate in the inquiry learning model. At the time of experiment activities, students more active than only listen to the teacher's explanation. The application of inquiry learning can increase the activity of students in both the experiment activity and class discussion[16]. The researcher concluded that the application of the inquiry learning approach in the learning Analysis Instrumentation experiment can improve the quality of the learning process, both in terms of qualitative and quantitative aspects[17]. At the time of discussion, student activity can be improved because students can be creative to convey their idea freely with a group and not monotonous than they were just listening to the lecturer's explanation [18].

Students gave a positive response to the chemistry learning that using teaching material in a chemical solution. Students also stated that they liked the teaching material in the chemical solution. Students feel motivated by this teaching material because it makes it easy to understand the material of the chemical solution.

4. Conclusion

Based on the results of this research, it concluded that:

1. Teaching material based on the inquiry learning model in a chemical solution for the second year in Study Program of Chemistry Education of FKIP Universitas Sriwijaya has score pedagogic, material, and design. The score of pedagogic is 3.30 (valid), the score of material is 3.81 (very valid) and the score of design is 3.20 (valid). It states that teaching material in a chemical solution for the second year in Study Program of Chemistry Education of FKIP Universitas Sriwijaya is valid.
2. Teaching material based on the inquiry learning model in a chemical solution for the second year in Study Program of Chemistry Education of FKIP Universitas Sriwijaya has score practicality in a one-to-one and small group. The score in one-to-one is 3.53 (very practical) and the small group is 3.85 (very practical). It states that teaching material in a chemical solution for the second year in Study Program of Chemistry Education of FKIP Universitas Sriwijaya has a practical category.
3. Teaching material based on the inquiry learning model in a chemical solution for the second year in Study Program of Chemistry Education of FKIP Universitas Sriwijaya has an n-gain score. The score is 0.68 (moderate score). It states that the effectiveness of teaching material based on the inquiry learning model in a chemical solution for the second year in Study Program of Chemistry Education of FKIP Universitas Sriwijaya has a medium category.

Teachers are expected to use teaching material based on the inquiry learning model in the chemical solution. For other researchers expected that there is further research on teaching materials based on the inquiry learning models valid, practical, and effective with different materials.

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