Advances in Social Science, Education and Humanities Research, volume 200

3rd Annual International Seminar on Transformative Education and Educational Leadership (AISTEEL 2018)

Development Learning Material Integrated Guided Inquiry-Based Worksheets On Chemical Equilibrium Material

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***Abstract*— This study aims to produce integrated teaching materials for effective Student Worksheets based on guided inquiry on the material of Chemical Equilibrium and determine the feasibility level of teaching materials developed based on BNSP standards. This research is a development research (Research and Development) developed by Borg & Gall (1983). The population in the study were all students of Medan State University. The sample selection in the study used purposive sampling technique taken 40 students who were studying the Kinetics and Chemical Equilibrium courses at the State University of Medan consisting of two classes, namely the experimental class and the control class. The experimental class uses integrated Worksheets teaching materials while the control class uses the student handbook. Validation of integrated Worksheets teaching materials is three lecturers from Medan State University. The results of the study showed that: (1) The teaching materials analyzed provided good results and did not require revision, but there were still deficiencies in each teaching material so that development needed; (2) Components that are integrated into teaching materials that have been developed, namely Worksheets, and learning models; (3) The results of the lecturers' assessment of the instructional materials that have been developed at 3.40 are valid (feasible) and do not need to be revised based on BNSP standards; (4) There is an increase in learning outcomes by using integrated teaching materials guided inquiry-based Worksheets on chemical equilibrium material compared to using student handbooks; (5) Students provide positive perceptions of the integrated teaching materials of guided inquiry-based Worksheets on chemical equilibrium material with an average rating of 80%.**

Keywords*— *Student Worksheet, research and development, guided inquiry

I. INTRODUCTION

Learning materials is one source of learning that has an important role to support the learning process. A learning materials should be designed and written with instructional rules by a lecturer to assits and support the learning process. The quality learning materials can be seen from three criteria namely validity, practicality and effectiveness [1]. One of the important problems that often faced by educators in learning activities is difficult to choose or determine the right learning materials in order to help students achieve competence. Currently the learning materials used are still sourced from certain publishers so it has not been right target and has not been able to active students. Students are accustomed to accept the concept of lecturers directly so as to make the learning process passive. To other hand lecturers often give notes and explain in detail so that students are not trained to formulate problems and solve them. Pre–research results showed 83% of students said that learning materials used as a supporter of chemistry learning have not shown the real problem phenomenon or picture that can lead students to find ideas and solve problems in the thinking process to solve the concept of learning. So students are not required to think [2]. Learning materials that are integrated worksheet should provide assistance in the form of a series of learning arrangements that they will learn by emphasizing on certain aspects so as to enhance the activity which is a display in the learning process [3]. Integrated learning materials worksheets are able to make students higher learning skills as they able to imagine, analyzing, interpreting, reflecting, and making conclusions [4]. Learning with inquiry model can be implemented by observation stage of verification, generalization and application [5]. Based on pre-research results in SMA 12 Surabaya 56,67% students considered the material of chemical equilibrium is a difficult material and 86,67% of students stated that learning activities are only done in the classroom without experimental activity [6]. The purpose of this research is to develop instructional materials for the integration of guide inquiry based worksheets that can be used as learning media to improve student learning outcomes on chemical equilibrium materials.

II. METHOD

A. Population in this study are all students who are studying Kinetics and Chemical Equilibrium courses at the State University of Medan academic year 2017/2018. Sample selection in this study using purposing sample. Sample technique in this study were 40 students. Experiments on integrated learning materials based on inquiry led by students Medan State University who are divided into control and experiment class.

B. This research uses development research and experimental research. Design in development of integrated learning materials based on inquiry on chemitry equilibrium materials including the development, compilation, standardization, evaluation and experiment of learning materials.

C. Procedure research is the steps taken in research. Research procedure consisting of 5 stages outline the preliminary stage, planning and design stage of the product. The research procedure is presented in figure 1.

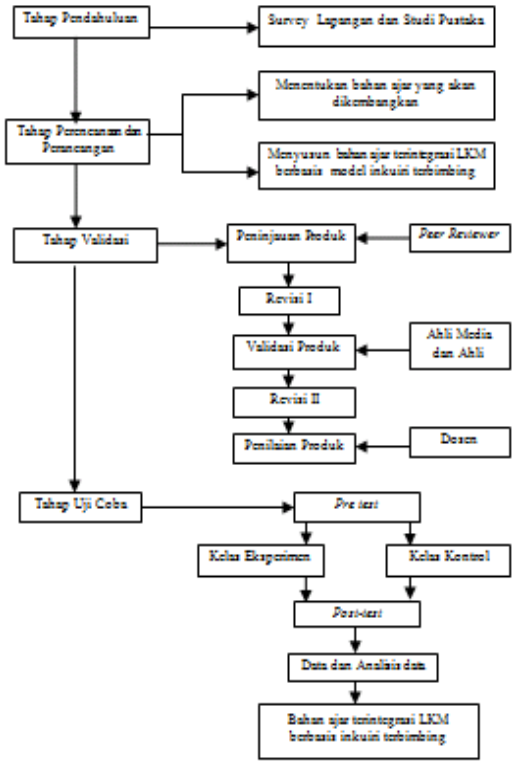

Fig 1. Stages of development of integrated learning materials based on guided inquiry worksheet

III. RESULT

A. Result of Development of Learning Materials.

Integrated chemistry materials based on guided inquiry worksheet have been developed for the teaching of chemical equilibrium consisting of several sub subjects. The development of learning materials is done by the addition of worksheets based on guided inquiry in accordance with the achievement on learning KKNI. The order of chemical resources for the subject of chemical equilibrium is arranged into several sub-topics. The sub-section of discussed development subjects are summarized in Table 1.

TABLE 1. Description of componens of learning materials for the integration of guided inquiry based worksheet on chemical equilibrium material

No	Sub - topics	Development	Worksheets Integrated	Guided Inquiry Model
1.	Equilibrium Approching	In the sub-subject of the Equilibrium Approching, a non-experimental activity with graphs of the relationship of reactants, products and the overall rate	Non-experimental worksheet on sub subjects with titles Achieving Equilibrium contains questions that guide students to understand the basic principles of equilibrium reactions	In this non-experimental worksheet there are 5 stages, ie 1) The formulation of the problem, containing the question "How is the forward reaction compared to the backlash? (at equilibrium) " 2) Establish the hypothesis, from the question of problem formulation set a hypothesis; 3) Data analysis, presented some laboratory data in the form of substance concentration, time and plot in the form of curve; 4) Formulate the explanation with the proof of hypothesis based on the data - the data being analyzed; 5) Make a conclusion.
2	The Law of Equilibrium and Equilibrium Constant	In the sub subject of Equilibrium law and Equilibrium Constant is made an experimental activity that is equilibrium reaction between yod with potassium iodide	The experimental worksheet aims to find out the concepts of chemical equilibrium and the factors that influence it and calculate the amount of the equilibrium constants based on the experiment	In this experimental worksheet there are 5 stages, ie 1) The problem formulation is to ask the question "How is the concept of chemical equilibrium and what are the factors that influence it and how to calculate the equilibrium constant price based on the experiment?" 2) Establishing the Hypothesis, ie the factors that influence it and the price of the reaction equilibrium constant. 3) Testing the hypothesis, which is choosing tools and materials, experimenting 4) Data analysis and discussion, students are guided through questions in the worksheet. 5) Making a Conclusion, in this section the students are asked to write their conclusions

				about the practicum that has been done.
3	Shifting Equilibrium	In the sub-subject of Shifting Equilibrium, a non-experimental activity is presented in the form of an observation table.	The non-experimental worksheet on sub subject of shifting Equilibrium with the title Le - Chatelier Principle contains the equilibrium reactions which are treated against each substance in table form.	In worksheet this non-experimental there are 5 stages: 1) Formulate the problem, that is by completing the table presented in the activity 3. 2) Establish a hypothesis, ie answer the question where the direction of each equilibrium system will shift to the application of equilibrium reactions given. 3) Collecting data, ie by answering the direction of equilibrium shift presented in each equilibrium reaction. 4) Data analysis, after the data - data is complete then analyzed anything that affects the equilibrium shift each equilibrium reaction. 5) make a conclusion
4	Equilibrium Constant	On this topic it is made a matter of calculation to better understand about Equilibrium Constant (Kc).	The worksheet presents pertinent questions about Equilibrium Constants, Reagents and product concentrations.	Students are only required to complete the calculation questions completely and correctly in accordance with the Equilibrium Constant formula that has been studied.
5	Free Energy Change In Equilibrium Reaction	On the sub subject of Free Energy Changes in Equilibrium Reactions, a non-experimental activity of enthalpy and entropy relating to endotherms and exotherms is made.	Non-experimental worksheet is on sub subject of Free Energy Change In Equilibrium Reaction contains questions that require a short answer the relationship between enthalpy / entropy with endotherm / exotherm	In this non-experimental worksheet there are 5 stages: 1) Formulate the problem, ie by determining whether the reactions shift toward the endotherm / exotherm if the entropy is raised or lowered. 2) Establishing the Hypothesis, after answering the questions of the given problem and then establishing the hypothesis by determining whether the reactions react perfectly or not react or reach equilibrium. 3) Data Analysis, after data obtained from each reaction then analyzed whether the reaction will occur if have small Kc, large Kc or Kc = 1. 4) Discussion, students discussed the results of the analysis. 5) Conclusion, draw conclusions from the results of the discussion.
6.	Review	All sub-subjects in the worksheet are repeated for the purpose of looking at the level of understanding of the students on each sub-topic.	The worksheet provides basic questions and students are expected to be able to explain all these questions well.	Students are expected to conclude conclusions from the results of the review.

B. Standardization of Chemistry Equilibrium Materials

Development learning materials are assessed based on four standars of feasibility according to the BSNP the feasibilityof content, feasibility of language, feasibility of presentation and feasibility of graphic. Learning materials are anaiyzed of checks with a rating of 1 = not worth, 2 = less worth, 3= reasonabbly worth and 4 = feasible. The feasibilitylevel of chemical equilibrium instructional materials developed based on modified BSNP includes feasibility of content, , feasibility of language, feasibility of presentation and feasibility of graphic shown in Figure 2.

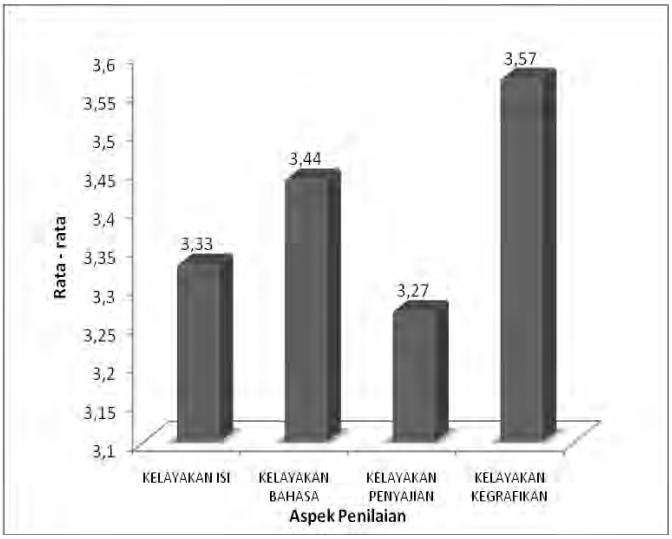

Fig 2. Graph of the result of feasibility analysis of integrated learning materials based on inquiry worksheets on chemical equilibrium materials.

Result of analysis of chemistry equilibrium materials developed based on BSNP questionnaire that has been modified include 1) the feasibility of content with avarage value 3,33 means valid and not need to be revised; 2) language feasibility obtained avarage value 3,44 means valid and not need to be revised; 3) feasibility of presentation obtained avarage value 3,27 means valid and not need to be revised; 4) feasibility of graphics obtained avarage value 3,57 means valid and not need to be revised. The conclusion

of the acquisition of the four aspects is 3,40 means valid and not need to be revised worth to use.

C. Implementation of Integrated Learning material Based on Guided Inquiry Worksheet

Integrated learning materials guided inquiry based worksheets have been implemented inthe classroom for chemistry equlibrium teaching on semester IV students. Student learning ourcomes were obtained from student's ability to carry out pretest and posttest exams before and after learning using guided inquiry based worksheet. Student learning outcomes are summarized in Table 2.

TABLE 2. Student Learning Outcomes based on Pretest and Posttest on Chemistry Equilibrium Teaching Kinetic and Chemical Equilibrium.

Exams	**Avarage learning outcomes**	
	Experiment	**Control**
Pretest	52,75	50,50
Posttest	88,25	65,75
N – gain	0,75	0,31

Based on Table 2 shows that N-Gain (level of student's understanding) on chemical equilibrium materials for the experimental class obtained an average of 0,75 (average is high). While for the control class obtained an average of 0,31 (the average is low). The effectiveness of instructional materials is calculated based on the result of student's average learning on posttest compared to the pretest in the experimental and control class. From result obtained that experiment class get higher learning result at posttest [7]. This is due to the increasing level of understanding students and students trying to solve their own problems on chemical equilibrium material.

The result of student's perceptions of integratedlearning materials based on inquiry worksheets on chemical equilibrium material can be seen in Table 3.

Table 3. The student's perceptions of integrated learning materials based on inquiry worksheets on chemical equilibrium material.

No	**Indicator**	**Percentage of respondents**	**Explanation**
1	I am happy about learning the chemical equilibrium that has just been implemented	82,50%	Good
2	The integrated materials of the worksheets used illustrate the concept of chemical equilibrium discussed.	77,50%	Good
3	I am interested in learning guided inquiry based chemical equlibrium with integrated learning materials for worksheet.	80%	Good
4	I feel active and participate in learning chemical equilibrium.	83,75%	Good
5	I find it easier to understand chemical equilibrium learning material by using guided inquiry based learning with worksheets.	78,75%	Good
6	Learning invites curiosity	80%	Good
7	Guide inquiry based learning encourages me to always ask questions about issue I have not been able to solve	78,75%	Good
8	Learning with the worksheets integration materials encourages me to further innovate.	80%	Good
9	Learning with integrated learning materials worksheets encourage me to be more creative	78,75%	Good
10	Every learning I want the learning process to use guided inquiry based learning with integrated worksheets.	80%	Good

Based on the responses of 20 students on the use of learning materials that have been developed in learning is quite good with an average percentage of 80%. This can be said that positive student perception during learning using guided inquiry based worksheets.

Guided inquiry learing model can be increase the learning activities so that lecturers and students can actively in the scientific communication of the material taught [7]. Worksheets proved to be effective in improving student learning outcomes on chemical equilibrium materials.

IV. CONCLUSION

Integrated learning materials based on guided inquiry have been successfully developed and implemented in the learning of chemical equilibrium. The result of standardization of learning materials to lecturer's respondents indicates that the learning materials have fulfilled the quality based on the BSNP standard. The implementation of learning materials in the lesson shows that integrated learning material based on inquiry worksheets can help students to achieve competence in accordance with the achievement of learning. The student's learning outcomes in the experimental class were higher than the control class. Integrated learning materials worksheets are very effective in improving student learning outcomes in Kinetic and Chemical Equilibrium materials.

Acknowledgment

The researcher would like to thank the Medan State University for providing a place and time for researching.

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