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RESEARCH ARTICLE

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Development of Learning Tools of Problem-based Learning to Enhance Scientific Thinking Skills

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Abstract: This study aimed to develop learning tools of Problem-Based Learning (PBL) model to enhance students' scientific thinking skills. This research was a research and development by modifying 4D model (Thiagarajan, Semmel and Semmel) consists of define, design, development and disseminate. The subjects of the test result of the learning tool were the students of the Department of Home Economic, Faculty of Engineering, Universitas Negeri Makassar, Indonesia, in the even semester of academic year 2015/2016 as many as 30 persons and lecturers as many as 2 (two) persons. The data of research were collected by using observation sheet, questionnaire, interview guide, and documentation, then analyzed descriptively. The results showed that learning tools of PBL model were valid, practical, and effective to enhance scientific thinking skill of students. Lecturers can use this learning tool in other courses by modifying that learning tools.
Keywords: learning model, problem-based learning, scientific thinking skills, research and development

1. INTRODUCTION

The government is always paying great attention to every effort to improve the quality of education, because it is well-realized that quality is a necessity, if not paid attention will surely be retarded, and will always lose superiority with other nations. Improving the quality of education is one of the important points in our efforts to catch up with other nations. The changing paradigm of the age must continue to be followed and adjusted to the demands and expectations of society, therefore the improvement quality of the education is an urgent demand, as urgent as the other dimensions in various development sectors.

The authoritarian paradigm is a paradigm of democracy, one form of community dynamics and implications for education, one of the implications is the desire of the community to receive a curriculum in which the content of participatory learning is compared to the passive, dogmatic learning compared to creative and innovative learning. The community in which the learner is no longer happy to be given learning with conventional approaches such as Teacher Center learning oriented), they demand to be given the freedom to think innovatively through a student center learning oriented.

Student-centered learning-oriented is a learning that is no longer appropriate to the changing times, such learning causes students to be imprisoned, deprived of reason and creativity, they accept dogmatic teacher material without alternative choice, so that rational scientific principles and neglected objectives. Therefore a learning model is needed that enables learners to gain learning outcomes that make learners self-reliant and independent. And the model was found in PBL [1] put it in his research that PBL could bring learners to solve life problems through the process of finding, learning and thinking independently. One such learning model is a problem-based learning (PBL) model.

Problem-based learning is one model that can be a reference because this active learning provides opportunities for students to learn to solve problems, choose a strategy to solve problems, however and in any circumstances. Therefore problem-based learning is learning where students are faced with problems then accustomed to solving through their own knowledge and skills, developing inquiry, accustoming them to construct critical and scientific thinking, based on objective, logical and methodological principles of science.

Reference [2] suggested that PBL is a model of learning. This model is designed in a variety of issues that require students to gain important knowledge, make them adept at solving problems, and have their own learning strategies and have the skills to participate in teams. The learning process uses a systemic approach to problem solving or faces the challenges that will be required in careers and everyday life and develop self-reliance and self-confidence.

Furthermore, [3,4] argued that PBL is a learning model that involves students to solve problems with several stages of scientific method so that students are expected to be able to learn knowledge related to the problem and students are expected to have the skills to solve problems. PBL will be a learning model that seeks to apply problems that occur in the real world, as a context for learners to practice how to think critically and gain skills to solve problems. As for the steps of the PBL model according to [5] there were five phases, they are (1) student orientation on the problem, (2) organizing students to research, (3) assisting independent and group investigation, (4) developing and presenting the work, 5) analyze and evaluate the problem-solving process

In addition to improving problem-solving skills, PBL could also improve students' scientific thinking skills, thinking based on objective, methodological, systematic and universal principles of science [6]. While reference [7] argued that scientific thinking is logical and empirical thinking. Logical means to make sense, and empirical means discussed in depth based on facts that can be accountable. According to reference [8] that the criticism was reasonable, reflective thinking that is focused on deciding what to belief or do. Critical thinking is both reasonable and reflective which focuses on what to believe and what to do. This means that when critical thinking will be able to decide exactly what should be believed and what should be done or done. Furthermore critical thinking was also an intellectual process and full of concepts of skills that are (1) applying, (2) analyzing, (3) synthesizing, (4) evaluating the information obtained, (5) generalizing the results of the process of observation, experience, reflection, or communication as a basis for trust and what to do [9].

PBL model can improve problem solving skills and students' scientific thinking is appropriately applied to students of Department of Home Economic, Faculty of Engineering, Universitas Negeri Makassar, Indonesia, especially the subject of FoodstuffKnowledge, this is due to the fact that this course not only demands creativity and innovation and skillful decisions for students but also required to skillfully think by using the principles of science. Foodstuff knowledge course have been provided using teacher-centered learning approaches, whereas this course is a prerequisite course that provides a solid foundation for advanced eyes, consequently the students are less creative and innovative and often can not make adjustments in advanced courses both theoretically and practice, which is not less important is the reality that the students are less accustomed to taking a role in solving problems scientifically. Based on this background, it is necessary to develop learning tools that can develop students' scientific thinking skills.

2. METHODS

This study was a research and development with modified development model from reference [10] through four stages: define, design, development and disseminate. Operationalization of development activities used a number of research approaches that are viewed in accordance with the needs of the application of certain phases. In the introductory phase, for example, a review of needs and field characteristics for learning materials development tools, using both quantitative and qualitative research approaches. The combination of both designs is also expected to increase the scope, depth, and strength of the research.

The subjects of small-scale trial of this research are the students of the Department of Home Economic in the even semester of academic year 2015/2016 as many as 30 students. The research data was intended to measure the validity, effectiveness, and effectiveness of learning tools. The instrument used to measure the validity of the learning device is the validation sheet; to measure the practicality used observation sheet RPP implementation and questionnaire response of students and lecturers of the subject of Foodstuffs Knowledge; and to measure the effectiveness of the model and the device used observation sheet of student activity in learning. The data collection was conducted by filling the validation sheet [11], the implementation of lesson plan [12] and the questionnaire of student and lecturer responses to learning models and tools.

3. RESULT AND DISCUSSION

The results of the define stage have found that learning in the subject of foodstuff knowledge has not been maximally as expected, this is due to the use of less precise learning devices, and the learning model is still conventional. Front-end analysis based on observation results found that the learning approach which is used by lecturers in the subject matter so far is still dominated by teacher-based approach, although student-based learning model is done but not implemented maximally, consequently the lesson becomes less effective. Observation result also found that from 2 lecturers who do the learning process in the subject of knowledge foodstuffs, 1 of whom still use more conventional lecture methods, and 1 other lecturers have implemented discussion learning models based on constructivism philosophy.

Student-based learning model and using lecture method are considered irrelevant and unsuitable for improving students' scientific thinking skills. This conventional model not only eliminates the potential of creativity, but also does not nurture students 'independence, motivation, innovation and initiative, therefore more innovative and constructive models are needed so that students' potential, both cognitive, affective and psychomotor potential can develop maximally, and through Problem-based Learning learning can produce intelligent, skillful outcomes, and have good scientific thinking skills.

The results of the Student Analysis stage, conducted to examine the characteristics of students covering the background, especially the basic skills of knowledge and skills knowledge of food. The result of the analysis shows that the scientific thinking ability of the students majoring in Family Welfare Education which is the subject of this research is in the category of developing and the result of the learning of food knowledge is enough, with an average score of 64.22 from the maximum score of 100. However, enabling the creation of a maximum learning process to improve students' scientific thinking skills. The low student's scientific thinking ability was associated with the conventional learning model as described above. Several lecturers of the subject of Food Science Knowledge that during this time sometimes the learning takes place one way, because it is considered the best, considering innovative learning is not fully understood. PBL model has not understood its syntax well, either among lecturers more especially among students.

In the conceptual analysis stage, it was known that the subject of food science discusses a number of basic competencies ranging from basic concept of food knowledge, basic competence on the classification of foodstuffs, then discusses the types of vegetable and animal food ingredients, a good criterion. Food science courses also contain material related to storing groceries and samples of produce, whether plant or animal foods.

Characteristics of the subject of knowledge of food stuff is slightly different from other courses, by him the instructor of the course is required to creatively choose the model and learning device in accordance with the characteristics of the subject of food stuff knowledge. However, based on interviews with lecturers who are the subject of this research, it is found that they generally do not understand and understand the

existence of this course that should be taught with creative and constructive models, but taught with conventional models that more lectures and dominated by lecturers.

In the task analysis, the assignment to the students was done by testing how their knowledge and skill about the knowledge of the foodstuffs studied. The task given is the topic of food problem with real situation to be developed and the solution of the solution either through literature review or in the field.Pemberian task to students is done by testing how their knowledge and skills about the concept of knowledge of foodstuffs learned. The tasks are topic of food knowledge problem with real situation to be developed and solution solution for example through literature review and so on.

The first assignment of a student in a group makes a paper/assignment related to grain, the second task is to put the paper in front of the class and the third task is to discuss it with the students and the discussion is carefully monitored by the lecturer whose position is the facilitator. Students 'habits to formulate problems, discuss and express opinions in front of peers and lecturers are expected to improve the ability to analyze, initiate, solve problems, percentage and so on in accordance with efforts to improve students' scientific thinking skills. Based on observations found that the ability of students to make papers or assignments , and the discussion has not been maximized, this is due to their knowledge and skills about the concept of knowledge of foodstuffs studied so far also not fully understood and understood.

The results of the next define study was the specification of learning objectives. This specification is done by extending the activity time in the classroom (lecture hall and laboratory). This method is set up with a constructivist environment that is expected to give students the opportunity to work on tasks/problems that are given in small groups. This method is done in the form of planning, action, monitoring and evaluation, the purpose so that students know and skillfully plan, execute and simultaneously evaluate and in this way of course will give birth to students with the ability to think scientifically good.

Based on the results of observations and interviews found that students who become subjects in this study generally do not understand and understand doing tasks in the form of projects so that the ability to do the planning, action and analyze the problem is still weak.

Based on the analysis of preliminary research results, especially in the defining stages of points 1 to 4, the objectives of the learning materials are set as follows: (1) students are able to explain the classification of vegetable and animal food ingredients and then skillfully present them in front of the class (2) students are able to explain the characteristics of good plant and animal food ingredients (3) students progress in improving their scientific thinking skills (4) students become independent, creative and innovative learners.

The results of further research has been carried out the stages of development of design, and develop and the results then obtained a valid learning tool, effective and practical. Called Validkarena based on the results of validation by experts/experts and test results obtained results with the level of validity and 3.16. The result of the test of the validity of three experts for the guidebook model and the device obtained respectively (model book = 3.13, RPP = 3.25; Module = 3.10) the average total of 3.16 with the coefficient of judment of expert index same with satudan valid categorized. Summary of validation results is shown in Table 1.

TABLE 1. SUMMARY OF VALIDATION

No	Aspect	Assessment	Validation Coefficient	Category
1.	Book of Model	3.13	1.00	Valid
2	Lesson plan	3.25	1.00	Valid
3	Module	3.10	1.00	Valid
	Average	3.16	1.00	Valid

Another result is the discovery of the Practicality of Learning Devices with the PBL Model. The practicality of the device with the developed PBL model is presented using test results, using a perception questionnaire of 2 lecturers who are the Teachers of Food Science and 30 students who have followed the lectures using PBL learning models and tools. The test results of practicality of learning model of PBL responded positively by lecturers and students with an average of 85.03%, the module tools used as supporters in the learning of 88.14%, RPP of 86.8%. Overall positive response given by the students of 86.66% with good category, so it can be said that the model and the device is practical to use. Practicality test results are shown in Table 2.

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TABLE 2. SUMMARY OF PRACTICALITY TEST RESULTS

No	Aspect	Positive Response (%)	Negative Response (%)
1	Model book	85.03	14.97
2	Lesson plan	86.8	13.2
3	Module	88.14	11.86
	Average	86.66	13.34

The effectiveness of learning can be seen from the observation of student activities related to formulating problems, diagnosing, formulating alternative strategies, determining and implementing problem solving strategies, collecting and analyzing data, discussing, teamwork and concluding with the average percentage of students active in learning is equal to 75.83%. This indicator shows that these models and tools are effective for improving students' scientific thinking skills.

Based on the results of the research, it is known that the implementation of the course Knowledge of Food Materials results have not been maximized. This is due to the improper

use of instructional devices, and still conventional learning models, found in front-end analysis, as the result of observation that the lecturers are still dominated by teacher learning approach, the lesson is not based on the constructivism philosophy that more flexible and tend to be student oriented. In addition, lecturers do not understand and understand the existence of this course that should be taught with creative and constructive models, but taught with conventional models that more lectures and dominated by teachers (teacher center approach).

Constructivism as an approach not only looks at learning as it appears on the surface, but more than that, sees learning as a process that has deeper meaning. In contrast to the behavioristic flow that understands the nature of learning as a mechanistic activity between stimulus responses, constructivism better understands learning as a human activity of building or creating knowledge by giving meaning to its knowledge according to its experience. According to this theory, one fundamental principle is that teachers not only give knowledge to students, but students must also play an active role to build their own knowledge in memory. In this case, the teacher can facilitate this process by allowing students to discover or apply their own ideas, and teach students to become aware and consciously using their own strategies for learning. Teachers can provide students who take students to a higher level of understanding with students' own notes that they write with their own language and words. From the description it can be said that the meaning of learning according to constructivism is an active activity, where learners coach own knowledge, search for the meaning of what they learn and is the process of solving new concepts and ideas with the framework of thinking that already exist and have.

Furthermore, at the stage of development. At this stage, the final form of the model and learning device after going through the revision phase based on input from expert validator and test result data. The steps taken at this stage of the trial are: (1) Expert validation. Assessment of validators of instructional devices includes format, language, construction and content coverage. Based on validator input, models and learning tools are revised to obtain valid models and devices. (2) The revised model and learning device trial is tested on students of FT UNM Family Welfare Education Department. Device testing involves aspects of model and device usage in the learning process. The data obtained in this trial is processed and analyzed to be used in assessing and revising learning models and tools prior to dissemination or dissemination.

Some of the above results are based on the define stage and the development stage shows that the subject of food knowledge taught by the lecturers to the students the results have not been maximally as expected, this is caused by the learning model that is used sometimes still using the teacher approach, have independence in solving problems, creativity and innovation is low, and of course less than maximum in scientific thinking. They do not have independence because in the learning process of the dominant teacher while the learners sometimes just quietly follow the learning, learners lose their creativity and initiative because of the potential it has buried, and never appear kepermukaan.Peserta treated like this must lose the ability of scientific thinking.

Departing from the problem that PBL makamodel need to be one alternative model, because this model has the ability: 1) Formulate the problem, 2) appropriate problem-solving strategy, 3 Implementation 4) Able to conduct discussions and percentages. Involving them in problem solving means giving knowledge and experience in life and at some point will be applied in real life. PBL will be a learning approach that seeks to apply the problems that occur in the real world, as a context for learners to practice how to think critically and gain skills to solve problems [2, 13].

PBLrelevan model is given to the learner because according to [1] that PBL seen from the learning process has characteristics that distinguish it from other learning model. Characteristics referred to is learning is student-centeredartinya learning process in PBL is more oriented to students as people learn. Therefore, PBL is supported also by constructivism theory where students are encouraged to be able to develop their own knowledge. If this model is applied properly then learners will get a strong mentality, no matter how hard the problem is, there is a way out, that is why this model is called by [14] aims tough and independent participants, accustomed to take the initiative and skilled use critical thinking solves problems.

The PBL learning model is relevant to the subject of food knowledge because the subject is related to the environment, as [15] argues that learning by problem is learning to interact between the stimulus and response, the relationship between the two directions of learning and the environment. The environment provides input to learners in the form of help and problems, while the brain's nervous system functions to interpret the aid effectively so that problems encountered can be investigated, assessed, analyzed, and sought the solution well. Problem-Based Learning is a learning approach that begins with solving a problem, but to solve that problem learners need new knowledge to be able to solve it.PBL is a concept of learning that helps teachers create learning environments that begin with important and relevant issues (related) for learners, and allows learners to gain a more realistic (real) learning experience.

The PBL model engages learners in an active, collaborative, learner-centered learning process that develops the problem-solving and self-learning skills needed to meet the challenges of life and careers, in today's increasingly complex environment. Problem Based Learning can also start by doing group work among learners. Learners investigate themselves, find problems, then solve the problem under the guidance of the facilitator (teacher).

Problem Based Learning suggests to learners to seek or determine relevant sources of knowledge. Problem-based learning poses challenges for learners to learn on their own. In this case, learners are more invited to form a knowledge with little guidance or teacher direction while on traditional learning, learners are more treated as recipients of knowledge given in a structured by a guru.PBL is one model of innovative learning that can provide active learning conditions to learners. PBL is a learning model involving students to solve a problem through the stages of scientific method so that learners can learn knowledge related to the problem and also have the skills to solve the problem.

To achieve optimal learning outcomes, learning with PBL needs to be well-designed from the preparation of problems that fit the curriculum to be developed in the classroom, raising the problems of the learner, the equipment that may be required,

and the assessment used. Teachers applying this approach must develop themselves through classroom management experience, through continuous training or formal education education. Therefore, problem-based learning is an effective approach to teaching high-level thinking processes. This learning helps learners to process ready-made information in their minds and develop their own knowledge of the social world and beyond. This learning is suitable for developing basic and complex knowledge.

4. CONCLUSION

The problem-based learning (PBL) model of true learning is found to improve students' scientific thinking skills. Previously, based on the research of the define stage, it was found that the subject of food stuff knowledge given to the students was not maximal, this was caused by the use of less precise learning devices, and the learning model was still conventional. Front-end analysis based on observations found that the learning approach used by lecturers of food subject material is dominated by teacher learning approach which is very different from PBL model. The PBL model based on the development stage of design, and develop has resulted in a valid, effective and practical learning tool and this learning tool was found to improve students 'learning outcomes and students' scientific thinking skills.

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