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

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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 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, thenanalyzed 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.

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-centered learning, they demand to be given the freedom to think innovatively through a student-centered learning.

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 PBL1 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. PBL provides opportunities for students to learn to solve problems, choose a strategy to solve problems, however, and in any circumstances. Therefore PBL 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.

PBL 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 teams2. 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, 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 problems3,4. 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.

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 believe 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.Based on this background, it is necessary to develop learning tools that can develop students' scientific thinking skills.

2. Experimental Details

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 a 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, practically, 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. Results and Discussion

The results of the define stage have found that learning in the subject of Foodstuff Knowledge has not been maximal 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 the teacher-based approach, although student-based learning model is done but not implemented maximally and less effective.

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 PBL can produce intelligent, skillful outcomes, and have good scientific thinking skills.

The results of the Student Analysis stage 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 the 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 Foodstuff Knowledge are 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 foodstuffs knowledge. The task given is the topic of food problem with a real situation to be developed and the solution of the solution either through literature review or in the field. Giving the task to students is done by testing how their knowledge and skills about the concept of Foodstuffs Knowledge learned. The tasks are topic of food knowledge problem with a real situation to be developed and solution for example through literature review and so on. Based on observations found that the ability of students to make the assignments, and the discussion has not been maximized, this is due to their knowledge and skills about the concept of Foodstuffs Knowledge studied so far also not fully understood.

The results of the next define study were 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 generally do not understand to do the 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 the further research have been carried out the stages of development of design, and develop and the results then obtained a valid learning tool, effective and practical. Called Valid because 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 the judgment of expert index same with student valid categorized as 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

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 has 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 the 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 (teacher-centered 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 the 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, the final form of the model and learning tools 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 Department of Family Welfare Education, Faculty of Engineering, Universitas Negeri Makassar. 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 maximal 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. Students treated like this must lose the ability of scientific thinking.

Departing from the problem that PBL 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 points 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].

PBL model is given to the learner because according to 1 that PBL seen from the learning process has characteristics that distinguish it from another learning model. Characteristics referred to is learning is the student means the 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.

PBL is relevant to the subject of food knowledge because the subject is related to the environment, as 15 argues that learning by the 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. PBL 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 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. PBL 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).

PBL 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 teacher 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. Therefore, PBL is an effective approach to teach 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 result of research and discussion found that the learning tools of PBL were valid and practical to enhance students' scientific thinking skills. But it is necessary to conduct the experimental research for effectiveness test of this learning tools.

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