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PROBLEM-BASED TEACHING AND LEARNING DEVICES: A RESEARCH AND DEVELOPMENT ON NATURAL SCIENCE MATERIALS FOR PRIMARY SCHOOL

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ABSTRACT: *This study aims to develop a model of teaching and learning devices of Natural Science subject for primary schools. The devices include curriculum, syllabus, lesson plan, instructional media, and evaluation devices. To achieve the objective, this research applied research and development adopted from Thiagarajan's 4-D model (1974) with modification. The development consists of four steps: define, design, develop, and disseminate. In developing the teaching and learning devices, this study applied problem-based learning approach by introducing the students to the real problems with five stages; the stages are (a) orient the students to the problem, (b) organize the students to learn, (c) guide the individual research or groups, (d) develop and present the results, and (e) analyze and evaluate the problem-solving process. State Primary school 12 Baruga Kendari, Indonesia was chosen as a place of research. The data were collected through documentation, observation, interviews, and testing. The data were analyzed descriptive qualitatively and quantitatively. The result of the research shows that the process of developing of the teaching and learning model (on Natural Science subject) with problem-based approach consists of several steps; they are identification, needs analysis, design, development, and evaluation (final revision). The teaching and learning devices developed are valid and appropriate to use. The learning devices are effective to be used because of three main reasons: (1) achieving criteria existed above the minimum mastery criteria; (2) the experiment class test results were significantly higher than the control class test results; (3) the developed devices model has met the criteria of practicality.*

KEYWORDS: Teaching, Learning Devices, Thematic, Problem-Based Learning.

INTRODUCTION

Professional teachers are those who are able to improve the quality of education (Sauri, 2010). Education will be of quality if the learning process goes effectively. Learning prosess will be effective if it is supported by effective learning devices. Learning devices can be the most important references in the implementation of teaching and learning. Therefore, the ability of teachers in preparing learning devices (include urriculum, syllabus, lesson plan, material, media, model and learning method, and evaluation devices) is very fundamental.

The current phenomena show that (1) in general, the teaching and learning process in primary schools, teachers still tend to use direct learning or teacher-centered models. Because of this reason students tend to be saturated and less motivated; (2) students are almost never invited be involved in practice of teaching and learnong process so they feel bored and lack the curiosity, and; (3) students have difficulties in remembering the content of the teaching and learning materials that teachers have taught because there is no experiential learning; (4) teachers are not optimum in applying effective teaching and learning strategies so that the

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students tend to sit, listen, record, and memorize passively, and this is due to (a) the lack of teacher interaction with the students; (b) students have difficulties in understanding the concept of the subject matter; (5) the teaching and learning Natural Science Subject still put emphasis on the concepts. Students are considered successful in learning if they have mastered the content of particular books.

This phenomena is also similar to the results of research conducted by Turi *at.al* (2017) which revealed that (a) the ability of primary school teachers in preparing learning devices has not been maximized, (b) the existence of lesson plans is limited to mere administrative needs, (c) materials, media, and learning evaluation devices have not been properly designed and are still very limited. Other results of research conducted by Hamdu *at.al* (2016), reveals the lack of source, theory, compilation, and examples of learning devices being the main cause of teachers' difficulties in developing teaching and learning devices. Similarly, Nuraini, *at.al*. (2016) found that (a) the Biology teacher's understanding of inquiry model-based learning devices is still very low, teachers need reference in developing these devices; (b) the use of learning devices in the learning process has not been maximized; (c) low problem solving ability of students in learning so that it needs innovation in the development of learning devices.

To overcome the problems, teachers can develop a model of teaching and learning devices that can encourage students to be active, creative, and innovative. It is expected that (1) teachers and students are equally active, and mutual interactions occur between teacher-students and student-student; (2) teachers and students can develop their creativity in the teaching and learning; and; (3) students feel comfortable during teaching and learning process.

The current Indonesian curriculum for primary schools uses a thematic-integrated approach. The thematic-integrated approach links the various basic competencies or subjects that are still in one concept in one particular theme. This approach aims to integrate students' knowledge where a concept can be entirely integrated so that the teaching and learning will be more meaningful. The teaching and learning tends to be linked with problems faced by students in their everyday life. To find solutions to these problems it requires a thorough knowledge of the concept and theme.

This research produces thematic learning devices with problem-based learning (PBL) model. PBL is a student-centered pedagogy of a subject where the students try to find solutions in solving problem (Hmelo-Silver, 2004). PBL is also an active way for students to learn basic of problem-solving skills and to acquire knowledge through interaction with others. The students learn in small groups and self-directed to define and carry out specific tasks in form of real-life and lesson-based. Loyens, Kirschner, and Paas (2011) reveal that PBL is a major development in educational practice that continue to affect education and learning around the world. PBL first appeared in the mid-1960s at McMaster University Medical School in Hamilton, Canada (Loyens et al., 2011). The results of study conducted by Phungsuk, R., *at.al* (2017) state that problem-based learning through learning virtual environment can improve learning performance and ability to solve problems among students.

Based on the background of research presented, the main problem of this research is: "How to develop a valid and effective learning devices model for primary school.

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RESEARCH METHODS

This research and development using Thiagarajan's 4-D model (1974: 5). This model consists of four stages of defining, designing, developing, and disseminating. By adopting and modifying the 4-D model, the development of this research becomes: (a) identification and analysis: this research develops learning devices including curriculum, syllabus, lesson plan, media, and evaluation devices of natural science subject using problem-based learning approach; (b) designing (c) developing, and (d) evaluating (final revision). The fourth-grader students of Primary school 12 Baruga Kendari in academic-year 2015 were chosen as the subject of the research.

The data were collected through documentation, interview, observation, and test. The qualitative data covering students' and teachers' activites including the students' response to questionnaire were analyzed descriptive qualitatively. Meanwhile, quantitative data in the form of test results were analyzed quantitatively.

RESULTS

The Description of Learning Devices Development.

This study aims to develop a valid and effective Natural Science teaching and learning devces using problem-based learning model. To achieve that goal, the Thiagarajan's model (4 D model) was adopted and modified. The development consists of four steps: problem identification and needs analyzing, designing, developing, and evaluating.

The stage of identification and needs analyzing is very important because the most important problem in learning is how a teacher conducts a fun teaching and learning process. In this case the relevant theories were examined, the characteristics of students were analyzed, and a pre-survey of the devices and the implementation of teaching and learning was conducted. Conceptual analysis aims to identify, to specify, and to arrange systematically the relevant materials to be taught. While, the task analysis is the identification of tasks required in accordance with the curriculum. Needs analysis in the development of teaching and learning devices using the PBL model includes need analysis on (1) lesson plan; (2) teaching and learning materials; (3) teaching and learning models/methods; (4) teaching and learning media; and (5) evaluation devices.

The design stage of draft 1 produces the initial design which includes (1) the design of learning programs in the form of curriculum, syllabus, and lesson plan; (2) material design, (3) designing models/ methods and teaching and learning procedures; (4) instructional media design; and (5) evaluation devices design. All the results of this design stage are called draft1.

Development stage is done to develop the design of the five models of learning devices according to the characteristics and needs. Before the five instructional devices were designed it was first validated by three experts to see the validity of the format, content, and language. Evaluation step is intended to analyze and to revise the final draft. The models developed, then, were validated before they were applied.

Evaluation stage (the final assessment) was conducted in forms of program assessment, sosialization, and dissemination of teaching and learning model. After try-out of the teaching

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and learning devices was done (test, evaluation, and revision) a suitable instructional devices on Natural Science Subject which with problem-based approach was produced. Then, the devices are ready to be implemented in the real situation.

The Analysis of Teaching and Learning Devices

First. The results of expert validation show that teaching and learning devices can be used with little revision. The learning devices model is valid, if the average score has validity proportion > 0.60 (categorized as high to very high). It is found out that the coefficient of curriculum validity reaches 0.891 and the coefficient of syllabus validity reaches 0.906. Whereas, the coefficient validity of lesson plans, instructional media, and evaluation devices respectively reach 0.869; 0.863; and 0.875. Thus the learning devices developed, according to the experts, is in valid category with little revision.

Second. The practicality of instructional devices is based on teacher's activity in managing teaching and learning. Teaching and learning devices are considered practical if the level of achievement achieved exist in good category (more than 80%). The results of the observation on teacher's activity in the first meeting reached 87%, and at the second meeting reached 84%. This shows that learning devices are in practical category as they reach > 80%. Similarly, students' responses toward problem-based teaching and learning are in the positive category. Hence, the achievenet test, in general, can be categorized as valid and reliable.

Third. The developed teing and aclearning devices are considered effective because they meet minimum mastery criteria. In addition, the experimental group is better than the control group in learning outcome. The average test result of minimum completeness criteria on students' learning outcomes ≥ 60 exceeded 65%. While the results of obtained proportion test showed that the students who got the value of ≥ 60 exceeded 65%. The results of the effectiveness at the first meeting reached 81.15% with good category. Meanwhile, at the second meeting, it reached 83.87% with good category. This shows that the students are actively involved in the teaching and learning with problem-based learning activities.

Based on the result of questionnaire analysis, it can be concluded that, in general, the teaching and learning activities and learning devices components are positive (more than 80% respond well). This is indicated by the percentage obtained on the teaching component that reached above 80%; most of the students (88%) were interested with the components of teaching and learning; 90% of students were agree if the next teaching and learning to apply problem-based teaching and learning model; 82% of students feel easy to understand the language contained in the teaching and learning devices; and, 85% of students thought that the teaching and learning media were interesting. The completeness of the teaching and learning was achieved because more than 80% of students have grades above 60. This is in accordance with Hobri (2010: 58). This shows that the students are able to understand the material presented by the teacher using problem-based learning approach. In addition, the test results analysis showed that the result of test was valid because the validity coefficient was > 0.60 (in high or very high category).

The students are interested with the use of learning devices model because they can learn together to find concepts and to solve problems of their own everyday life. Students immediately see the phenomenon in the field; students can build their own knowledge under teacher's guidance. Students also acquire problem-solving skills due to the exercises given.

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The use of this model can also encourage teachers to organize teaching and learning and can create active, innovative, creative, and fun learning activities.

DISCUSSION

The teaching and learning devices of Natural Science subject with problem-based learning approach was developed on four main steps: identification and needs analysis, design, development, and learning evaluation. The teaching and learning devices have been validated by the validators, and it was recommended for use. Based on the results of the test, this device meets the requirements (valid and reliable). It means that the level of difficulty of the test was ideal, the discrimation power of the test was significant, and revisions were done several times based on the results of experts' validation. All of the three validators provide recommendation that the test of Natural Science achievement is valid and can be used with little revision.

Revisions to the instructional devices are done, in particular, on the language. Before the revision there is still unclear statements that might confuses the students in understanding the problem. Revised on syllabus was done mainly on the process of teaching and learning activities and on indicators of learning. Revisions to the lesson plan are made on indicators, models, methods, media, learning scenarios, and evaluation devices.

Prior to the revision, the teaching and learning indicators were not yet specific and unclear; however, after the revision the indicators became more specific; it is not so difficult for the teacher in achieving the indicators. Revisions to the contents of subject are conducted primarily on language, and materials. The language of test is simplified to make it easy to understand (not confusing or ambigu). While, the materials on the achievement test are adapted from the materials regarding to "natural resources and utilization by the community", with the probem-based learning model. The results showed that the development of the teaching and learning devices has produced valid and effective learning devices with problem-based approach.

The development of valid teaching and learning devices by profesionals is important to be done because teachers of lementary schools still have a lot of problems in developing their own devices. This fact is in line with Nunan (1993: 8) stating that only a few teachers are able to design their own syllabus. Nunan (1987) also reported that the development of the syllabus should be done by people with special skills, and he believed that classroom teachers should be trained in accordance with the skills and information needed to design their own syllabus, if they want to be successful teachers. Both syllabus and curriculum should be negotiated between teacher and student based on the needs analysis of learners (Brindley, 1984). Briefly, Brindley suggests that teachers may follow Stern (1984) who advocates curriculum negotiation emphasis, as it emphasizes flexibility and curriculum negotiation. It is important for teachers to have something definite to negotiate. Thus, Brumfit, Widdowson, and Yalden (in Stern, 1984: 12) have also emphasized the importance for teachers to define parameters, provide direction, and have the resources available to form effective learning and useful subject matter for education.

A valid and effective curriculum and syllabus plays a very important role in the teaching and learning learning process. This is supported by the results of the Orlandina and Elena studies which emphasize that to create a student-centered teaching and learning system, it is very

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important to develop the personality of primary school students. Not only is it supported theoretically by the syllabus but also supported by by various school programs that are useful in the implementation of the curriculum since personal development contributes to the overall development of students. The syllabus needs to cover the students' physical, cognitive, affective, social, moral, and spiritual dimensions; it also needs to guide them toward an awareness of how these dimensions are related and how to develop students' persoality. If teachers approach the contents of the syllabus from an integrated perspective, students are given the opportunity to gain relevant knowledge, to develop an understanding of concepts that enable them to make connections throughout their learning, to acquire transdisciplinary and disciplinary skills and also take action as a result of their learning (Orlandina and Elena, 2014).

The teaching and learning devices developed are considered effective because they meet the minimum of completeness criteria. It also strenghted by the resuts of the experimental class learning outcomes which are better than learning outcomes of control class. As have been determined before the minimum criterion of learning result of Natural Science subject was 60 ($\mu = 60$). By using SPSS version 21, the value of significance obtained (sig) was 0.000 = 1%, so that the average value was above the mean score; it was 60. While, based on test of proportion, the students who get score ≥ 60 exceeded 65%.

The result of research also proves that, in terms of performance, experiment class is better than control class. Results of data analysis using SPSS version 21 (which can be seen from the sequence of equal variances assumed) is sig = 0,000 < 0.05. It means that there is enough evidence to reject H_0. So it can be concluded that there is any significant difference between the experimental class and the control class in terms of performance. This is in line with the research conducted by Muchayat (2011) which shows that the effectiveness of teaching and learning devices developed is shown by the ability of students in solving problems; the students' mastery, at least, exist over the minimum mastery criteria.

The findings of this study are supported by the results of research conducted by Rahmawati *et. al* (2013) which concluded that the development of mathematics teaching and learning devices through problem-based instruction for grade VII of elementary school was valid, practical and effective. Similarly, Sumaji (2015) concludes that the teaching and learning devices of Mathematic subject developed with problem-solving learning models are valid and effective for improving mathematical reasoning abilities.

CONCLUSIONS AND SUGGESTIONS

The development of teaching and learning devices on Natural Science subject with problem-based approach, adapted from Thiagarajan (1974), consists of identification and needs analysis, design, development and evaluation (final revision). The developed draftt is revised based on experts judgment and the results of try-out. The result of revision is draftt II; it is the product of the development process through problem-based learning model. Learning devices product is used to improve the learning result of the subject because the level of validity has been tested. This is shown from the average score of curriculum validation that reached 3.39 and the average score of syllabus validity was 3.40. The average score of lesson plan, learning media, and the result of the test were respectively 3.58, 3.68, and 3.85. All of the devices have validation scores greater than 3.00 which means valid. It can be concluded that

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the teaching and learning devices with problem-based learning model is effective to improve students' performance on Natural Science subject. Thus, the teaching and learning devicesdeveloped has met the criteria of practicality.

Based on the result of the research, it can be suggested that the research of teaching and learning devices development with problem-based learning model can be developed also in other field of study. Teachers should be able to use this teaching and learning device to improve primary schools students' learning outcomes.

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