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DEVELOPMENT OF MATH-INTEGRATED LIGHT AND OPTICAL INSTRUMENTS TEACHING MATERIALS USING THE PROBLEM-BASED LEARNING MODEL FOR STUDENTS OF ELEMENTARY SCHOOL TEACHER STUDY PROGRAM (PGSD)

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ABSTRACT

This study aimed to develop math-integrated light and optical instruments teaching materials using the problem-based learning model that are valid, practical, and effective. This research was developed using a 4D model consisting of stages of defining, designing, developing, and distributing. Teaching materials and learning devices used were validated by experts in terms of education, language and graphics. The subjects of this study were the first semester students of the elementary school teacher study program (PGSD) in a teacher training institution (LPTK). The results showed that the results of the validation of RPS, SAP and teaching materials were on average 91%, 91%, and 83%, respectively. The practicality test results in the trial phase of the first semester students at the LPTK in Region A showed that the percentages of the SAP implementation, responses from lecturers, and responses from students were, on average, 78%, 79%, and 83%, respectively. The effectiveness test was done by viewing the students' activities in the learning process whose the value was 70%, while the results of their pre-test and post-test were 63.9 and 79.6, respectively, and n-gain was 0.4. The dissemination stage was implemented on the first semester students of the LPTK in Region B. The percentages of the SAP implementation, responses from lecturers, and responses from students were, on average, 83%, 83%, and 77%, respectively, while the achievement of the students in their pre-test and post-test were 64.5 and 81.2, respectively, with n-gain of 0.5. Thus, it can be concluded that the development of math-integrated light and optical instruments teaching materials using the problem-based learning model in this development research was in the criteria of valid, practical, and effective.

Keywords:Teaching Materials, Math-Integrated Light and Optical Instruments Teaching Materials

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INTRODUCTION

It has become a common understanding that the development of science and demands in the work environment should be accompanied by the development of students' abilities and skills as prospective educators in the future. In this context, one effort that can be done is to integrate several disciplines studied with each other, which is expected to increase the understanding of prospective teachers of the material they will teach.

The quality of learning is closely related to the selection of the right learning models to apply. According to Kurt (2013), empirical studies analyzing the efficiency of the integrated science and math show that the integrated programs have positive effects. Hence, the concept of integrated learning models can be recommended to be applied to all levels of education. However, it requires proper development and selection. According to Fitria (2014); Hermon (2015), integrated science learning is a learning concept that develops essential or basic scientific literacy and can participate dynamically in the community environment and encourage cross-curriculum science learning.

One learning model that can involve students in an active learning process is the problem-based learning model. Kamdi (2014) explained that the problem-based learning model can be interpreted as a learning model that requires efforts by involving students to solve problems by encouraging them to search for and integrate all related knowledge and, at the same time, to improve their skills. According to Aris Shoimin (2014), problem-based learning is a teaching model that is characterized by the existence of real problems as a context for students to learn about how to think critically and learn about skills needed to solve problems and gain knowledge. This is also supported by the opinion of Sumartini (2015) who stated that problem-based learning is learning that uses problems that exist in the real world as a context for students to gain knowledge from learning materials.

A learning process is inseparable from a teaching material that will become a guide for the teacher on teaching. Teaching materials are materials or learning materials that have been systematically arranged and can be used by teachers and students in the learning process. Prastowo (2013) revealed that teaching materials are a collection of

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materials that have been systematically compiled to create a learning environment. In fact, lectures that have been taken by educators have not used the concept of integrated learning as implemented in learning at schools at this time. According to Lukito (2015) integrated learning model is one of the curriculum implementation models that are recommended to be applied to all levels of education. Related to teaching materials, Kemendinas (2010) states that teaching materials are forms of materials used in the learning process that will be carried out by the teacher. Whereas Nurhidayati (2017) revealed that teaching materials are all forms of material used to help teachers/instructors in carrying out teaching and learning activities. Teaching materials can be either written material or unwritten material. Teaching materials have a very important role in learning, namely as a representation of the teacher's explanation in the classroom.

METHOD

The type of this research is development research. As stated by Sugiyono (2009), development research is a study that will be used to produce a product and test the effectiveness of the research product itself. In line with this statement, Putra (2012) revealed that research and development is a systematic study of complete scientific knowledge or understanding of a subject to be studied. This study used the 4-D development model, a model proposed by Thiagarajan (1974) who explained that the stages of the model are to define, design, develop, and disseminate. In order for research to be able to obtain data as expected, the instructional materials developed should be valid, practical, and effective.

RESULTS DISCUSSION

In the development stage (design), the results of the research on the development of math-integrated light and optical instruments teaching materials using the problem-based learning model showed that the content validity test on the RPS (Semester Learning Plan) used in learning obtained an average score of 41 or 91%, which was categorized as very valid. Whereas in the aspect of language, the average value obtained

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was 18 or 90%, which was categorized very valid. From the two validation tests on the RPS used, it can be said that it was very valid. The validity test of the content aspect carried out on the SAP (Learning Event Unit) used showed that the average value was 40 or 91%, so that it was categorized as very valid. Meanwhile, on the aspect of language, the average value was 18 or 90%, which was categorized as very valid. From the two validation tests on the SAP used, it can be said to be very valid.

In another side, the validation of teaching materials was carried out by experts so as can be used in accordance with the aspects of content, language, and graphics. It was found that he content aspect had the average value of 54 or 83% and was categorized very valid, while the language aspect had the average value of 45 or 82% and was categorized very valid, and on the graphic aspect, the average value was of 97 or 84% and categorized very valid. So, from the results of validations by experts, it can be said that the developing teaching material is in a very valid category.

The practicality test was done by observing the implementation of the SAP and the lecturers' the students' responses. Data from the observation showed that the implementation of the SAP got 51.5 or 78%, which was categorized as practical. The data from the recapitulation of questionnaires showed that lecturer responses were 134 or 79% and categorized practical, while the data of the students' responses were 1426 or 83% and categorized very practical.

Furthermore, the effectiveness test was done by paying attention to the activities and student learning outcomes in the learning process. At the first meeting, student activities were 59% and categorized as medium, at the second meeting were 74%, categorized as high, while at the third meeting were 76% and categorized as high. Meanwhile, the learning outcomes, based on the pre-test and post-test, obtained values of 63.9 and 79.6, respectively, with n-gain of 0.4 in the medium category. At the stage of dissemination (disseminate), it was obtained that the data on the SAP implementation results were 54.5 or 83% and categorized as very practical. The response given by students was by 1870 or 83%, categorized as very practical. Furthermore, in student activities, at the first meeting was 68% and categorized as high, at the second meeting was 80% and categorized as high, and at the third meeting was increased to 82% and

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categorized as very high. Meanwhile the average values of students in the pre-test and post-test were 64.5 and 81.2, respectively with n-gain of 0.5, categorized as medium.

The development of math-integrated light and optical instruments teaching materials using the problem-based learning model has been carried out. The trial phase was for 23 students of first semester in LPTK (Teacher Training Institute) in Region A, while the distribution phase was carried out for 30 students of first semester in the LPTK in Region B. Learning in higher education is inseparable from the planning of SAP and RPS that will be carried out during learning. Rahim (2018:101) explained that the purpose of compiling a Learning Event Unit (SAP) is to show a number of teaching materials and the learning process that will be implemented. Whereas Nurdin (2018: 131) explained that the Semester Learning Plan (RPS) is a description of activities that will be carried out by lecturers in the learning/lecturing process in the classroom. In an RPS, there should be the following components: (1) RPS Identity, (2) Learning achievements, (3) Indicators, (4) Learning methods, (5) Time, (6) Learning experience, (7) Criteria and weights of assessment, and (8) List of references.

These SAP and RPS were designed and then validated by the validation. This validation was carried out in the aspect of the feasibility of content and language. At this stage, the validation were asked to assess the SAP and RPS that had been designed and then provide input and values on the validation instruments. From the results, it was found that SAP was scored 59 on 91% and categorized very valid, while the RPS was scored 58 at 91% and categorized very valid. The teaching materials were also validated by alidation by taking into account the feasibilities of the content, language, and graphics. The materials, the aspects of content, language, and graphics, reached a value of 54 on 83% 45 on 84%, 97 on 84%, respectively, that were categorized as very valid.

The implementation of the SAP was seen from the results of observations to the implementation of math-integrated light and optical instruments teaching materials using the problem-based learning model. The trial stage was done on students of first semester in the LPTK in Region A, where during the first meeting they were in the category of medium with a percentage of 59%, in the second meeting were in the category of high with a percentage of 74%, and in the third meeting were in the category of high with a percentage of 76%. Whereas the distribution phase was carried

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out for students of first semester in the LPTK in Region B, where during the first meeting they were in the category of high with a percentage of 68%, the second meeting were in the category of high with a percentage of 80%, and the third meeting were in the category of very high with a percentage of 82%.

The results of the analysis of the student response questionnaire on the practicality of math-integrated light and optical instruments teaching materials using the problem-based learning model showed that in the trial phase, the value was 1426 at 83% with the category of very practical. Whereas, at the dissemination stage, the value is 1870 at 83% with the category of very practical. The results of the analysis of the lecture response questionnaire on the practicality of math-integrated light and optical instruments teaching materials using the problem-based learning model showed that in the trial phase, the value was 134 at 70% with the category of practical.

The activities that were observed were students' visual, oral, listening, and writing activities which showed that during the trial stage, at the first meeting, the value was 59% in the category of medium, at the second meeting was 74% in the category of high, and at the third meeting was 76 in the category of high. Whereas, at the dissemination stage, the first meeting got 68% in the category of high, the second meeting got 80% in the category of high, and the third meeting got 82% in the category of very high. From the data, it can be seen that before using teaching materials developed at the trial stage, the average score of the students in the pre-test was 63.9. After using the developed teaching material, the post-test value obtained was 79.6 with n-gain 0.4 which was included in the category of medium. Whereas, the value of student learning outcomes during the dissemination stage in the pre-test and post-test were 64.5 and 81.2, respectively, with n-gain of 0.5 which was categorized in the medium category.

CONCLUSIONS

The math-integrated light and optical instruments teaching materials using the problem-based learning model in this development research were very valid. This can be seen in the percentages, based on the validation, of the feasibilities of content, language, and graphics that were 83%, 82%, and 84%, respectively. The math-

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integrated light and optical instruments teaching materials using the problem-based learning model in this development research were very practical, based on the lecture response questionnaire and the student response questionnaire that got 79% and 83%, respectively. The math-integrated light and optical instruments teaching materials using the problem-based learning model in this development research were effective, based on the students' activities and achievements. The student activities, at the time of the trial, got an average score of 70% and were categorized as high, while at the stage of dissemination became 77% and were categorized as high. Meanwhile, in terms of learning outcomes, during the trial, the students got average values of 63.9 and 79.6 for their pre-test and post-test, respectively, with n-gain of 0.4 which was categorized as medium, and at the time of distribution they got with an average values of 64.5 and 81.2 for their pre-test and post-test, respectively, with n-gain of 0.5 which was categorized as medium.

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