Needs analysis in development of physics student books based on STEM approach for 11th grade senior high school

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Abstract. Physics learning is learning to emphasize giving direct experience to students to foster the ability to think, work and be scientific, and communicate. In this case, physics learning by STEM approach can equip the skills needed by students. STEM (Science, Technology, Engineering and Mathematics) approach provides training for students to be able to integrate Science, Technology, Engineering and Mathematics in physics learning. In addition, the need for effective learning tools is helping students to build their knowledge independently. One effective learning tool is student books. However, there are still books on physics students who have not used the STEM approach. This study aims to analyze the needs of physics student books based on the STEM approach. This research is a descriptive study carried out through direct observation at senior high school (SMA N 4 Padang), with a sample of research is students of 11th grade. Needs analysis of physics student books includes analysis of students, analysis of teaching materials, and analysis of learning activities, with questionnaires and interview sheets. Based on descriptive data analysis of material teaching, the result obtained 73.8. Therefore need to be developed a physics book based on the STEM approach.

1. Introduction

Education is a process to help humans develop their potential and talent so they can compete globally. Superior human resources can be produced through quality education. The higher the level of education in a country, it will produce higher human resources and have strong potential in their respective fields. The quality of human resources is expected to be developed in the Development of Science and Technology. In Indonesia, the quality of human resources is still relatively low because it is influenced by the quality of education. The ability of students to answer application questions and reasoning is lower than the matter of understanding. These results are supported by the 2015 PISA (Program for International Students Assessment) research which shows that Indonesia has an average value of 403 from the international average of 500 and 501[1]. Data from the 2015 TIMSS (Trends in International Mathematics and Science Study) research, Indonesia ranks 69 out of 76 countries involved[2]. Improving student learning outcomes can be improved through learning tailored to the demands of the times through education both formally and informally.

21st Century learning requires students to have the skills to communicate, collaborate, think critically, be able to solve problems, be creative, and be innovative. This relates to physics learning which emphasizes direct assistance for students to foster the ability to think, communicate, work and think scientifically. In equipping the skills needed by students, teachers need to use and develop teaching materials that are appropriate to the needs of students. Bappenas (2013) states to improve education quality by developing teaching materials [3]. Teaching material has an important role in the learning
process, because it can be used as a learning resource for students to understand a concept of learning material. Learning to use teaching materials in the process of learning physics can affect student learning outcomes.

One form of teaching material that can support independent learning is student books. Student books are books that contain learning material in the form of concepts and understanding, which will be constructed by students through problems that are in it and arranged based on the approach[4]. Therefore, student books are needed by students as a source of learning and can motivate to learn, so learning can run optimally and improve learning outcomes.

In addition to the use of teaching materials, teachers also need to use a learning approach that can train students' thinking skills. One learning approach that can be used is the STEM approach. STEM is one of the new approaches in the development of education that can integrate more than one discipline[5]. Learning with the STEM approach can shape students to reason, think critically, logically, and systematically, so that students are able to face global challenges. The STEM approach can be developed with real life experienced by students in daily life[6, 7].

This means learning with the STEM approach, students do not just memorize scientific concepts, but rather how students can find and understand science concepts and are able to link problems with phenomena in their lives. In terms of technology, students can find out the application of technology related to learning material. Then, through educator techniques can teach students to make simple tools related to learning material, and mathematics is used to formulate mathematical equations related to the concept of learning material and in terms of calculation.

Based on observations made at senior high school (SMA N 4 Padang) in 11th grade, it was found that the teaching materials used in learning were not varied because using only student worksheet, existing teaching materials only emphasized mathematical representations and did not insert approaches suitable to physics learning. Physics teachers at the school concerned stated that they knew about learning based on the STEM approach, but had never applied it in the learning process. Therefore, it is necessary to develop teaching materials and approaches that can support the physics learning process in the form of physics student books based on the STEM approach. In this paper, research was conducted with the aim of analyzing the needs of physics student books based on the STEM approach.

2. Method
This type of research is a qualitative descriptive study. Descriptive research is conducted to describe, interpret and explain or explain a variable or situation[8]. The research data is in the form of descriptive data and qualitative data. The sample was taken from 32 students of 11th grade at senior high school (SMA N 4 Padang). The instruments of data collection used were questionnaires and interview sheets. The questionnaire was filled out by students and the interview sheet was filled out by physics teachers in the school concerned. The scale on the questionnaire uses a Likert scale consisting of four alternative answers. The value for each indicator can be determined by the equation (1)[9]. The categories of this analysis can be seen in Table 1.

\[ Value = \frac{\text{obtained score}}{\text{maksimum score}} \times 100\% \]  

| No. | Value | Category     |
|-----|-------|--------------|
| 1   | 90 < N \leq 100 | Very Good (A) |
| 2   | 75 < N \leq 90  | Good (B)      |
| 3   | 60 < N \leq 75  | Less (C)      |
| 4   | \leq 60         | Very Less (D) |

Table 1. Descriptive analysis of observations [10]
3. Results and Discussion

The results of this study are the percentage analysis of the needs of physics student books based on the STEM approach that was carried out in 11th grade senior high school (SMA N 4 Padang). Analysis of the needs of physics student books based on the STEM approach includes: analysis of students, analysis of teaching materials, and analysis of learning activities.

3.1 Analysis of Students

Analysis of students was obtained through a questionnaire that had been given to 32 students of 11th grade senior high school (SMA N 4 Padang) as a sample. The questionnaire consists of several aspects, namely the interest in learning of students, the learning approach used by the teacher, and understanding of material physics. Each of these aspects there are several indicators and students analysis is shown in Figure 1.

Figure 1 shows that the learning interest of students is 66.60 with less category, the learning approach used by the teacher is 61.46 with less categories, and the understanding of physics material is 62.24 with less categories. Overall analysis of the characteristics of students obtained an average value of 63.43. Based on these results it can be explained that the characteristics of students in physics learning are in the less category and need to be improved in each of these aspects.

3.2 Analysis of Teaching Materials

Analysis of teaching materials is obtained through a questionnaire filled out by students. This questionnaire consists of 5 indicators, which are understanding physics by using books, eager to take part in learning using books, the benefits of using books in learning, developing student books to be more interesting and innovative, and integrated STEM student books. Analysis of the use of teaching materials is shown in Figure 2.
Figure 2. shows that students can understand physics material by using books with a score of 78.9 with good categories, students eager to take part in learning using books get a score of 76.6 with good categories, students feel the benefits of using books in learning scores 80.5 with a good category, students want the development of student books to be more interesting and innovative in obtaining a value of 81.25 with good categories, and student books that are used already integrated with STEM get a value of 51.6 with very less categories.

Overall the analysis of teaching materials obtained an average value of 73.8. Based on these results it can be explained that the use of teaching materials in physics learning is in the less category and needs to be improved, especially in developing STEM integrated student books so that learning becomes more interesting, innovative, and can improve students thinking skills.

3.3 Analysis of Learning Activities

Analysis of learning activities was obtained from the results of the teacher questionnaire. The instrument used was a questionnaire consisting of several aspects including: preliminary activities, STEM approach, Physics material with STEM approach, and closing activities. Each of these aspects has several indicators and analysis of learning activities is shown in Figure 3.
Figure 3. shows that the preliminary activities obtained a value of 75 with good categories, the use of STEM approach in physics learning obtained a value of 63 with less categories, the physics material with the STEM approach obtained a value of 60 with less categories, and closing activities obtained a value of 75 with a good category. Overall analysis of learning activities in physics learning obtained an average value of 68.25 and was in the less category. Based on these results it can be explained that the aspects of the preliminary activities and closing activities have been carried out properly. While the aspects of the STEM approach and physics material with the STEM approach have not been implemented properly.

4. Conclusion

Based on the analysis conducted it can be concluded that the analysis of learners obtains an average value of 63.43 with less categories, analysis of the use of teaching materials obtained an average value of 73.8 with less categories, and analysis of learning activities obtained an average value of 68.25 with less categories. Therefore, it is necessary to develop teaching materials and approaches that can support physics learning in the form of physics student books based on the STEM approach.

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