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Development of Integrated Science Teaching Materials on Energy and Environment Themes to Improve Reading Literacy and Numerical Ability

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Abstract: Integrated science learning is expected to be able to prepare students to have 21st century skills, especially literacy skills needed to meet the needs of these students. This research is motivated by the limited number of science teaching materials that are presented in an integrated manner with the theme of Energy and Environment. This study aims to test the feasibility of integrated science teaching materials for seventh grade junior high school students using the ADDIE method. This research was conducted in a private junior high school in Bandung. The instruments used are quality tests and tests of understanding of teaching materials. The validator tested the quality of teaching materials on 2 expert lecturers and 10 junior high school science teachers and the test of understanding the main ideas of the discourse was given to 26 students. The data analysis technique used descriptive statistics. The results of data analysis showed that the results of the quality test of teaching materials were 83.51% in the very feasible category and the results of the comprehension test of the main ideas of the discourse obtained 72.17% in the high category. The average quality test and understanding test obtained 77.84%. From this research, it can be concluded that the integrated science teaching materials are appropriate to be used as independent teaching materials that equip reading literacy skills and numeracy skills.

Keywords: science teaching material, reading literacy, numerical ability.

Abstrak: *Pembelajaran IPA terpadu diharapkan mampu mempersiapkan siswa untuk memiliki keterampilan abad 21, terutama keterampilan literasi yang diperlukan untuk memenuhi kebutuhan siswa tersebut. Penelitian ini dilatarbelakangi oleh terbatasnya bahan ajar IPA yang disajikan secara terpadu dengan tema Energi dan Lingkungan. Penelitian ini bertujuan untuk menguji kelayakan bahan ajar IPA terpadu siswa kelas VII SMP dengan menggunakan metode ADDIE. Penelitian ini dilakukan di salah satu SMP Swasta di Bandung. Instrumen yang digunakan adalah tes kualitas dan tes pemahaman bahan ajar. Validator menguji kualitas bahan ajar pada 2 orang dosen ahli dan 10 orang guru IPA SMP dan uji keterpahaman ide pokok wacana diberikan kepada 26 siswa. Teknik analisis data menggunakan statistik deskriptif. Hasil analisis data diperoleh hasil uji kualitas bahan ajar diperoleh 83,51% dalam kategori sangat layak dan hasil uji keterpahaman ide pokok wacana diperoleh 72,17 % dalam kategori tinggi. Rata-rata uji kualitas dan uji keterpahaman diperoleh 77,84%. Dari penelitian ini dapat disimpulkan bahwa bahan ajar IPA terpadu layak digunakan sebagai bahan ajar mandiri yang membekali keterampilan literasi membaca dan kemampuan numerasi.*

Kata kunci: *bahan ajar IPA, literasi membaca, kemampuan numerik.*

▪ INTRODUCTION

Education has a very important role to be improved and developed. Education aims to prepare students to be able to face life in the future. Education in the 21st century leads to learning that has a context that can be linked to real life (Asrizal et al., 2018). Education has a very important role to be improved and developed. Education

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aims to prepare students to be able to face life in the future. Education in the 21st century leads to learning that has a context that can be linked to real life (Asrizal et al., 2018). 21st century education is expected to be able to prepare students to have the skills needed in the future. In its development, technology and science play a role in various aspects of life (Ogunkola, 2014). Students need access to technology that can help their learning process (Chung et al., 2018). The importance of providing 21st century skill sets that student need to face every aspect of life (Soh, Arsad & Osman, 2010). The use of technology that supports learning needs to be prepared so that there is a good relationship and communication between students and teachers (Ersoy & Bozkurt, 2015). The Covid-19 condition that occurred is strong evidence that online learning is an opportunity where 21st century skills can be developed (Sournelis, Ioannou & Zaphiris, 2017). 21st century skills that students must possess need to be trained (Trilling & Fadel, 2009). Teachers should be able to equip students with the skills needed in the 21st century (Paige, 2016). One of the requirements for realizing 21st century skills is student literacy skills (Introduction, 2021). Integrated science learning is the right step in applying the nature of 21st century learning that encourages students to connect learning materials with real-world content (Asrizal et al., 2018). Teaching materials are part of the learning process and are in accordance with the needs of students (Setyasih, 2018). The existing teaching materials are not enough to make it easier for students to explore information in the learning process (Komalasari et al., 2019).

The impact of technological developments encourages teachers to prepare teaching materials that are able to support these developments (O'Neal, Gibson & Cotton, 2017). This also encourages teachers to create creative and effective learning, especially in preparing learning tools that support technological development (Ghavifekr & Rosdy, 2015). The themes used in the development of teaching materials are energy and the environment. The theme is taken because it relates to the real world where the concept is closely related to everyday life. The discussion of the themes in this teaching material is related to energy, the use of energy in the environment and the impact of energy on the environment. The teaching materials developed are oriented towards reading and numeracy skills. Reading literacy needs to be understood more deeply so that students have complete literacy competencies in addition to numeracy skills which also have a big role for students to master (Rahim & Suryani, 2022). Literacy is very important for students who can help students understand learning resources that can affect student learning success (RTI, 2014). Basic literacy skills need to be possessed by students (Clay, 2001). One of the teacher's efforts to improve the quality of learning is to develop teaching materials that suit the needs of students. In this case, the teacher acts as a learning designer that is adapted to the times and needs of students (Reigeluth et al., 2016). The important role of the teacher in creating extraordinary learning (Gracia & Morrell, 2013). This is also supported based on the results of previous research that there are still limited teaching materials that meet the needs of students (Bagus et al., 2022).

Teaching materials can provide opportunities for students to acquire knowledge and skills and can increase students' self-confidence (Olayinka, 2016). Students need to be equipped to have literacy skills to read and count in accordance with 21st century educational skills. These 21st century skills require students to be able to identify,

search, find, evaluate, and utilize the information they receive which is closely related to literacy. In fact, the teaching materials used in schools still use teaching materials in the form of textbooks. The limitations of teaching materials do occur in teaching materials for students. The teaching materials used by students are still in the form of 2013 curriculum textbooks published by the government. (Romadhoni, Sugiyanto, 2017). Science teaching materials developed are presented in an integrated manner. This is in line with the opinion of other researchers that science learning that is presented in an integrated manner will have a good influence on student achievement. Science learning that has been carried out so far is still taught separately between physics, biology and chemistry (Astiti et al., 2021). Preparation of teaching materials that are presented in an integrated manner to assist students in understanding the learning process. In combining teaching materials there are several ways according to student needs (Fogarty, 1991). Integration in science learning can help students better understand its application in everyday life (Afuwave, 2012).

The development of natural science (IPA) which continues to grow rapidly can encourage the world of education to make efforts so that students have literacy skills (Samsu et al., 2020). The most basic abilities that students need to have at a certain level include reading literacy skills and numeracy skills. This ability is in accordance with 21st century skills where students are able to keep up with the times (Perdana & Suswandari, 2021). According to Bellova in her research, the initial abilities possessed were quite good but the ability to understand and find ideas from a problem could not be utilized (Bellova et al., 2018). This shows that reading literacy skills need to be trained on students (Ikawati et al., 2013). Holbrook and Rannikmae argue that learning needs to be supported in the preparation of teaching materials that can improve students' scientific literacy skills. In addition to reading literacy, what needs to be improved is numeracy skills (Holbrook & Rannikmae, 2009). This is in line with previous research which argues that numeracy skills need to be developed properly because it has a good impact on a person's development and thinking problem solving abilities, but students still experience difficulties so it is necessary to develop interesting students to improve. numeracy skills (Haerudin, 2018).

Based on the existing problems, researchers are interested in developing teaching materials that can train reading and arithmetic literacy skills. The research questions are 1) How is the quality of integrated science teaching materials developed to equip reading and numeracy skills?; 2) How are the students' understanding of teaching materials developed to equip reading and numeracy skills? 3) What is the feasibility of developing teaching materials that equip reading and numeracy skills? For the purpose of this study to determine the feasibility of the developed teaching materials that equip reading and numeracy skills by designing the developed teaching materials. Based on the description above, it is necessary to develop integrated science teaching materials that can meet the needs of students. The teaching materials used are expected to be able to meet the learning objectives where the teaching materials are able to help students understand and find their knowledge independently. The contribution of researchers to the development of science learning through the design of making teaching materials.

▪ METHOD

The research method used is a type of development research. The development model used in this development is the ADDIE development model. The stages in the ADDIE model consist of analysis, design, development, implementation and evaluation (Ghirardini, 2011). The analysis stage is the initial stage in development which consists of needs analysis, student analysis and material analysis. At the design stage, the design of the teaching materials that will be developed begins. by studying teaching materials related to the theme of energy and the environment. The next stage is the development stage where the process of writing teaching materials begins to be prepared by combining topics and sub-topics using multiple representations based on the order of the material. At this stage, the feasibility test of the teaching materials developed includes a test of the quality of teaching materials and a test of understanding the main ideas of the discourse. In the next stage, the implementation stage where the developed teaching material products are then applied to schools. The final stage is the evaluation stage where the evaluation process is carried out continuously so that in the end the development gets perfect results. In this study, the purpose of the feasibility study is to find out the teaching materials developed are suitable for use by going through an understanding test and quality test of teaching materials so that students easily understand the teaching materials developed.

The development carried out in this research is the development of integrated science teaching materials with the theme of energy and the environment used to improve reading and arithmetic literacy skills. Integrated science teaching materials before being applied to students then go through several stages. This research is limited to the trial phase of the feasibility of teaching materials. The tests carried out in this study were in the form of a test of understanding of teaching materials given to students and a test of the quality of teaching materials to determine the feasibility of teaching materials to be used. For the place of testing carried out in one of the junior high schools in the city of Bandung. Data collection techniques using research instruments. The instrument used in this study was used to validate teaching materials to be developed using a test of understanding of teaching materials and a test of the quality of teaching materials in the form of a questionnaire. To test the quality of teaching materials, ten junior high school science teachers and two expert lecturers were given in the form of a questionnaire consisting of several aspects. The instrument used to test the quality of teaching materials is in the form of a questionnaire with a rating scale with intervals of 1 – 4.

The classification of the instrument for testing the quality of teaching materials is described as very appropriate, appropriate, not suitable. and very inappropriate which consists of 22 columns of questions and suggestions that must be completed so that researchers get input for the teaching materials developed. The teaching materials developed are oriented towards reading and numeracy skills. The science teacher and two expert lecturers were asked to fill out a questionnaire in accordance with the available statements which aim to see the level of quality of the teaching materials developed by the researcher. The next test was to see the understanding of the main ideas of the discourse that was tested on 26 students. The test instrument for understanding the main idea of the discourse includes writing the main idea, determining the supporting sentences for the main sentence, determining foreign words, and determining words that are difficult to understand in any given discourse (Sinaga et

al., 2014). The data obtained is then analyzed which is needed to produce a conclusion..

The data analysis technique was carried out quantitatively with descriptive statistics. Data analysis based on the results of the quality test of teaching materials aim to determine the characteristics of teaching materials from the aspect of the suitability of basic competencies and indicators, the suitability of writing content and grammar, as well as the suitability of student activities and content. The results of the validation test for the quality of teaching materials are then processed using the following formula:

$$\%X_{in} = \frac{\sum S}{S_{max}} \; x \; 100\%$$

Notes: $\%X_{in}$ is the percentage of respondents' answers to the questionnaire given, S is the number of answer scores and Smax is the maximum expected score (Sudjana, 2005)

In filling out the questionnaire for the content of the suitability aspect, four choices were assessed, namely SS (very suitable), S (appropriate), KS (less appropriate), and STS (very inappropriate). The score of each choice has a different value where SS = 4, S = 3, KS = 2 and TS = 1. The data obtained is converted into percentages and then interpreted by classification based on the quality criteria of teaching materials where the category is very feasible (81<X<100), feasible (61<X<80), quite feasible (41<X<60), less feasible (21<X<40), and not feasible (0 <X<20) (Arikunto, 2011)

The Discourse Understanding Test for its analysis uses the following formula:

$$K = \frac{Jb}{S}$$

Notes: K is understanding, Jb is the average number of students answering the main idea correctly and S is the number of students.

The data analysis of the understanding test results aims to determine the category of the level of understanding of the teaching materials developed. The data obtained from the results of the comprehension test were converted into percentages and then interpreted with a classification based on the understanding criteria where the categories were high (X > 60), Medium (40 < X 60) and low (0 < X 40) (Rankin & Culhane, 1969). The feasibility of developing energy and environmental themed teaching materials can improve reading and numeracy skills through measuring the quality of teaching materials and understanding of teaching materials. The results of the average quality of teaching materials and understanding of teaching materials indicate the feasibility of the developed teaching materials

▪ RESULT AND DISSCUSSION

The results of the study aim to answer research questions, namely developing and obtaining integrated science teaching materials which are what students need to improve reading and numeracy literacy skills by developing and testing the quality of teaching materials. Integrated science teaching materials with the theme of energy and the environment are described in 3 sub-themes, namely energy, energy use in the environment and the impact of energy on the environment. Instruments for understanding teaching materials In the validation stage, which was carried out by testing the validity of the quality of teaching materials to 10 junior high school science

teachers and two expert lecturers who understood the needs of students in the field. So that the validator is considered feasible to assess the quality of the teaching materials developed in this study. The following are the results of the validation assessment of two expert lecturers in Figure 1

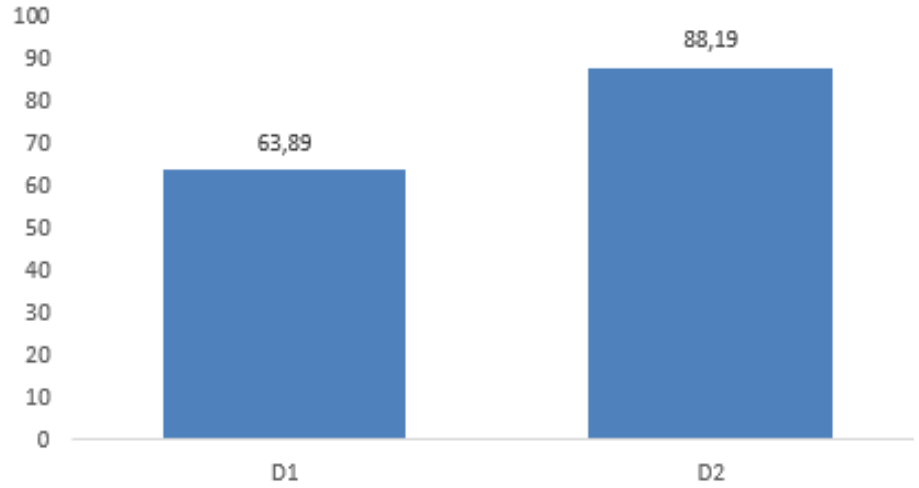

Figure 1. The results of validation of the quality of teaching materials by two expert lecturers

Figure 1 shows the results of the assessment of the quality of teaching materials by two expert lecturers, so the teaching materials developed have a decent quality with an average percentage of 76.04%. In the validation process of the quality test of teaching materials in the form of a questionnaire given, expert lecturers are asked to provide comments as input to the developed teaching materials so that they can improve the developed teaching materials.

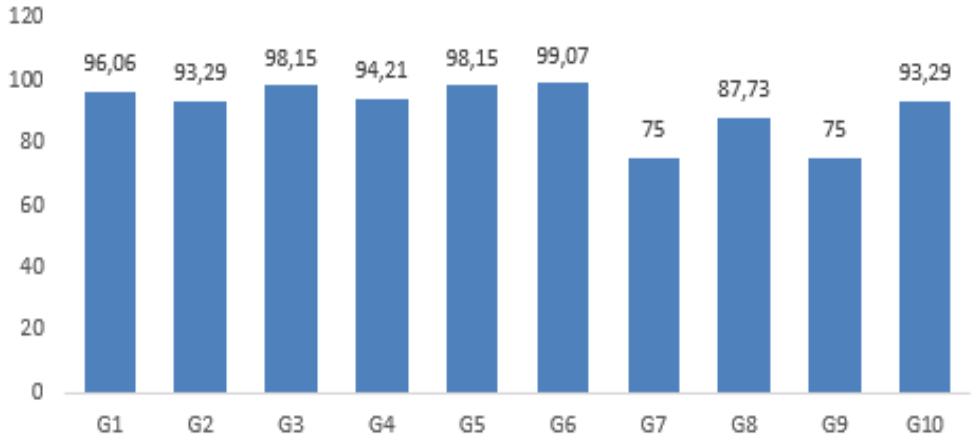

Figure 2. The results of the validation of the quality of teaching materials by 10 junior high school science teachers

Judging from the results of the assessment of the quality of teaching materials presented in Figure 2 of 10 science teachers gave an assessment that the teaching materials developed had a very decent category with an average percentage of 90.99%. To test the quality of teaching materials, the teacher does not forget to provide input to improve the teaching materials developed. The data analysis technique of the average quality test of teaching materials developed based on 22 statements in the form of a questionnaire obtained from two expert lecturers and 10 science teachers was converted in the form of a percentage of the quality of teaching materials obtained by 83.51%.

The teaching materials developed need to have a sentence structure that can be understood by students. The steps taken to determine the understanding of the discourse used in teaching materials are then carried out a discourse understanding test. The instrument for testing the understanding of teaching materials uses a test consisting of aspects of the main idea and details supporting the main ideas contained in the given discourse. There are 24 discourses given. The following are the results of the discourse understanding test presented in Figure 3. Based on Figure 3, the results of the discourse understanding test on the developed integrated science teaching materials show an average percentage of 72.17%. There are 22 discourses in the high understanding category in this teaching material and 2 discourses in the medium category. Thus, the integrated science teaching materials developed have high understanding.

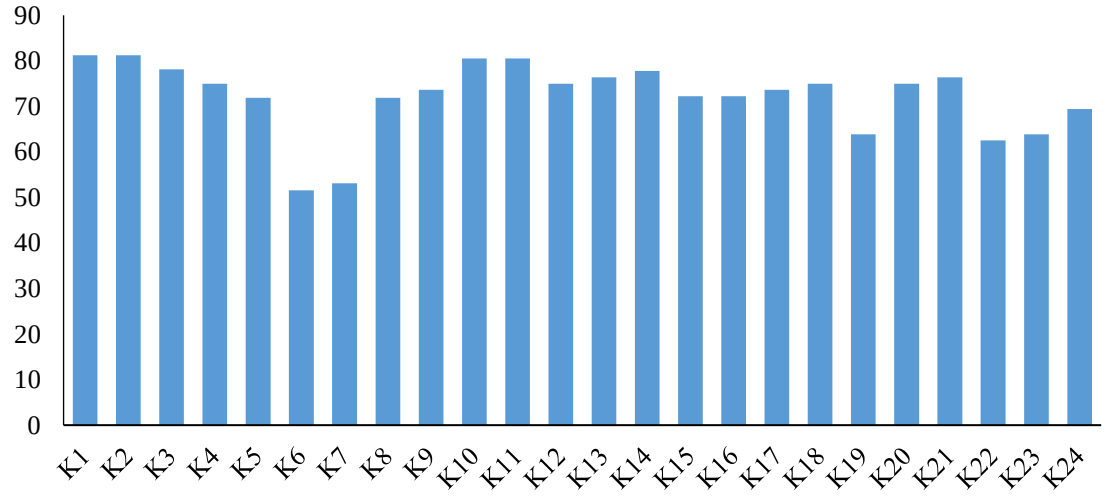

Figure 3. Discourse understanding test results

Previous research has shown that teaching materials are very important in the learning process (Sephania et al., 2017). The development of teaching materials with the theme of energy and the environment must refer to the basic competencies used because they are related to the learning process carried out. In fact, basic competencies at the same grade level are still arranged separately, so it is necessary to develop teaching materials that present learning as a whole so that it can make it easier for students to understand teaching materials. The use of teaching materials in learning can help students to participate actively in learning (Akani, 2016). In the development of these teaching materials the combination of text, images, tables and diagrams is expected to motivate students in understanding learning so that students are more active in the

learning process in class. The teacher's role in facilitating and guiding students to learn independently can create creative learning (Boholono, 2017). Student-centered learning encourages students to construct their own knowledge (Child, 2016). The importance of prepared teaching materials so that they can encourage more interactive learning (Parvin & Salam, 2015). According to the Ministry of National Education, it is of the opinion that a teaching material has one component of the assessment of teaching materials, namely the linguistic aspect which includes sentence legibility, information clarity, conformity with good and correct Indonesian language rules. Based on the results of the quality test and the test of understanding of teaching materials, the average results of these two results were 77.84% and then interpreted in the appropriate category, teaching materials developed to equip reading and arithmetic skills were in the appropriate category.

▪ CONCLUSION

Based on the results of the study, it can be concluded that through the process of testing the quality and testing the understanding of teaching materials developed to equip reading and numeracy literacy skills in the category suitable for use by students to help students understand the material being taught and can help students learn independently. The teaching materials developed are recommended for science teachers at the junior high school level. The limitation of this research is that students are not accustomed to using teaching materials that are presented in an integrated manner so they need assistance. Finally, this research can be followed up for further research by exploring other influences in order to be able to develop teaching materials that can equip reading and numeracy literacy skills.

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