



RESEARCH ARTICLE

EFFECTIVENESS OF TEXTBOOK WITH BRAIN-BASED LEARNING APPROACH ACCOMPANIED BY A QUESTION CARD GAME IN HUMAN RESPIRATORY SYSTEM TO IMPROVE PROBLEM SOLVING ABILITY

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Manuscript Info

Manuscript History

Received: 01 April 2020

Final Accepted: 05 May 2020

Published: June 2020

Keywords:-

Science Textbook, Problem-Solving Ability, Brain-Based Learning, Human Respiratory System

Abstract

Fun textbook is able to make students become not bored when participating in learning activities so that learning outcomes can be improved. This research aims to examine the effectiveness of textbook with a brain-based learning approach to students' problem-solving abilities. This research design used was one-shot case study, with two meetings in two different schools, namely SMPN 1 Tanggul and SMPN 5 Jember, Indonesia. Data was obtained from worksheet values of problem-solving ability. The results showed that there was an increase in the average value of students' problem-solving abilities from the schools. The average score in SMPN 1 Tanggul at first meeting was 74 and second meeting was 80.7 with good criteria. Furthermore, the average score in SMPN 5 Jember at first meeting was 71.6 and second meeting was 80.2 with good criteria. So, it can be concluded that the textbook with brain-based learning approaches are effective in improving problem-solving abilities of junior high school students.

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Introduction:-

In the 21st-century learning, there are four kinds of competencies, namely critical thinking and problem solving, communication, collaboration, creativity and innovation (Scott, 2015; Rochmawati et al., 2020). These four competencies can be mastered if students use textbooks that are able to train students to solve surrounding problems (Acedo & Hughes, 2014). The use of printed textbooks is a component that can not be separated from teaching and learning activities. Printed textbooks have several advantages including being easy to read wherever and whenever without being affected by the signal and do not require tools to use (Alexander and Singer, 2017; Ross et al., 2017; Engbrecht, 2018).

However, science textbooks used by junior high school students in Indonesia currently do not have fun features, such as games that have advantages in solving problems in the surrounding environment. This is based on the results of student questionnaire needs given to 59 junior high school students in Jember Regency which stated that 83.1% of students felt the textbooks used as material explanations were still abstract, lacked examples in the surrounding environment, and lack of features that we're able to make learning activities fun, so student become bored and have difficulty understanding the material being taught. Science learning currently requires students to actively do scientific work and discuss solutions to problems in the surrounding environment (Syahroniet al., 2016). Problem solving ability is one of the competencies in 21st-century learning. Students who have good problem-solving abilities can help students improve their intellectual abilities, ability to work together, and social attitudes of students (Nurita et al., 2017). One of the natural science learning material is the material of the human respiratory system. This material is classified as material that is difficult for junior high school

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students to understand. This is proven by research conducted by Tekkayaet al., (2001) of 30 students with the results of 22 students feeling the material of the human respiratory system is a complex and difficult to understand the material with a percentage of perception of the difficulty level the material was 17.4%.

In this research, the results of the teacher’s questionnaire given to 14 junior high school science teachers in the Besuki Residency showed that 64.3% of teachers felt the textbooks used lacked examples of the questions given in the textbooks that did not train students’ problemsolving abilities and lacked there are features that can make learning activities fun. This is because 57.1% of teachers do not know about the brain-based learning approach, so 41.9% of students have an average score below 70.

The brain-based learning approach is an approach that is oriented to the workings of students’ brains naturally (Caine and Caine, 1994; Prihatinet al., 2017; Prihatinet al., 2019). In addition, the brain-based learning approach connects learning with music involvement and body movements that make students’ brains work optimal (Thomas and Swamy, 2014). Meanwhile, the brain-based learning approach in its application does not always use the rote method, so students can apply learning styles that are suitable to their brain’s work abilities (Uzezi and Jonah, 2017). One technique used in the brain-based learning approach is the question card game. A question card game is a type of card game that aims to train students in solving problems that exist in the surrounding environment (Mardikaret al., 2013). Furthermore, the use of this game can make students learn the material in a fun way without them realizing that they are studying abstract material and are considered difficult.

The selection of media that is easy to apply, informative, and communicative is a solution to problems in learning activities (Fihidayatet al., 2019), such as students’ problem-solving abilities. One of the learning media that can be used is a textbook with a brain-based learning approach accompanied by a question card game. Therefore, this research aims to examine the effectiveness of textbooks using a brain-based learning approach accompanied by a question card game on human respiratory system material on students’ problem-solving abilities.

Research Method:-

The research design used was one-shot case study with performance test of problem-solving abilities. The subjects of the research consisted of 2 schools in which 58 students participated in the research; 29 students of VII A SMP Negeri 1 Tanggul and 29 students of VII E SMP Negeri 5 Jember. The assessment of problem-solving abilities was obtained from the assessment result of problem-solving abilities worksheet that was discussed in group for 15 minutes. The production of the worksheet was done by the teacher and it consisted of 6 problem solving questions in which the students did 3 questions for each meeting. The questions were integrated into the textbook with Brain-based Learning on the feature of question card. The assessment of problem-solving abilities was done in two meetings. The questions of problem solving were given in each meeting and the results were analyzed by using measurement method of problem-solving abilities to determine the score criteria of the students’ problem-solving abilities (formula 1). The assessment of each indicator used 5-point of semantic different scale. The score criteria of problem-solving abilities can be seen in Table 1.

$$P = \frac{\Sigma achievedscore}{maximumscore} \times 100 \dots\dots\dots (1)$$

Table 1:- The criteria of Students’ Problem Solving Abilities.

Problem Solving Abilities	Criteria
84 ≤ x < 100	Very Good
68 ≤ x < 84	Good
52 ≤ x < 68	Fair
36 ≤ x < 52	Poor
20 ≤ x < 36	Very Poor



(Source: Laksanaet al., 2019 with modification)

In this research, there are 4 indicators of problem-solving abilities used namely understanding the problem, compiling the completion plan, implementing the plan, and reviewing the process and result. The criteria of each indicator of problem-solving abilities can be seen in Table 2. Then, the example of problem-solving abilities question can be seen in Table 3.

Table 2:-The indicators of Students’ Problem Solving Abilities

Indicators	Score criteria of each indicator				
	1	2	3	4	5
Understanding the problem	Answering the problem incorrectly	Answering the problem less correctly	Mention the occurrence of the problem	Answering correctly but not understandable	Answering correctly, clearly and understandable
Compiling the completion plan	Making a question but not in line with the problem	Make a question but less in line with the problem	Making one right question	Making two right questions	Make more than two right questions
Implementing the plan	Solution is not in line with the problem	Solution less in line with the problem	Provide one right solution	Provide two right solutions	Provide more than two right solutions
Reviewing the process and result	Does not make conclusions	Conclusion does not match the problem	The conclusion contains only solutions without describing the problems and its causes	Conclusions contain problems and solutions but the causes are not elaborated	The conclusion contains a description of the problem, causes, and solutions

Table 3:- The Example of Questions of Students’ Problem Solving Abilities.

Meeting 1	Meeting 2
	
What kind of breathing is used by a running athlete? (Source: republika.co.id)	Why are Bajau people able to dive in the water for a long time without using breathing aids? (Source: tribunews.com)
	
Which one is better, breathing through the nose or through the mouth? (Source: health.detik.com)	Why can someone lose his voice? (Source: radarpekalongan.co.id)

Result and Discussion:-

The result of problem-solving abilities was obtained from the assessment of problem-solving abilities worksheet which was discussed in group. The assessment was done of 58 students in which 29 students from SMP Negeri 1 Tanggul and 29 students from SMP Negeri 5 Jember. Each class were divided into 5 groups. The display of the question card including the answer sheet can be seen in Figure 1, while the result of the research regarding the problem-solving abilities can be seen in Figure 2.

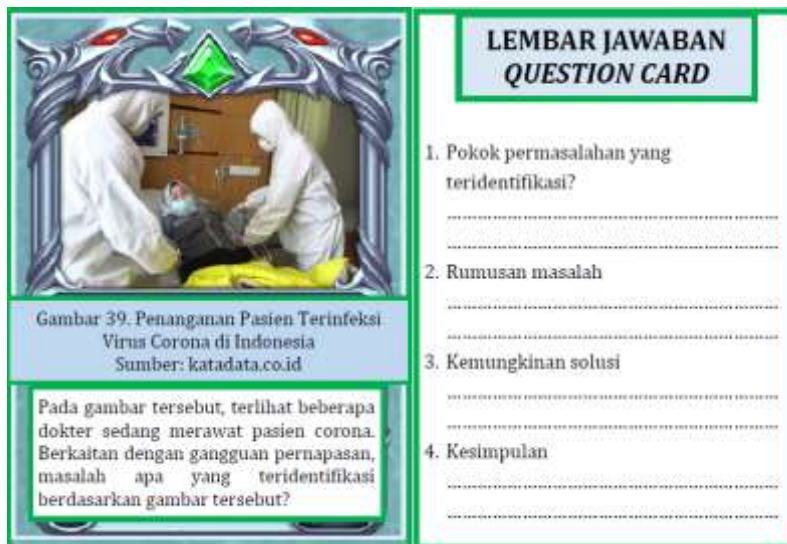


Figure 1:-The Display of Question Card including the Answer Sheet.

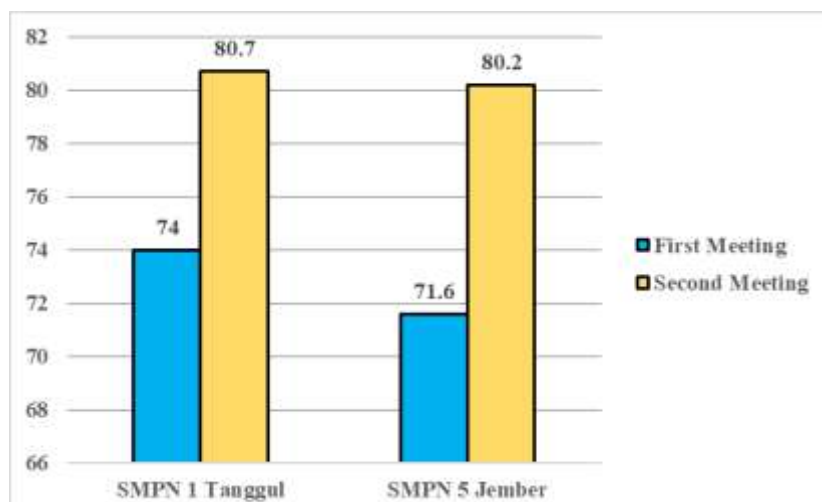


Figure 2:-The Assessment Result of Problem-Solving Abilities.

Figure 2 shows that the average assessment of problem-solving abilities increased. The mean score at SMPN 1 Tanggul in the first meeting was 74 with category of good while in the second meeting was 80.7 with the same category as the first meeting. Besides, the mean score at SMPN 5 Jember in the first meeting was 71.6 with category of good while in the second meeting was 80.2 with the same category as the first meeting. The results showed that the textbook with Brain-based Learning approach attached with question card game in Human Respiratory System material was effective to improve the students' problem-solving abilities. The assessment result of each indicator of problem-solving abilities can be seen in Table 4.

Table 4:-The Assessment of Problem Solving Ability.

No.	Indicator	SMPN 1 Tanggul		SMPN 5 Jember	
		Meeting I	Meeting II	Meeting I	Meeting II
1.	Understanding the problem	71.7	83.4	79.3	75.9
2.	Compiling the completion plan	64.1	71	71.7	72.4
3.	Implementing the plan	71.7	80	67.6	84.1
4.	Rereviewing the process and result	88.3	88.3	67.6	88.3
Mean Scores		74	80.7	71.6	80.2
Standard Deviation		8.9	5.8	7.3	4.5
Criteria		Good	Good	Good	Good

As it is shown on Table 4, the mean scores on each indicator of problem solving ability increased. The mean scores of each indicator at SMPN 1 Tanggul obtained in the first meeting were 71.7, 64.1, 71.7, and 88.3 with 8.9 as its standard deviation. In the second meeting, the mean scores gained were 83.4, 71, 80, and 88.3 respectively with 5.8 as its standard deviation. Moreover, the mean scores acquired at SMPN 5 Jember in the first meeting were 79.3, 71.7, 67.6, and 67.6 with 7.3 as its standard deviation. Whilst the mean scores gained in the second meeting were 75.9, 72.4, 84.1, and 88.3 respectively with 4.5 as its standard deviation. The values of standard deviation in the second meeting at the two schools became lower. It revealed that the sample data used were more homogeneous or almost the same with the mean scores.

The increase on each indicator revealed that the indicator of understanding the problem at SMPN 1 Tanggul increased as much as 11.7 points, the indicator of compiling the completion plan increased as much as 6.9 points, the indicator of implementing the plan increased as much as 8.3 points, the indicator of reviewing the process and result did not gain any increase. While at SMPN 5 Jember, the indicator of understanding the problem had a decrease as much as 3.4 points, the indicator of compiling the completion plan had an increase as much as 0.7 points, the indicator of implementing the plan showed an increase as much as 16.5 points, and the indicator of reviewing the process and the result raised as much as 20.7 points. The lowest mean score found on the indicator of compiling the completion plan was 64.1 under the “fair”. The highest mean score obtained on the the indicator of reviewing the process and the result was 88.3 under “very good” criteria. These results pointed out that the textbook with Brain-based Learning accompanied by the question card game were proven to be effective in improving the students' problem solving abilities.

Discussion:-

According to the research results at 2 schools, the implementation of textbook with Brain-based Learning approach accompanied by the question card on the human respiratory system material was effective to improve the students' problem solving abilities. It was due to the results of the research shown on Table 4 in which there was an increase in the value of problem solving abilities at two schools in which, the mean scores obtained at SMP Negeri 1 Tanggul in the first meeting was 74 and there was an increase in the second meeting as much as 80.7 under “good” criteria. Moreover, the increase on the mean score found at SMP Negeri 5 Jember in the first meeting was 71.6 and there was also an increase in the second meeting as much as 80.2 under “good” criteria. The textbook containing the characteristics of Brain-based Learning approach was able to make the learning activities fun, so that the students found it more meaningful (Lidiastutiet al., 2019). It was due to the textbook provided with some features which were adapted to 12 principles of Brain-based Learning such as the existence of brain gym, alpha music, and learning videos which were linked to the barcode facilities. The features on the textbook were adapted to the students' different learning styles of auditory, visual and kinesthetic. The students who had known their own learning style made the teachers easier in delivering the learning material, so that the students put more active participation during learning (Mertha et al., 2019). The features on the textbook suited the students' student learning styles are seen on Figure 3 to Figure 5.



Figure3:-Visual Learning Style (Watching the Learning Video)



Figure4:-Auditory Learning Style (Listening to Music)



Figure5:-Kinesthetic Learning Style (Doing the Brain Gym Movement)

The figure showed at the beginning discussion of human respiratory system material was related to Brain-based learning approach in which learning involved both the conscious and unconscious processes. The use of interesting pictures were able to facilitate the students in understanding the abstract material. Besides, pictures were also able to give the stimulation on the students' thinking process and help them in understanding the concept correctly (Shabiralyaniet al., 2015; Stefanikova and Prokop, 2015; Sutarto et al., 2018). The use of features on the textbooks with Brain-based Learning approach was able to optimize the right and left brain at the same time. The functional structures of left brain affected on the skills of language, analytic, logic, science, and mathematics while the right brain gave the effect on the imagination, intuition, music, images, creativity, and emotions (Nielsen et al., 2013; Corballis et al., 2014). The features of interesting pictures, music, brain gym movements were used to optimize the students' right brain while the feature of

question card containing the problems were useful to optimize the left brain. Besides the feature of interesting pictures, there was also brain gym. Brain gym was done by using several movements along with the music which was often listened by students. The brain gym movement balanced the works of the students' right brain and left brain, so that they were able to concentrate during their participation in learning activities (Watson and Ginger, 2014; Handayani et al., 2018).

Material of human respiratory system discusses about human respiratory organs, mechanism of human respiratory, volume of human respiratory, and disorders that attack human respiratory system. The explanation of the material mostly related to the problems that exist around students who need to find a solution. In this research, students in groups were assigned to find solutions to problems related to human respiratory system. One example of problem-solving questions at the first meeting, one of which was *"Which one is better, breathing through the nose or through the mouth?"*. From this problem, in average, students answered correctly, which is better to breathe through the nose because in the nose there are several filter organs that are able to filter out dust and dirt that enter along with the air. However, the average of students answered that in the nose organ there is only nose hair without them knowing that inside the nose there are also mucous membranes and konka. This is in accordance with the statement of Saravana (2017) who stated that breathing through the nose can help us eliminate allergens and microbes in the air. Furthermore, the air is trapped by the mucous membrane and is likened to the temperature by the konka which contains a lot of blood capillaries.

Next, an example of a problem-solving questions at the second meeting was *"Why can someone lose her voice?"*. The results showed that the average of students were able to answer this problem correctly, which is caused by the use of excessive voice, causing the vocal cords to swell and the voices gradually disappear. However, the students did not know the name of the disease that causes loss of voice. Thomas et al., (2017) stated that inflammation of the larynx is called laryngitis. This disease is caused by mechanical irritation such as excessive use of sound or it can also be caused by a bacterial infection. The material of human respiratory system was classified as material that was difficult for students to understand because the description of the material was abstract, so it made students easily got bored in learning. Therefore, a question card game was needed so that students became enthusiastic and practiced their problem-solving abilities. The question card contained problems related to the material of the human respiratory system in the form of questions that trained students' problem-solving abilities (Mardikar et al., 2013). The question card game is related to one of the principles of Brain-based Learning, which is the search for meaning is innate. The use of this game was able to encourage students to actively look for possible suitable solutions and discussed with classmates to solve the problems given (Su et al., 2014). In addition, students who have been trained to get used to solve a problem will be more able to survive when faced with problems in the surrounding environment. The results of this research were in line with research conducted by Purwati et al., (2017) which stated that the use of question card games led students to find solutions or proof of a problem around them.

Furthermore, the results of the research on Table 4 also discussed the assessment of each indicator of problem solving. Table 4 shows that the average assessment of each indicator conducted at the 2 schools showed an increase at each meeting. The lowest average result of the two schools was in the indicator of "compiling the completion plan" with a value of 64.1 and was in good enough criteria. This was because students had difficulty in making problem formulation for more than two questions. In average, students were only able to make a maximum of 2 questions from the given problem. This showed that at the first meeting students were not accustomed to make questions that led to the suitable solution. The highest average result was in the indicator of "reviewing the process and result" with a value of 88.3 and was in a "very good" criteria. The result indicated that students did not find it difficult to make conclusions based on solutions that had been found. In general, the research results indicated that textbook with a Brain-based Learning approach accompanied by question card on the material of human respiratory system were effective in improving the problem-solving abilities of junior high school students.

Conclusion:-

Based on the presentation of the results and discussion, it showed that there was an increase in the average score of the problem-solving ability of the two schools studied after participating in learning using textbook with a Brain-based Learning approach accompanied by question card on the material of human respiratory system. This can be seen from the average value of the ability of problem solving conducted for two meetings at SMPN 1 Tanggul with an average value of 74 at the first meeting and increased at the second meeting as much as 80.7 with good criteria. The same result also happened in SMPN 5 Jember with an average value at the first meeting of 71.6 and an increased at the second meeting of 80.2 with good criteria. So, it can be concluded that textbook with Brain-based Learning approach accompanied by a question card game on the material of human respiratory system was effective in improving students' problem-solving abilities.

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