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Problem Based Learning Model Assisted by PhET Interactive Simulation Improves Critical Thinking Skills of Elementary School Students

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ABSTRAK

Permasalahan yang dihadapi siswa adalah kesulitan dalam memahami soal dan tidak memiliki kemampuan yang cukup untuk mengerjakan soal baru yang diberikan oleh guru. Tujuan penelitian ini yaitu menganalisis pengaruh model Problem-based Learning berbantuan aplikasi phET Terhadap materi pembelajaran listrik. Jenis penelitian ini yaitu ekeperimen semu. Populasi penelitian berjumlah 192 siswa. Jumlah total sampel yaitu 35 orang siswa. Metode untuk mendapatkan data yakni dengan metode tes uraian. Instumen yang digunakan berupa tes uraian. Teknik analisis data yaitu analisis statistic deskriptif kualitatif, kuantitatif dan inferensial. Hasil penelitian yaitu hasil Uji-t yang memperoleh t-hitung = 52,07 lebih besar dari t-tabel = 2,034, sehingga terdapat perbedaan kemampuan berpikir kritis yang signifikan antara siswa yang menggunakan model konvensional dengan siswa yang dibelajarkan menggunakan model Problem-based Learning berbantuan aplikasi PhET materi listrik kelas VI SD. Disimpulkan Problem-based Learning berbantuan aplikasi PhET dapat meningkatkan kemampuan berpikir kritis siswa kelas empat sekolah dasar pada materi listrik. Implikasi penelitian ini Problem-based Learning dapat digunakan dalam meningkatkan kemampuan berpikir kritis.

ABSTRACT

The problems faced by students are difficulties in understanding the questions and not having sufficient ability to work on new questions given by the teacher. The purpose of this study is to analyze the effect of the Problem Based Learning model assisted by the phET application on electricity learning materials. This type of research is quasi-experimental. The research population totaled 192 students. The total number of samples is 35 students. The method for obtaining data is the description test method. The instrument used is a description test. The data analysis technique is descriptive qualitative, quantitative and inferential statistical analysis. The results of the study are the results of the t-test which obtain t-count = 52.07 greater than t-table = 2.034, so that there is a significant difference in critical thinking ability between students who use the conventional model and students who are taught using the Problem-based Learning model assisted by the application of PhET material for class VI elementary school electricity. It was concluded that Problem-based Learning assisted by the PhET application could improve the critical thinking ability of fourth grade elementary school students in electricity material. The implication of this research is that Problem-based Learning can be used to improve critical thinking ability.

1. INTRODUCTION

Science learning has a goal to supposed students are able to apply knowledge (Baumfalk et al., 2019; Kusumayuni & Agung, 2021; Subali et al., 2019). Science learning requires students to be active, has the effect of increasing thinking skills so that students can identify knowledge well (Jampel et al., 2018; Lo et al., 2021; Zulherman et al., 2021). In learning activities the teacher is obliged to provide opportunities for

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students to use their skills such as finding, searching, concluding and communicating the knowledge gained while participating in science learning (Anif et al., 2020; Lai et al., 2019; Sasono et al., 2017). Science learning must be done by relating science to real life to make it meaningful. Apart from that, in learning students are also given the opportunity to ask a question and build curiosity about the environment, so that it can build student skills and raise awareness that science learning is very necessary (Arisantiani et al., 2017; Wijanarko, 2017; Y. Wulandari et al., 2020). Science learning in elementary schools is also required to equip students to face challenges (Astalini et al., 2018; Kurniawan et al., 2018). Science learning needs to apply constructivism learning theory. Learning that applies this theory can make students able to think in solving a problem to get an idea to make a decision (Dewi et al., 2018; Subali et al., 2019). Therefore by science learning process, elementary school students can also develop critical thinking skills.

Critical thinking skills must be accustomed in learning process in order to make it easier for students to participate in learning activities in class (Sa'adah et al., 2019; Widyaningsih et al., 2020). Precticing students in critical thinking also are able to train students' decisions making and be able to provide good and correct problem solving (Andoko, 2020; Dahlan et al., 2020). The ability to think critically is a way of utilizing the mind (Afrita & Darussyamsu, 2020; Hamdi et al., 2018). Students who have this ability are certainly able to identify material properly and correctly. In the revised bloom taxonomy, critical thinking ability includes C4 analysis so that this ability is seen as very important for students to have (Ani Rahmawati, Nur Lailatin Nisfah, 2019; Pratiwi, 2017). Students who have critical thinking skills can analyze the information obtained correctly so that they are able to solve problems properly (Gunada et al., 2021; Hamidah & Wulandari, 2021; Nurmala & Mucti, 2019; Prastikawati et al., 2021). Students who have abilities at this level will have critical and thorough thinking patterns, so they can make the right decisions.

But the problem that currently occurs is that students have difficulty understanding the questions and students are not yet skilled in working on new questions given by the teacher (Prastikawati et al., 2021; Sa'adah et al., 2019). Students who have difficulty in learning science lead to low students' critical thinking skills (Fadzam & Rokhimawan, 2020; Sidiq et al., 2021). The low ability of students' critical thinking is due to the fact that in delivering learning material the teacher tends to only explain so that students are passive (Acesta, 2020; Astra et al., 2020). Based on the observations result, found that science learning especially in the subject of electricity, students had difficulty learning. This is because the teacher-center so that students become passive. Lack of media also affects ability. The lack of learning media facilities causes students difficulties in understanding learning material. The provision of critical thinking ability skills training is still rarely applied by teachers. Test results regarding the hot ability of grade 4 students also showed that 57% of the 22 students did not complete. This confirms that the ability of critical thinking ability is low.

The solution to improve critical thinking skills in elementary school students is to apply Problem-based Learning with the help of the PhET application. Problem-based Learning is a model to make students active in learning (Hotimah, 2020; Suryawati et al., 2020). This model challenges students to solve a problem from the real world (Haji et al., 2015; Nurlaily et al., 2019). Problems from the teacher regarding the problems to be solved make students think in solving a problem (Hendriana et al., 2018; Kamid et al., 2021). Problem-based learning is an ideal learning model applied in science learning (Suryawati et al., 2020; Tanti et al., 2021). Broad science topics directed at scientific activities are expected that students can contribute to learning activities based on everyday experiences. The syntax of this learning model is to orient students towards problems, guide students in investigating problems (Devi & Bayu, 2020; Nuswowati et al., 2017). In addition, the use of media can help students (Arisantiani et al., 2017; Jazuli et al., 2018; Wati & Widiansyah, 2020). PhET simulation connects real phenomena and feedback in learning activities (Darmawan & Dwijayati, 2019; Ekawati et al., 2015). PhET simulations can make learning activities interesting because they can provide learning and playing experiences for students (Alam et al., 2021; Masruroh et al., 2020). Learning activities with PhET will certainly make students interested in doing practicum. The use of phet simulation in learning that leads to questions so as to make its application interactive.

Good media can help students (Fuadati & Wilujeng, 2019; Y. Wulandari et al., 2020). Problem-based Learning increases activity (Kamid et al., 2021; Sitompul, 2021; Tanti et al., 2021). Problem-based Learning improves student learning outcomes significantly (Pramestika et al., 2020; Rozhana & Harnanik, 2019; Saputra et al., 2019). There is no research study on the Problem-based Learning learning model assisted by the PhET application on electricity material on the critical thinking ability of 4th grade elementary school students. The advantage of this research is that the PhET simulation design that will be developed can be used to test students' ideas in series and parallel electrical device activities. This will certainly help students in learning science. The purpose of this study is to analyze the effect of the Problem-based Learning learning model assisted by the phET application on electricity learning materials.

2. METHOD

This type of research is quasi-experimental. The population is all groups of class VI students in Cluster V, Sukasada District, totaling 192 students. The sample selection technique used in this study was simple random sampling technique. the number of samples used were 21 students (SDN 5 Panji) and 14 students (SDN 2 Sambangan). The method of getting that is by the description test method. The instrument used is in the form of a description test in which the preparation applies the revised bloom taxonomy, namely C4 (analyze) and C5 (evaluate), the grid is presented in Table 1.

Table 1. Gride of Science Critical Thinking Ability Instrument for Class VI Elementary School Students

Indicator	Cognitive Dimension	Question Number	Number of Questions
3.4.1 Analyze the characteristics of electrical circuits	C4	1,2	2
3.4.2 Find the pros	C4	3,4	2
3.4.3 Find flaws	C4	5.6	2
3.4.4 Associate the use of parallel electrical circuits	C4	7,9	2
3.4.5 Linking the use of series electrical circuits	C4	8	1
3.4.6 Project future events	C5	10	1
Total Questions			**10**

In the content validity test carried out by applying the Gregory formula. The content validity coefficient on the students' critical thinking ability assessment instrument is in the range of 1.00 (very high). The technique of analyzing the data is descriptive qualitative, quantitative and inferential statistical analysis.

3. RESULT AND DISCUSSION

Result

The experimental class was given treatment by applying Problem-based Learning to 21 students. In order to obtain data on the Critical Thinking Ability of sixth grade elementary school students in the experimental class, a post-test was carried out. The results of data analysis showed that the highest score was 90 and the lowest score was 54. From these calculations, the average (mean) was 72.29. The calculation results show that the variance (S2) is 130.11 and the standard deviation (S) is 11.41. After obtaining the average, variance and standard deviation will be converted with a PAP scale of 5. The data to be converted is the average value data for the experimental group's critical thinking ability of 72.29, so that the critical thinking skills of the sixth grade elementary school students in the experimental group are categorized as sufficient.

In the control class, 14 students were given the conventional model treatment. In order to obtain data on the critical thinking ability of class VI students, it is necessary to give a post-test. After that, the result was that the highest score was 58 and the lowest was 30. Based on these calculations, the average value was 41.57, the variance (S) was 96.73 and the standard deviation (S) was 9.84. The average value, variance, and the standard deviation in the control group will be converted with a PAP scale of 5. The converted data is the average value of the control group which is equal to 41.57, so that the critical thinking skills of class VI elementary school students in the group are categorized as sufficient.

Based on the results of calculations using the Liliefors formula, the result is that the fcount score for the critical thinking skills of class VI students in the experimental group is 0.145, while the ftable at the 5% significance level is 0.19. So the data on students' critical thinking skills in the experimental group is normally distributed. Then, the fcount score of students' Critical Thinking Ability in the control group is 0.143, while the ftable at the 5% significance level is 0.2. Then the control group is normally distributed. Based on the homogeneity test, fcount <ftable, the data is homogeneous.

This study obtained the results of significant differences in critical thinking skills between the experimental class and the control class group. This study is based on the results of the t-test which obtains tcount = 52.07 greater than ttable = 2.034. This shows that there is a significant difference in Critical Thinking Ability between students who use the conventional model and students who are taught using Problem-based Learning assisted by the PhET application on electricity material for grade VI elementary school. It was concluded that Problem-based Learning assisted by the PhET application could improve students' critical thinking ability in electricity material.

Discussion

PhET application-assisted Problem-based Learning enhances critical thinking ability. First, the Problem-based Learning model assisted by the PhET application is feasible because it makes learning activities fun. In the application of the Problem-based Learning learning model assisted by the PhET application, the learning activities and class atmosphere look conducive. Learning activities by giving problems to students make students more enthusiastic. Problem-based Learning can improve student learning atmosphere (Aslan, 2021; Culclasure et al., 2019; Lin, 2015; Waite et al., 2020). In addition, giving real problems related to learning materials also causes students to be more enthusiastic about learning (Hendriana et al., 2018; Mertasari & Ganing, 2021; A. Wulandari & Suparno, 2020). In addition, students who are enthusiastic in solving problems in groups so that learning activities become fun too. Group learning activities create a fun atmosphere (Hadi & Ibnu, 2015; Magta et al., 2019; Rosnaeni et al., 2018). Problem-based Learning can also make students active in learning (Hotimah, 2020; Suryawati et al., 2020).

Second, the Problem-based Learning model assisted by the PhET application is feasible because it can improve students' critical thinking skills. The Problem-based Learning learning model assisted by the PhET application is systematic and student-centered learning activities. This makes it easier for students to understand learning material (Juliawan et al., 2017; Nurtanto et al., 2019; Priani et al., 2019). The teacher's task is only to guide students so that they have good critical thinking skills because the problem solving process is well organized (Hamdi et al., 2018; Hamidah & Wulandari, 2021; Nugraheni et al., 2021; Widana, 2017). There are differences in treatment when delivering a material which is a factor causing differences in the ability of critical thinking ability in students (Anisah & Lastuti, 2018; Destiniar et al., 2020). This Problem-based Learning learning model also facilitates learning activities because students are required to use high-level skills. Problems related to problems that must be solved so that students think in solving a problem. Problem-based Learning can also trigger students' curiosity (Hendriana et al., 2018; Kamid et al., 2021).

Third, the Problem-based Learning model assisted by the PhET application is feasible because the media used helps students learn (Arisantiani et al., 2017; Jazuli et al., 2018; Wati & Widiansyah, 2020). PhET simulations can make learning activities interesting because they can provide learning and playing experiences for students (Alam et al., 2021; Masruroh et al., 2020). Learning activities using PhET will certainly be interesting. The use of PhET simulations in learning leads to questions that can train abilities. PhET simulation connects real phenomena and provides feedback in learning activities (Darmawan & Dwijayati, 2019; Ekawati et al., 2015). This makes it easier for students to learn. Problem-based Learning challenges students to solve everyday problems (Haji et al., 2015; Nurlaily et al., 2019). It was concluded that Problem-based Learning with the help of PhET application on electrical material can improve critical thinking ability (Fuadati & Wilujeng, 2019; Y. Wulandari et al., 2020). The implication of this research is that the PhET simulation design can be used to test students' ideas in series and parallel electrical device activities. This will certainly help students in learning science.

4. CONCLUSION

This study obtained the results that there were significant differences in critical thinking ability. PhET application-assisted Problem-based Learning also improves student learning atmosphere. Moreover, PhET simulation connects real phenomena and provides feedback in learning activities. It was concluded that Problem-based Learning assisted by PhET applications could increase critical thinking ability in electrical materials and is very useful for teachers in applying learning, especially in electrical materials.

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