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Efforts to Improve Student Learning Outcomes by Using Phet Colorado Learning Media in Fractional Material for Class 5a in Min 1 Boalemo

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Abstract:
This study aims to improve students' learning outcomes in understanding the concept of fractions through the use of PhET Colorado interactive learning media. Mathematics learning, especially in fractional materials, is often a challenge for students because of its abstract nature. Therefore, learning media is needed that can help students understand the concept of fractions more visually and interactively. This study uses the Kemmis & McTaggart model Classroom Action Research (PTK) method which consists of two cycles. Each cycle includes stages of planning, action, observation, and reflection. The subject of this study is a student of class 5A MIN 1 Boalemo. Data was collected through learning outcome tests, observations, and student questionnaires. The results showed that the use of Colorado PhET in fractional learning was able to improve student learning outcomes. This can be seen from the increase in the average score of the learning outcome test from pre-cycle to cycle 2. In addition, students become more active and enthusiastic in learning. Thus, the use of PhET Colorado as an interactive learning medium can be an effective alternative in improving the understanding of the concept of fractions in elementary schools.

Keywords: PhET Colorado, Fractions, Learning Outcomes, Interactive Media

INTRODUCTION

Mathematics is one of the fundamental subjects in the educational curriculum that plays a role

in developing critical thinking and problem-solving skills in students. However, in practice, many students have difficulty understanding mathematical concepts, especially fractional materials. This difficulty is due to the abstract nature of fractions which requires an understanding of the concept of comparison and number operations which are more complex than integers. Several studies show that the low learning outcomes of students in fractional materials are caused by the lack of use of learning media that helps visualize the concept.

Based on the results of initial observations in class 5A MIN 1 Boalemo, it was found that most students had difficulties in understanding the concept of fractions, such as comparing fractions, performing fraction calculation operations, and connecting fractions with real situations. This is reflected in the low daily test results, where many students get scores below the Minimum Completeness Criteria (KKM). The results of a study by Rahmawati et al. (2021) show that conventional learning methods that only rely on lectures and practice questions without visual media make students less understanding of the concept of fractions in depth. Therefore, more innovative learning strategies are needed to improve students' understanding of this material.

One solution to overcome these difficulties is to use interactive learning media. According to research by Sari and Wulandari (2022), the use of technology-based interactive media can increase students' motivation and understanding in learning mathematics because it helps them see concepts visually and exploratorily. One interactive medium that can be utilized in fractional learning is PhET Colorado, a computer-based simulation platform designed to help students understand math and science concepts through interactive digital experiments.

PhET Colorado provides fraction simulations that allow students to practice comparing fractions, converting fractions to decimals, and understanding the relationship between fractions and percentiles. A study conducted by Nugraha et al. (2023) shows that the use of PhET Colorado in math learning contributes significantly to improving students' understanding of concepts as well as encouraging their active involvement in the learning process. Therefore, the application of this media in fractional learning is expected to help improve the learning outcomes of students in class 5A MIN 1 Boalemo.

This study aims to analyze the effectiveness of the use of PhET Colorado in improving students' learning outcomes on fractional materials. Specifically, this study seeks to answer the question: (1) How is the application of PhET Colorado learning media in fraction learning? (2) Can the use of PhET Colorado learning media improve students' learning outcomes in fractional material in class 5A MIN 1 Boalemo? By answering this question, research is expected to contribute to the development of more innovative and technology-based learning methods.

This study uses the Classroom Action Research (PTK) method with the Kemmis & McTaggart model, which consists of two cycles. Each cycle includes stages of planning, action, observation, and reflection to evaluate the effectiveness of using the Colorado PhET in improving student understanding. Data was collected through learning outcome tests, observation of student activities, and questionnaires used to measure student responses to interactive simulation-based learning. With this approach, the research is expected to provide a clearer picture of how digital learning media can be used to improve student learning outcomes in elementary schools.

Thus, this research is expected to contribute to teachers, students, and the world of education more broadly. For teachers, the results of this research can be a reference in developing more effective technology-based learning strategies. For students, the use of PhET Colorado is expected to make fractional learning more interesting and easy to understand, thereby increasing their motivation and learning outcomes. Meanwhile, for the world of education, this research can be one of the references in integrating technology-based interactive learning media as part of mathematics learning at the elementary school level.

METHODS

This study uses the Classroom Action Research (PTK) method with the Kemmis & McTaggart model, which consists of two cycles. Each cycle involves four stages, namely planning, acting, observing, and reflecting. This method was chosen because PTK allows teachers to identify and solve learning problems directly through real actions in the classroom. The main focus of this study is to measure the effectiveness of the use of PhET Colorado as an interactive learning medium in improving the learning outcomes of class 5A MIN 1 Boalemo students on fractional materials.

From the table above, it can be seen that there is a significant increase in learning outcomes from pretest to posttest of the second cycle. The average score increased from 58.3 (pretest) to 72.1 (posttest cycle 1) and 85.4 (posttest cycle 2). In addition, the percentage of students who achieved a score above KKM (70) increased from 33.3% (pretest) to 55.6% (cycle 1) and 83.3% (cycle 2).

The results of this analysis were also reinforced with questionnaire data, which showed that 88.9% of students felt more helped by the use of PhET Colorado in understanding fractions. In addition, 77.8% of students stated that learning with interactive simulations was more fun than conventional methods, while 83.3% of students felt that this medium motivated them to be more active in learning mathematics.

Thus, based on the results of the pretest and posttest, as well as observation and questionnaire data, it can be concluded that the use of PhET Colorado significantly improves student learning outcomes on fractional materials. This increase is not only seen in terms of academic grades, but also from students' motivation and active participation during learning. Therefore, interactive media such as PhET Colorado can be an effective solution in overcoming the difficulty of learning fractions, so it is recommended to be applied more widely in mathematics learning in elementary schools.

RESULTS

Data validation in this study was carried out to ensure that the results obtained really reflect the improvement of student learning outcomes due to the use of PhET Colorado as a learning medium. Validation is carried out through triangulation methods, namely by comparing the results of several data collection techniques, such as pretest, posttest, observation, and questionnaire. In addition, validation was also strengthened by descriptive statistical analysis, which showed that there was a significant increase in student learning outcomes from the first cycle to the second cycle. In terms of quantitative validation, the results of the pretest and posttest were analyzed using the average test to see the numerical change in the value. The results showed an increase in the average score from 58.3 in the pretest to 72.1 in the first cycle posttest, and increased again to 85.4 in the second cycle posttest. This increase proves that the use of PhET Colorado significantly assists students in understanding the concept of fractions. This result is reinforced by the analysis of the score distribution, which shows that the number of students who achieved a score above KKM (70) increased from 6 students (33.3%) in the pretest to 15 students (83.3%) in the second cycle posttest.

In terms of qualitative validation, observational data showed that students who were previously passive in learning mathematics became more active when using PhET Colorado. They look more enthusiastic in exploring the concept of fractions through interactive simulations, which allows them to understand the concepts in a visual and direct way. In addition, the results of the questionnaire showed that 88.9% of students felt helped in understanding fractional material, and 83.3% of students stated that PhET Colorado increased their motivation in learning. To ensure the reliability of the data, source triangulation is carried out, namely by comparing the results obtained from several measurement instruments (tests,

observations, and questionnaires). The results showed a harmony between the improvement of academic grades, changes in students' learning behavior, and their positive responses to this learning medium. In other words, the improvement in learning outcomes is not only seen from test scores, but also from changes in students' motivation and way of understanding mathematical concepts.

The results of this validation are in line with previous research which states that interactive simulation-based learning media can significantly improve student understanding. A study by Nugraha & Prasetyo (2023) found that students who studied with PhET Colorado showed better understanding than those who studied with conventional methods. In addition, research by Widodo & Nurhayati (2023) confirms that interactive media can increase student engagement in learning, thus having a positive impact on their academic outcomes. Thus, the validation results show that the use of Colorado PhET in fractional learning has been proven to be effective in improving student learning outcomes. These findings confirm that educational technology can be used as a powerful tool to overcome difficulties in learning mathematics at the primary school level. Therefore, this study recommends the application of interactive simulation media in mathematics learning more broadly, especially in concepts that require visual and exploratory understanding such as fractions. Overall, this study provides empirical evidence that PhET Colorado is an innovative solution in improving students' understanding of fractional materials, both in terms of learning outcomes, student engagement, and their learning motivation. With strong data validation and consistent results, this study can be a reference for teachers and education practitioners in implementing technology-based learning media to improve the quality of mathematics learning in elementary schools

DISCUSSION

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CONCLUSION

This study shows that the use of PhET Colorado learning media significantly improves students' learning outcomes in understanding the concept of fractions. Based on the results of data analysis, there was an increase in the average student score from 58.3 (pretest) to 72.1 (posttest cycle 1) and 85.4 (posttest cycle 2). In addition, the percentage of students who achieved a score above KKM (70) increased from 33.3% in the pretest to 83.3% in the second cycle posttest. These findings prove that the interactive simulation provided by PhET Colorado is able to help students better visualize the concept of fractions, so that their understanding of the material becomes more optimal.

In addition to improving academic outcomes, the use of PhET Colorado also has a positive impact on student motivation and engagement in learning. The observation results showed that students were more active and enthusiastic when using interactive simulations compared to conventional methods. The questionnaire data also supported these findings, where 88.9% of students felt helped in understanding the material, and 83.3% stated that learning with PhET Colorado was more enjoyable. This shows that interactive media such as PhET Colorado not only improve cognitive comprehension, but also help build a more engaging learning experience and motivate students to be more active in the learning process.

Based on the results of this study, it can be concluded that PhET Colorado is an effective learning medium to improve the understanding of fraction concepts in grade 5A students. Therefore, it is recommended for teachers to utilize interactive media in mathematics learning, especially in materials that require visual understanding. In addition, further research can be conducted to test the effectiveness of PhET Colorado on other materials or at different levels of education. Thus, the use of educational technology in mathematics learning can be further developed to improve the quality of education in Indonesia.

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