Prisma Sains: Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram
https://e-journal.undikma.ac.id/index.php/prismasains/index
e-mail: prismasains.pkpsm@gmail.com

July 2024. Vol. 12, No. 3
p-ISSN: 2338-4530
e-ISSN: 2540-7899
pp. 500-508

The Effect of the Problem-Based Learning Model Assisted by the Kahoot Application on the Understanding of Concepts Related to the Nervous System in High School Students

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Received: June 2024; Revised: June 2024; Published: July 2024

Abstract

The comprehension of concepts is crucial in educational activities and serves as the basis for achieving learning outcomes. However, students often encounter difficulties when it comes to understanding biological concepts, especially those related to the nervous system. This study aims to evaluate the impact of using the Problem-Based Learning model, with the support of the Kahoot application, on students' understanding of concepts related to the nervous system. The research design employed a Quasi Experiment approach, utilizing a Two Group Pretest and Posttest Design. Cluster random sampling was used to select the participants. A 20-question multiple-choice test was employed as the research instrument to measure conceptual understanding. Descriptive analysis techniques, including the calculation of mean, median, mode, and standard deviation, were employed for data analysis. Prior to hypothesis testing, normality and homogeneity tests were conducted to ensure data validity. An independent t-test was utilized for hypothesis testing. The descriptive analysis demonstrated that the average posttest score in the experimental group was 81.09, compared to 54.53 in the control group, indicating higher scores in the experimental group. The results of the t-test (2-tailed) yielded a significant value of 0.000 < 0.05, leading to the rejection of the null hypothesis (Ho) and accepting the alternative hypothesis (Ha). This suggests that the Problem-Based Learning model, in conjunction with the Kahoot application, has a positive impact on students' understanding of concepts.

Keywords: Kahoot; Nervous System; Concept Understanding; Problem Based Learning

How to Cite: Khairunnisah, T., & Rasyidah, R. (2024). The Effect of the Problem-Based Learning Model Assisted by the Kahoot Application on the Understanding of Concepts Related to the Nervous System in High School Students. *Prisma Sains : Jurnal Pengkajian Ilmu dan Pembelajaran Matematika dan IPA IKIP Mataram*, *12*(3), 500-508. doi:https://doi.org/10.33394/j-ps.v12i3.12153

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INTRODUCTION

Education plays a crucial role in enhancing the quality of human resources. Within this pursuit for improved quality, teachers are responsible for fostering innovative learning environments in the classroom. Innovative learning places students at the center of the educational experience (Purwanto et al., 2021), thereby fostering active learning atmospheres. In the realm of biology education, every topic holds significant value and carries profound impacts on individuals' lives. Biology education entails contextual learning, involving the study of the intricacies of life as it manifests in real-world scenarios. Consequently, teachers must skillfully design learning strategies and models that enable the effective communication of abstract biological concepts in concrete terms to students (Zendrato et al., 2024).

Fundamentally, the learning process does not require students to rote memorize every aspect of the subject matter. Instead, it emphasizes the comprehension of concepts and the development of reasoning skills for problem-solving applications in students' everyday lives (Wahyuni et al., 2023). Conceptual understanding is akin to the foundation of a building; a

strong understanding of one concept serves as a sturdy base upon which subsequent knowledge can be built (Nugraheni & Sugiman, 2013). Once students possess a correct understanding of a concept, they will find it easier to grasp subsequent lessons (Radiusman, 2020). As such, a comprehensive grasp of various concepts relevant to the subject matter proves invaluable in students' achievement of learning objectives. In this endeavor, the role of the teacher in providing real-life contexts and relating the material to the students' environment should not be overlooked (Ikstanti & Yulianti, 2023).

Biology education holds particular significance in cultivating conceptual understanding that allows students to perceive the interconnectedness between biological concepts and daily life. A profound understanding of biological concepts serves as a foundation for critical thinking and decision-making, enabling the practical application of these concepts in everyday situations (Tendrita et al., 2016). Unfortunately, it is often observed that students exhibit a lack of engagement in the biology learning process, resorting to rote memorization of theoretical knowledge only. Consequently, they encounter difficulties in comprehending the underlying concepts of the subject matter (Mazlin et al., 2023). This observation corroborates Azizah & Alberida's (2021) assertion that biology education may face obstacles hindering its full optimization, including low levels of learning motivation, limited critical thinking, and inadequate cognitive abilities among students.Based on observations conducted at SMA Negeri 16 Medan, biology teachers in class XI IPA were interviewed to gain insights into the biology learning process, specifically in the sub-material of the nervous system. It was found that the teachers initiated the learning process by motivating the students. Following this, the students were tasked with creating concept maps in their textbooks, after which the teacher would explain the material. It has been noted that a lack of active student participation in the classroom can hinder their understanding of the subject. Moreover, the use of one-way teaching methods and less structured learning models can lead to boredom (Indriani et al., 2021). Additionally, it has been observed that teachers at SMA Negeri 16 Medan have not yet fully utilized technology-based learning resources, such as learning applications (Janattaka & Tiyana, 2022).

According to Anshari et al. (2023), biology learning materials, particularly those related to the nervous system, often prove challenging for students to comprehend. This is due to the abstract nature of the nervous system mechanism, which presents information that is not easily perceptible by the five senses or observable with the naked eye. The material includes an extensive use of scientific language that students struggle to grasp. Consequently, students tend to resort to rote memorization of the characteristics and mechanisms of the nervous system, often failing to establish connections between concepts or relate the material to their everyday lives (Raida, 2018).

Hence, there is a need for innovative teaching methods to enhance students' understanding of these concepts. One approach is the utilization of Problem Based Learning (PBL) as a teaching tool. The PBL model revolves around presenting students with problems, pushing them to engage in collaborative learning and solution-seeking endeavors. By employing this model, there is an opportunity for interaction between stimuli and responses. Furthermore, PBL places students at the center of the learning process—requiring them to adapt to their role as the primary participants (Wulandari et al., 2023). PBL not only addresses the conceptual aspects related to the problem but also cultivates scientific problem-solving skills. Its focus on real-life problems makes learning more captivating and relevant (Nababan et al., 2024). Additionally, the PBL model encourages students to think critically, develop a deeper understanding of concepts, and seek out their own sources to solve problems (Rubianti et al., 2019).According to Darmawan (2020), achieving learning objectives requires students to master all learning materials. In addition to utilizing the appropriate learning model, the mastery of learning materials can be facilitated through the use of learning media. One such innovative learning media is the Kahoot digital platform. Kahoot functions as a learner response system that engages students through game-based activities such as quizzes, discussions, and impromptu surveys. By incorporating Kahoot into the learning process,

instruction becomes more innovative and captivating. Furthermore, Kahoot offers a game show-style interface that presents questions and can be accessed at no cost (Marwa et al., 2023). Additionally, Kahoot enhances the learning experience through its interactive features, incorporation of artificial intelligence, and ability to improve the overall quality of instruction (Janattaka & Tiyana, 2022). Using Kahoot fosters a pleasant learning atmosphere and prevents students from becoming disengaged. Consequently, it is expected to enhance student motivation, interest, and comprehension of learning concepts (Niama et al., 2023).

Research conducted by Auliah et al (2023) reveals that the implementation of Problem-Based Learning (PBL) models may encounter challenges. Various obstacles, such as differences in student mindset, abilities, and interests, can impede the effectiveness of PBL in the classroom. Therefore, teachers must employ different approaches to capture students' attention and generate enthusiasm. To address this, teachers can integrate innovative learning media, such as the Kahoot application. Kahoot offers numerous benefits, including interactive features, captivating elements, and a competitive nature that encourages student engagement, strengthens comprehension of taught concepts, fosters collaboration, healthy competition among peers, and provides effective formative assessment opportunities (Desi & Efendi, 2023). Muzeliati et al (2022) support these findings, demonstrating that the use of Kahoot in conjunction with PBL can overcome classroom challenges. The infusion of Kahoot games enlivens the classroom environment, while students exhibit a high level of enthusiasm, ultimately facilitating faster comprehension of the learning material.Several studies have been conducted on the Problem Based Learning (PBL) model, but there is limited research specifically using the Kahoot application to teach nervous system material. Rubianti et al (2019) and Yanti et al (2019) examined the application of the PBL model to improve students' understanding of mathematical concepts. Additionally, Manalu et al (2023) investigated the effect of the PBL model with a differentiated learning strategy on students' understanding of concepts and science process skills. Muzeliati et al (2022) explored the application of the Kahoot-based PBL model to enhance student learning outcomes in chemistry, while Rembang et al (2023) examined the effect of a problem-based learning model on learning outcomes in ecosystem material. These studies provide an opportunity to explore the impact of the Kahoot application-assisted PBL model on understanding concepts related to the nervous system.

The purpose of this research is to investigate how the PBL model, with the assistance of the Kahoot application, influences students' comprehension of the nervous system. The findings of this study aim to encourage educators to enhance students' understanding of concepts through active learning methods, such as utilizing PBL models and interactive media like Kahoot.

METHOD

This study utilized a Quasi Experimental design called the Two Group Pretest and Posttest Design. This design involved two groups receiving different treatments, with measurements taken before (pretest) and after (posttest) the treatments were administered. The main objective was to assess the impact of these treatments on the variables being investigated and to compare the changes between an experimental group and a control group. The research was conducted in two separate classes: one experimental class where students received Problem Based Learning (PBL) supported by the Kahoot application, and one control class where students underwent traditional teaching methods. The independent variables (X) in this research were the Problem Based Learning (PBL) model assisted by the Kahoot application, while the dependent variable (Y) was the students' understanding of concepts.

Population and Sample

This research was conducted in the even semester of the 2023/2024 school year. The population of the study consisted of all students in class XI IPA in one of the SMA Negeri 16 Medan, Medan City, North Sumatra Province, totaling 6 classes with 192 students. The sampling technique used in this study was cluster random sampling. Two classes were

randomly selected from the 6 classes of XI IPA, resulting in XI IPA Lupus class, with a total of 32 students, as the experimental class, and XI IPA Orion class, with a total of 32 students, as the control class. Therefore, the total sample size for this study was 64 students.

Instrument

The instrument used in this study was a concept understanding test in the form of multiple choice questions, totaling 20 questions, based on a lattice of concept understanding indicators that had been validated by expert lecturers. The test was administered to the students, and the results were subjected to a validity test and a reliability test. The validity test was considered valid if [missing information]. After the validity test, a reliability test was conducted to determine the consistency of the measurement results when using the same instrument. The reliability of the test instrument was calculated using the Cronbach-Alpha formula through SPSS, with a criterion that the Cronbach-Alpha value should be ≥ 0.60. Based on the results of the reliability test conducted on the 20 multiple choice questions, with a value of 0.893, the instrument was deemed valid and reliable for use.

Procedure

This research was divided into three phases: preparation, implementation, and conclusion stages. The preparation stage involved defining the research population, creating a Learning Implementation Plan (RPP), developing teaching materials (LKPD), and constructing research instruments in the form of multiple choice test questions and quiz questions assisted by the Kahoot application. After the preparation phase, validation was carried out by expert lecturers to ensure the validity of the materials. The implementation stage included administering a pretest to the students before conducting the learning process. After three sessions of nervous system material using the Problem Based Learning learning model assisted by the Kahoot application and providing LKPD, a post-test was administered. The final stage involved data collection and processing using SPSS 25.

Table 1. Description of *Problem Based Learning* learning activities assisted by *Kahoot* application

Syntax PBL	*Kahoot*	Teacher and Student Activities
Phase 1: Orienting Learners to the Problem	Showing a video stimulates learners	1. The teacher provides basic concepts/stimulates students related to learning 2. Learners look closely, then formulate a problem on what has been looked at
Phase 2: Organising Learners to Learn	-	3. The teacher assists learners in identifying the concepts in the problem and organising learners into group learning tasks. 4. Learners follow the directions given by the teacher
Phase 3: Guiding the investigation	Display source/reference videos	5. The teacher provides references and guides learners in gathering information, finding solutions related to the problem. 6. Learners conduct enquiry (find references/sources) for problem solving
Phase 4: Develop and Present Work	-	7. The teacher monitors the discussion and guides learners in preparing the group discussion results so that they are ready to be presented.

Syntax PBL	*Kahoot*	Teacher and Student Activities
		8. Learners (groups) discuss to solve the problem so that the results can be presented
Phase 5: Analyse and Evaluate the Problem Solving Process	Display online quiz as learning evaluation	9. The teacher provides feedback on group presentations, and the teacher guides learners to evaluate the process that has been learnt. 10. Students pay close attention to the teacher's explanation and conduct evaluation through the *kahoot* application.

Data Analysis

The data in this study were analyzed using both descriptive and inferential methods. Descriptive analysis aimed to provide an overview of the implementation of learning and the scores obtained for concept understanding in each group. This included calculating measures such as the mean, standard deviation, minimum score, and maximum score. Before conducting inferential analysis, prerequisite tests were conducted. These tests included the Kolmogorov-Smirnov test to assess normality and the Levene statistical test to assess homogeneity. For the normality test, a sample size of ≥ 50 students was used, and data was considered to be normally distributed if the sig value was > 0.05. The Levene test was used to examine the similarity of variances between different groups of data. A sig value > 0.05 indicated that the data was homogeneous. The inferential analysis utilized the independent sample t-test to determine whether there was a significant difference between two independent samples: one group that received the Kahoot-assisted PBL learning model and another group that received the conventional learning model. The study's criterion for significance was a t-test significance value < 0.05. In such cases, the null hypothesis (Ho) would be rejected, and the alternative hypothesis (Ha) would be accepted, indicating an influence of the independent variable on the dependent variable.

RESULTS AND DISCUSSION

This research study has yielded quantitative data. The data obtained from the pretest and posttest results of both the experimental and control groups were carefully analyzed. Descriptive statistics were used to analyze the data, which provided valuable insights. The analysis indicated that in the control group, the pretest scores ranged from 30 to 55, while the posttest scores ranged from 30 to 70. On the other hand, in the experimental group, the pretest scores ranged from 30 to 60, with posttest scores ranging from 65 to 95. The average scores for both the pretest and posttest are presented in Figure 1.

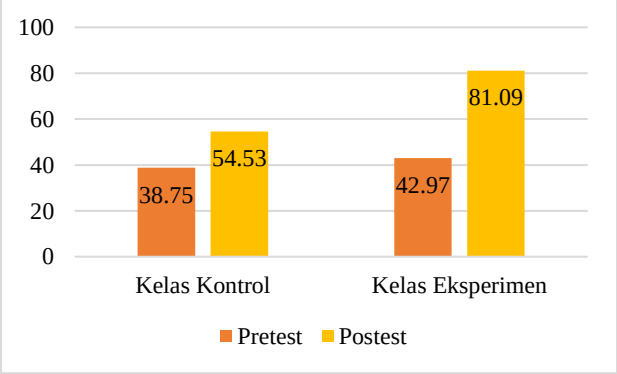

Figure 1. Average score of pre-test and post-test

According to Figure 1, the control class had an average pretest value of 38.75 and a posttest value of 54.53, indicating an increase of 15.78. The experimental class, on the other

hand, had an average pretest value of 42.97 and a posttest value of 81.09, showing an increase of 31.12. The posttest results revealed a significant difference between the control and experimental classes, as the average value in the experimental class (81.09) was higher than that in the control class (54.53), with a difference of 26.56. This suggests that the Problem Based Learning model, assisted by the Kahoot application, facilitated a better understanding of concepts in the experimental class compared to the conventional model in the control class. The pretest and posttest data obtained in both classes will be subjected to a series of analyses, including normality test, homogeneity test, and t-test.

For the normality test in this study, the Kolmogorov-Smirnov test was utilized. The results revealed that the significance level (Sig.) >0.05 in both the control and experimental classes. Specifically, the pretest values for the control class and experimental class had Sig.0.200>0.05, while the posttest values had Sig.0.170>0.05 for the control class and Sig.0.067>0.05 for the experimental class. These findings indicate that the data used in the study were normally distributed. The subsequent homogeneity test was performed using the Levene statistical test in the SPSS program. A data set is considered homogeneous if the probability (Sig.) >0.05. Based on the results of the homogeneity test, conducted with the Levene statistic test, we can conclude that the data exhibited equal variances and were homogeneous, given that the significance (Sig.) value was 0.519, exceeding the threshold of 0.05.Based on the obtained results of the prerequisite test, indicating that the learning outcomes exhibit a normal distribution and homogeneity, hypothesis testing was performed using the t-test. The aim was to determine the significant effect of the Kahoot-assisted Problem Based Learning model on students' ability to understand concepts. The results of the t-test revealed a significance level (2-tailed) of 0.000, which is less than the critical value of 0.05. Therefore, the null hypothesis (Ho) was rejected, and the alternative hypothesis (Ha) was accepted.

This finding is further supported by comparing the average scores of the posttest acquisition between the control class (mean = 54.53) and the experimental class (mean = 81.09). The results suggest that there is a significant influence of the Problem Based Learning model assisted by the Kahoot application on students' understanding of the nervous system material. This finding aligns with the research conducted by Inayah et al. (2021), which indicates that students who utilize the Problem Based Learning model with Kahoot assistance exhibit better understanding compared to those exposed to conventional learning models.

The Kahoot-assisted Problem Based Learning model can enhance students' concept understanding by exposing them to real problems and promoting critical thinking skills. This approach allows students to independently or collaboratively tackle the problems and construct their knowledge (Rifai, 2020). Moreover, the incorporation of the Kahoot application in PBL learning enhances students' interest, increases effectiveness, and fosters a more engaging classroom environment (Anviani & Pujiriyanto, 2022).

Furthermore, studies by Wahyuni & Sholichah (2022) and Muzeliati et al. (2022) also support the notion that the experimental class shows greater improvement in concept understanding compared to the control class. The implementation of the PBL model in experimental classes encourages students to take an active role in seeking information, expressing opinions, and engaging in discussions (Hotimah, 2020). On the other hand, the conventional model utilized in the control class does not provide opportunities for students to actively explore the learned concepts. As a result, students tend to focus solely on problem-solving, leading to a less active and meaningful induction of concepts (Tresnawati et al., 2019).Based on the results of the data acquisition, it was observed that the experimental class had a higher average posttest value compared to the control class. The average posttest value in the experimental class was 81.09, whereas in the control class it was 54.53. The implementation of the Kahoot-assisted Problem Based Learning (PBL) model had a positive impact on student engagement and enthusiasm in the learning process. This, in turn, facilitated a quicker and more meaningful understanding of the subject matter. The students in the experimental class exhibited improved levels of activity, enthusiasm, and active participation

in every learning session. Additionally, the delivery of material and quizzes through Kahoot provided an engaging and non-monotonous learning experience for the students. These findings align with prior research conducted by Marwa et al. (2023), which demonstrated significant outcomes in terms of student concept understanding with the utilization of the Kahoot PBL model. As a result, the alternative hypothesis (Ha) was accepted, while the null hypothesis (Ho) was rejected. This implies that the implementation of the Problem Based Learning (PBL) approach, assisted by the Kahoot application, exerted a positive influence on students' concept understanding, particularly in relation to the nervous system topic. The benefits of utilizing the Problem Based Learning (PBL) learning model greatly support students in enhancing their conceptual understanding.

CONCLUSION

Based on the conducted research and the analysis of the data, it has been found that utilizing the Problem Based Learning (PBL) instructional model, combined with the Kahoot application, can significantly enhance students' comprehension of the nervous system subject matter. This is supported by the higher average posttest score of the experimental class, compared to that of the control class. Additionally, the results of the t-test, with a significant value of 0.000 < 0.05, reject the null hypothesis (Ho) and accept the alternative hypothesis (Ha). Therefore, it can be concluded that the Problem Based Learning (PBL) approach, when supported by Kahoot, has a positive impact on students' conceptual understanding. Consequently, it is recommended to continue and further develop initiatives aimed at improving students' conceptual understanding.

RECOMMENDATION

To further enhance the academic rigor of this study, it is suggested that future researchers endeavor to develop Problem-Based Learning (PBL) models utilizing alternative instructional materials. Additionally, future researchers may consider employing diverse samples and research methodologies to explore similar research questions. The ultimate objective of such endeavors is to facilitate students' comprehension of societal phenomena in alignment with scientific content.

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