The Effect of Problem-Based Learning on Grade XI Students' Creativity in Heat Topics

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Abstract *-This study aims to investigate the influence of the Problem-Based Learning (PBL) model on students' creativity in the topic of heat at SMAN 2 Praya. The study reveals that students' creativity in this topic is still low, caused by a lack of interest in lecture-based learning or other conventional methods. The PBL model, which integrates real-life problems, is expected to help students develop thinking skills and construct their knowledge independently. This research employs a quantitative approach with a quasi-experimental method. The population consists of Phase F, 11th-grade students at SMAN 2 Praya. The sample was selected using purposive sampling, with class F1-1 designated as the control group and class F1-2 as the experimental group. The data collection instrument was an essay test, tested for validity, reliability, difficulty level, and discrimination power. Data analysis was performed through normality, homogeneity, and hypothesis testing using the ANOVA test. The results indicate a significance value of 0.00, suggesting that the PBL model has a significant effect on improving students' creativity. This conclusion supports the implementation of PBL as an effective learning method to enhance students' creativity in the topic of heat.*

Keywords: *Heat; Creativity; Problem-based learning*

INTRODUCTION

Science and Technology (IPTEK) have rapidly advanced over time. These developments significantly influence the lifestyle of Generation Z, who frequently interact via gadgets and can quickly access information through the internet (Hastini, 2020). Naturally, science and technology also have a profound impact on the field of education.

Education is a fundamental aspect of a nation's development. The quality of education greatly influences the advancement of science and technology, which drives innovation and progress in a country. Education is generally defined as a human effort to nurture and develop their physical and spiritual abilities in alignment with societal and cultural values (Aristawati, 2018). With the passage of time, the education sector has continued to evolve, including periodic revisions of the curriculum.

The curriculum serves as a guideline for structuring effective learning objectives. A well-designed curriculum allows educators to organize teaching more systematically while providing greater opportunities to develop students' character and competencies. Particularly at the secondary education level, a flexible curriculum enables students to explore their interests more freely, fostering creativity and innovation in their learning process (Hutabarat, 2022).

Creativity is a cognitive process that drives individuals to innovate, either by creating new products or combining existing ideas in novel ways. In the context of teaching, educators must possess creativity, reflecting their ability to generate innovative ideas and approaches. Educators who introduce fresh perspectives and methods in the teaching and learning process can open new horizons for students. Thus, incorporating creativity into teaching not only enriches students' learning experiences but also fosters the development of fresh ideas and innovative approaches in education.

In education, creativity is defined as the ability to produce innovative ideas. A creative educator can introduce new perspectives and methods, broadening students' horizons. This is crucial for enhancing the learning experience and encouraging the development of fresh and innovative approaches in education (Ahmad & Mawarni, 2021). Developing students' creativity is a key factor in improving learning quality, as it helps them think critically and innovatively to solve everyday problems (Anggraini et al., 2020).

One of the subjects taught in schools is physics. Fundamentally, physics is a branch of natural science that studies natural phenomena. In physics learning activities, students are required to actively engage in the learning process. This study focuses on the topic of heat, as it involves many concepts directly related to daily life (Oktaviani et al., 2017).

Observations and interviews conducted at SMAN 2 Praya revealed that physics learning within the implementation of the "Merdeka Curriculum" remains unengaging and difficult for students to understand, especially on the topic of heat. Creativity is essential in the learning process, and teachers must create more meaningful and enjoyable learning experiences (Romadhon & Imawan, 2024).

A major factor contributing to the low levels of creativity is the use of teaching models that fail to encourage active student involvement. Instructional methods often focus on delivering information without providing opportunities for students to innovate, collaborate, or solve problems. This approach makes it challenging for students to enhance their creativity, particularly in understanding heat, which involves abstract concepts requiring deep comprehension.

Assessment results for class XI F 1-1 and F 1-2 during the 2022/2023 academic year at SMAN 2 Praya indicate low performance. This is evident from the majority of students scoring below the minimum competency standard (KKM), which has been set at 75.

Table 1. Daily Assessment Results for Class XI F 1-1 and F 1-2 for the Academic Year 2022/2023

Phase F	Score	Number of Students	Percentage	Description
XI F 1-1	≤ 75	20	62,5 %	Tidak Memenuhi KKM
	> 75	12	37,5%	Memenuhi KKM
XI F 1-2	≤ 75	18	51,42%	Tidak Memenuhi KKM
	> 75	14	40 %	Memenuhi KKM

(Source: Document of Physics Teacher of SMAN 2 Praya)

The data above shows that in class XI F 1-1, out of 32 students, only 12 students (37.5%) achieved the minimum competency standard (KKM), while in class XI F 1-2, only 14 students (40%) met the standard. These results indicate that the average scores of students in classes XI F 1-1 and F 1-2 are still below the KKM. This outcome is attributed to the limited and passive learning processes conducted by both educators and students.

Due to the constrained learning experiences, students face challenges in developing independence and creativity. According to Azizah (2019), active participation in learning is minimal, leading to rote memorization of concepts and an inability to solve problems effectively.

Interviews with educators at SMAN 2 Praya revealed that the Problem-Based Learning (PBL) model was used only once in physics lessons. However, students struggled to understand the stages of the PBL model, rendering the implementation ineffective. The most commonly used method by educators remains the conventional teaching approach, focused on lectures and teacher-centered question-and-answer sessions.

Based on these challenges, equipping students with skills relevant to contemporary demands requires educators to be creative and ensure students understand the stages of the learning model used. Selecting the appropriate learning model is essential. Proper implementation of a learning model during the teaching process significantly influences students' creativity. According to Janah et al. (2018), the Problem-Based Learning model emphasizes active student engagement to discover and relate the learning material to real-life contexts.

The Problem-Based Learning model is considered an effective method that allows students to become active learners and directly involved in solving real-world problems. Rooted in constructivist learning theory, PBL facilitates knowledge construction by enabling students to build their understanding through interaction with learning materials and problem situations. This provides opportunities for students to develop creativity by devising new solutions to given problems. Empirical evidence also supports the positive impact of PBL in enhancing student creativity.

According to Robiyanto (2021), Problem-Based Learning offers authentic learning experiences, encouraging students to actively participate in the learning process, create their own knowledge, and integrate educational contexts into real-life scenarios. This approach helps students comprehend concepts related to the material more effectively.

This study differs from previous research by introducing innovations in heat-related topics and focusing on creativity as a measurable variable in a different location and timeframe. The study aims to contribute uniquely to educational development, particularly in enhancing student creativity through more innovative and effective learning methods.

RESEARCH METHODS

This study employs a quantitative research method with an experimental approach. According to Sugiyono (2017), quantitative methods are scientific methods that adhere to scientific principles, including being concrete or empirical, objective, measurable, rational, and systematic. The type of research used in this study is Quasi-Experimental. This form of experiment is a development of the True Experimental design. Quasi-Experimental research involves a control group but does not fully control external variables that may influence the execution of the experiment (Sugiyono, 2017).

This study involves two classes: an experimental class and a control class. The experimental class is treated with the Problem-Based Learning (PBL) model, while the control class uses a direct instruction model with the lecture method. The sample for this study consists of two groups selected using purposive sampling. Class F 1-1, consisting of 36 students, serves as the control group and employs conventional learning (lecture method), while Class F 1-2, also consisting of 36 students, serves as the experimental group and applies the Problem-Based Learning model.

The data analysis method used in this research involves parametric statistical tests, including the independent sample t-test and ANOVA (Analysis of Variance). The t-test is employed to compare the means of the two groups: the control class and the experimental class.

RESULTS AND DISCUSSION

Results

The instrument tested consisted of a heat creativity test. This instrument was administered to students in Class F 1-3, with 36 students per class, on Wednesday, May 15, 2024. The test results were subsequently analyzed for validity, reliability, difficulty level, and discriminating power before being used for the pre-test and post-test.

Based on the validity, reliability, difficulty level, and discriminating power analysis conducted on the creativity test instrument, it was found that out of seven test items provided, five items were deemed acceptable. Further prerequisite testing was performed to determine whether the data analysis for hypothesis testing could proceed. In hypothesis testing, several prerequisites must be met, including homogeneity and normality tests.

Based on the pre-test and post-test conducted in both the experimental and control classes, a comparison of the average pre-test and post-test scores was made. The results of the normality and homogeneity tests using SPSS 27 for creativity are presented in Figure 1.

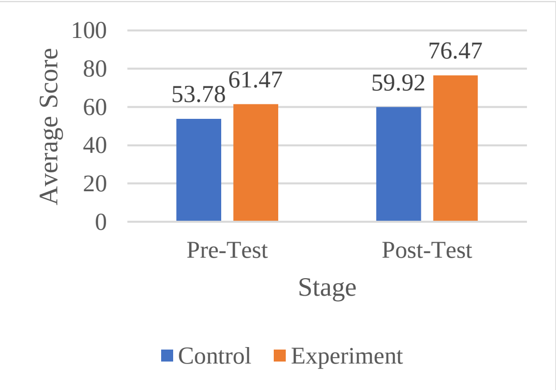

Figure 1. Comparison of Average Pre-Test and Post-Test Creativity Scores

Based on Figure 1, it is evident that there are differences between the pre-treatment and post-treatment conditions in both the control and experimental classes. The results are presented in Table 2.

Table 2. Results of Homogeneous test

	Group	N	Sig.	Desc.
Pre-test	Experiment	36	0,471	homogeneous
	Control	36	0,471	
Post-test	Experiment	36	0,788	homogeneous
	Control	36	0,788	

Based on **Table 2**, it is noted that the significance value is 0.471 for the pre-test and 0.788 for the post-test, which fall into the homogeneous category. Therefore, it is concluded that the data are homogeneous, as the significance values are greater than 0.05.

Table 3. Normality Test Results

	Group	N	Sig.	Desc.
Pre-test	Experiment	36	0,066	normally distributed
	Control	36	0,071	normally distributed
Post-test	Experiment	36	0,068	normally distributed
	Control	36	0,072	normally distributed

Based on **Table 3**, it is observed that the significance values for the pre-test in the experimental and control classes are 0.066 and 0.071, respectively, while the significance values for the post-test in the experimental and control classes are 0.068 and 0.072, respectively. This indicates that the data are normally distributed, as the significance values are greater than 0.05. Since both tests (normality and homogeneity) have been conducted and meet the requirements, hypothesis testing can proceed.

The hypothesis test was performed using ANOVA with the IBM SPSS 27 program. The prerequisite for conducting hypothesis testing through ANOVA is that the data must be normally distributed and homogeneous. ANOVA is used to determine whether the Problem-Based Learning model influences the dependent variable (creativity). The results of the ANOVA test are presented in **Table 4**.

Table 4. ANOVA Test Result

	Sum of Squares	Df	Mean Square	F	Sig.
Between Grups	10020.9 10	3	3340.3 03	28.21 4	.00 0
Within Groups	16574.9 17	14 0			
Total	26595.8 26	14 3			

The results of the ANOVA test, as shown in Table 4, indicate a significance value of 0.000. Using a significance threshold of 0.05, where 0.000 < 0.05, it can be concluded that H_0 is rejected and H_a is accepted.

Discussion

The analysis of the average pre-test creativity scores reveals that the experimental class scored 59.92, while the control class scored 53.78. After treatment, the average post-test score for the experimental class increased to 76.47, significantly higher than the control class's average post-test score of 61.47. This indicates an improvement in student creativity on the heat topic in both classes. The experimental class experienced an increase of 16.55, while the control class improved by 7.69.

The comparison of creativity outcomes shows that the highest improvement occurred in the experimental class. This result is attributed to the use of the Problem-Based Learning (PBL) model, which enabled students to explore the material more effectively through active collaboration among individuals and groups, guided by the educator. This collaborative approach ensured that the knowledge acquired went beyond what students could achieve independently.

The pre-test creativity data for both the experimental and control classes were tested using SPSS 27 for homogeneity and normality. The homogeneity test results indicated that the pre-test scores of both classes were homogeneous, meaning the creativity levels of the two classes were comparable. The normality test results also showed that the creativity of students was normally distributed.

These findings align with previous studies showing that the PBL model enhances student creativity, particularly in developing critical thinking and problem-solving skills. For example, Hidayati (2019) demonstrated a significant improvement in creativity among students in the experimental class using PBL compared to those taught with lecture methods. This supports the findings of this study, highlighting the positive impact of PBL on enhancing student creativity.

Based on the results of this study, it is recommended that the Problem-Based Learning model be more widely implemented in schools, especially for subjects that require the development of creativity and problem-solving skills. Additionally, further research could involve other variables, such as learning motivation or the level of active participation by students, to examine the relationship between these variables and creativity enhancement.

Future studies could also explore the application of PBL in other subjects with different student conditions or compare PBL with other learning models that also focus on enhancing creativity, such as Cooperative Learning or Inquiry-Based Learning. This would provide deeper insights into the effectiveness of various learning models in improving creativity across different contexts.

CONCLUSION

Based on the research results and discussion as presented, it can be concluded that the Problem-Based Learning (PBL) model significantly influences students' creativity in the topic of heat. This conclusion is supported by hypothesis testing, which indicates a significant difference between the control class and the experimental class.

Recommendations and Future Research: It is recommended that the Problem-Based Learning model be more widely implemented in schools, especially for subjects that require creativity and problem-solving skills. Further studies could explore the application of PBL in other subjects with different student conditions or compare PBL with other creativity-focused learning models, such as Cooperative Learning or Inquiry-Based Learning. This would provide deeper insights into the effectiveness of various learning models in enhancing creativity across diverse contexts.

REFERENCES

Ahmad, Y. M., Mawarni, I. (2021). Kreativitas Belajar Peserta Didik pada Pembelajaran Pendidikan Agama Islam: Pengaruh Lingkungan Sekolah dalam Pengajaran. *Jurnal Pendidikan Agama Islam Al-Thariqah*, 6(2), 222-243.

Anggraini, T., Mustar, S., & Putri, D. P. (2020). Peningkatan Kreativitas Berpikir Peserta didik Dalam Implementasi Kurikulum 2013 Pada Pembelajaran Pai. *Al-Mau'izhoh*, 2(2), 362950.

Aristawati, N. K., Sadia, I. W., & Sudiatmika, A. A. I. A. R. (2018). Pengaruh Model *Problem Based Learning* Terhadap Pemahaman Konsep Belajar Fisika Peserta Didik SMA. *Jurnal Pendidikan Fisika Undiksha*, 8(1), 31-41.

Azizah, Z., Taqwa, M. R., & Assalam, I. T.(2020). Analisis Pemahaman Konsep Fisika Peserta Didik Menggunakan Instrumen Berbantuan Quizziz. *Edusains Jurnal Pendidikan Sains & Matematika*, 8(2).

Dewi, S. M., Harjono, A., & Gunawan, G. (2016). Pengaruh model pembelajaran berbasis masalah berbantuan simulasi virtual terhadap penguasaan konsep dan kreativitas fisika siswa SMAN 2 Mataram. *Jurnal Pendidikan Fisika dan Teknologi*, *2*(3), 123-128.

Hastini, L. Y., Fahmi, R., & Lukito, H. (2020). Apakah Pembelajaran Menggunakan Teknologi dapat Meningkatkan Literasi Manusia pada Generasi Z di Indonesia?. *Jurnal Manajemen Informatika (JAMIKA)*, 10(1), 12-28.

Hutabarat, H., Harahap, M. S., & Elindra, R. (2022). Analisis penerapan kurikulum merdeka belajar di SMA Negeri Sekota Padangsidimpuan. *Jurnal MathEdu (Mathematic Education Journal)*, *5*(3), 58-69.

Janah, M. C., Widodo, A. T., & Kasmui, K. (2018). Pengaruh model *problem based learning* terhadap hasil belajar dan keterampilan proses sains. *Jurnal Inovasi Pendidikan Kimia*, 12(1).

Melanie, T. S., Taufik, M., & Harjono, A. (2023). Problem-Based Learning Assisted by Mobile Pocket Book in Mechanical Wave to Enhances Students' Concepts Mastery and Creativity. *Jurnal Pendidikan Fisika dan Teknologi*, *9*(2), 234-242.

Oktaviani, W., Gunawan, G.,& Sutrio, S. 2017. Pengembangan Bahan Ajar Fisika Konseptual Untuk Meningkatkan Penguasaan Konsep

Peserta didik. *Jurnal Pendidikan Fisika dan Teknologi*. 3(1):1-7.

Robiyanto, A. (2021). Pengaruh model problem based learning terhadap hasil belajar siswa. Mahaguru: Jurnal Pendidikan Guru Sekolah Dasar, 2(1), 114-121.

Romadhon, D. W. S., & Imawan, M. R. (2024). Kemampuan komunikasi dan berpikir kreatif peserta didik pada materi organisasi kehidupan melalui penerapan model Project Based Lerning (PjBL). Proceeding Umsurabaya, 1(1).

Sugiyono. (2017). *Metode Penelitian Kuantitatif, Kuantitatif dan R&D*. Bandung: Alfabeta, CV.