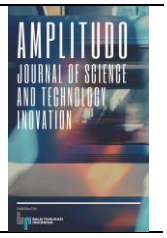
AMPLITUDO 2(2) (2023)

AMPLITUDO: Journal of Science & Technology Innovation

https://journals.balaipublikasi.id



Application of Problem-Based Learning Model (PBL) as an Effort to Overcome Misconceptions in Black Body Radiation Material

Thufail Mujaddid Al-Qoyyim[1]*

[1] Physics Education Study Program., Faculty of Education, University of Mataram, Lombok, Indonesia.

Received: April 20, 2023
Revised: Mei 25, 2023
Accepted: July 26, 2023
Published: Agustus 31, 2023

Corresponding Author:
Thufail Mujaddid Al-Qoyyim
thufail.mujaddid19@gmail.com

DOI: 10.56566/amplitudo.v2i2.84

Abstract: Physics cannot be separated from things that are conceptual. The concept of physics is a description or definition of the physical variables that exist in events in the universe. It's just that, often there is a problem in students' understanding of concepts where there is a discrepancy between the definitions that are understood and those conveyed by experts. This problem is called a misconception. Misconceptions can occur because the concepts that students understand through observation of everyday events are different from the theories obtained in the learning process in class, one of which is on black body radiation material. One learning model that can overcome misconceptions is a problem-based learning model or Problem Based Learning (PBL). The purpose of this study was to reduce misconceptions about black body radiation and to determine the effectiveness of PBL in overcoming misconceptions about black body radiation. This research is a type of experimental research using a pre-experimental design pre-test post-test group. The results showed that PBL can reduce misconceptions and is quite effective as an effort to reduce misconceptions about black body radiation material marked with an N-Gain value of 0.55.

Keywords: Black body radiation; Misconceptions; Problem Based Learning.

Introduction

Science is a studies events in the universe based on their causes and effects (Pitrah et al., 2018). One branch of knowledge in science is Physics. Physics is stated as a science that examines the relationship between energy and material entities and events related to them (Hermansyah et al, 2015). Existing events are analyzed through a series of systematic flows with due regard to scientific ethics so that a scientific product can be produced in the form of theories, principles and concepts (Trianto, 2010). Gunawan et al (2014) details that physics contains matters related to laws, principles, models, facts, and concepts. Based on this description it can be concluded that Physics is a branch of natural science that examines physical events in the universe through a series of scientific processes with principles, theories, laws and concepts as products.

When viewed from the existing definition, physics cannot be separated from things that are conceptual. The concept of physics is a description or definition of the physical variables that exist in events in the universe. An understanding of physics concepts will lead to a good learning process (Haryadi et al., 2016)). A good concept is an idea that is synthesized through meaningful experiences in everyday life (Fadllan et al., 2019). It's just that, often a problem occurs in students' understanding of concepts where there is a discrepancy between the definitions understood and those conveyed by experts. These problems are called misconceptions.

Misconceptions can occur because the concepts that students understand through observation of daily events are different from the theories obtained in the

How to Cite:
Al-Qoyyim, T. M. (2023). Application of Problem-Based Learning Model (PBL) as an Effort to Overcome Misconceptions in Black Body Radiation Material. *AMPLITUDO: Journal of Science and Technology Innovation*, 2(2), 125–129. https://doi.org/10.56566/amplitudo.v2i2.84

learning process in class (Anggrayni & Ermawati, 2019; Fratiwi et al., 2019). Physics misconceptions often occur in various physics materials, for example Newton's law, work and energy, temperature and heat, Archimedes' law, black body radiation and other matter (Energi et al., 2019; Lulut et al., n.d.; Setyabudi & Rosdiana, 2020). Existing misconception problems will hinder students' thinking processes and learning processes so that the objectives of learning cannot be achieved in full

Efforts to overcome misconceptions need to be planned and implemented seriously. One way to reduce misconceptions is to facilitate the learning process of students using appropriate learning models so that students get meaningful learning. A learning model that can overcome misconceptions is a problem-based learning model or Problem Based Learning (PBL) (Yul Launde et al., 2020.). PBL is a learning model that facilitates the learning process through actual and realistic problems and emphasizes the use of communicative discussion patterns and promotes collaborative values. The use of the right PBL Model and according to the needs of students, can improve various abilities of students, not only overcome physics misconceptions. PBL can improve understanding of physics concepts (Manalu, 2022), critical thinking skills (Yanti et al., 2021), creative thinking skills (Ridwan et al., 2021), learning outcomes (Robiyanto, 2021) and can reduce misconceptions in students.

Nafiah & Suyanto (2014.) state that through PBL students will get problems related to everyday life. Syntax in PBL facilitates students to build their own knowledge independently. Nurfadhillah et al (2022) explained the steps in PBL, that is, the stages in PBL begin by giving problem orientation to students. Then organize students to be given further investigation guidance. Finally, the development and presentation as well as the results of the analysis and evaluation of the results of the investigation are carried out on oriented problems

Based on this description, the author intends to conduct research that aims to overcome the misconceptions of prospective student researchers on black body radiation material using PBL. Besides that, this research's goal is aslo to determine the effectiveness of PBL in overcoming the misconceptions of prospective student researchers on black body radiation material.

Method

This study used a pre-experimental design with a one-group pretest-posttest design (table 1). The independent variable in this study is the PBL model and the dependent variable is a misconception about black body radiation. First given a pretest then given treatment (treatment) intentionally and systematically in class groups using the PBL model and given a post-test at the end of learning.

Table 1. Research Design One Group PreTest-PostTest

Group	Pre-test	Treatment	Post-test
Experiment	O1	X	O2

(Sugiyono, 2021)

The research population was all physics education students at the University of Mataram who took astronomy courses. The research sample is Astronomy B class with a purposive sampling technique. The instrument in this study was a multiple-choice Diagnostic Test that had been tested by experts. The effectiveness of PBL on the material misconception of black body radiation is determined through the N-Gain Score data analysis method (equation 1). The results of the N-Gain interpretation can be seen in table 2.

$$N - Gain = \frac{posttest - pretest}{Maximum\ Score - pretest} \quad (1)$$

Table 2 Interpretation of N-Gain Score

N-Gain Score	Interpretation
x > 0.70	very effective
0.30 < x < 0.7	quite effective
x < 0.30	less effective

Results and Discussion

This study uses a problem-based learning model or Problem Based Learning (PBL). This study aims to overcome the misconceptions of prospective research students on black body radiation using PBL and to determine the effectiveness of PBL to overcome misconceptions. The research was conducted in the astronomy course class at the Physics Education study program at the University of Mataram with 17 students as the sample. Data collection in this study was to determine the effectiveness of using PBL to reduce student misconceptions about black body radiation by using the N-Gain interpretation.

First, before learning begins, a pre-test is given to students. The pre-test was given to measure students' initial misconceptions about black body radiation. The pre-test instruments are arranged based on the grid in the table. There are 12 items with 4 main sub-chapters, namely heat radiation, Wien's displacement law, Planck's quantum theory, and Kirchoff's law of spectra. The pre-test is a multiple-choice diagnostic test. The average value of the pre-test results is 35 with a minimum value of 16 and a maximum value of 60.

Table 3. PBL implementation syntax

Learning Stages	Learning Activities
Orient problems to students	• Researchers direct students to observe the video on the link: https://www.youtube.com/watch?v=_0tkbp8yk-w&t=198s • Researchers ask questions to students • Students comment by raising their hands
Organizing Students	• Researchers direct students to sit in groups (into 4 groups) • The researcher asked several questions based on the black body radiation subchapter
Guiding Research	• Students discuss and find answers to each question through books, articles or the internet.
Develop and present the work	• The researcher directed students to present a sub-discussion of the discussion results for one group, while the others listened
Analyze and evaluate	• The researcher asked the students' willingness to provide questions and input to the group that delivered the presentation • The researcher gave a reflection in the form of a slide presentation that had been prepared

From the results of the pre-test carried out, it can be seen that more than 60% of students experience misconceptions about all sub-matter of black body radiation. The highest misconceptions occur in the sub-matter of the Stefan-Boltzmann law equation, Wien's displacement law, and types of spectra according to Kirchoff's theory. The results of the pre-test analysis then become a reference in implementing PBL learning.

After the pretest was carried out, a student discussion group was formed with 5-6 members. Then, learning is carried out by referring to the PBL syntax. Learning begins with the introduction of problem orientation regarding black body radiation. A learning video is shown which contains problems and black body radiation material. At the beginning of the video, it is explained about the concept of a color spectrum according to Kirchoff's law, that there are objects that can display a spectrum continuously, by absorption, and by emission. It then explains the concept of a black body and its relation to the Stefan-Boltzmann law and the Wien shift law. Wien's Shift Law explains that the shorter the wavelength of a spectrum, the greater the energy emitted. Finally, the video gives an example of a black body case observed using a thermal camera. The video is given as a stimulus for students so that they are stimulated to ask questions and gather information. In addition, learning videos are also able to provide a stimulus so that learning takes place more systematically and directly(Hafizah, 2020)

The next step is to organize students by asking questions related to the displayed learning videos. Four questions become the topic of discussion for each group. The questions are how the laws and theories are shown in the video, how the meaning of each law is shown in the video, and why the events shown in the video can occur.

The next stage is to guide the investigation of the problem according to the topic of the questions that have been given so that group discussions occur. The discussion is intended so that each student can express their respective understanding. Guided and directed discussions are also able to increase students' understanding so that they can improve learning outcomes (Al Munawwarah et al., 2018.) Then students present the results of the discussion in front of the class and get questions from other groups.

Table 4. The results of the analysis of misconceptions before and after being given treatment

Material	The number of students who have misconceptions (%)	
	Before PBL	After PBL
Understand the Stefan-boltzmann law	73.30	23.60
State the Stefan-Boltzmann law equation	80.00	17.70
Understand the factors that affect the luminosity of a black body	73.30	35.30
Understanding Wien's displacement law	86.70	52.90
Determine whether a statement is true or false based on Wien's displacement law	86.70	47.10
Determine the equations of Planck's quantum theory	67.30	23.50
Determine the type of kirchoff spectrum	60.00	23.50
Understanding the types of spectra according to Kirchoff's theory	73.00	11.80

Finally, reflection is made on efforts to strengthen concepts and correct concepts that are still wrong so that misconceptions can be reduced. Among the concepts with high misconceptions is the meaning of the Stefan-Boltzmann law and its equations, the meaning of the Wien shift law and its equations, and the understanding of the spectrum concept based on Kirchoff's law. In the discussion of the Stefan-Boltzmann law, it is explained that the amount of energy emitted by a perfectly black

body is directly proportional to the fourth power of the absolute temperature of the object and the surface area of the black body. In the discussion of Wien's displacement law, it is explained that the shorter the wavelength of an object's spectrum, the greater the amount of energy emitted by an object. As for the discussion of the color spectrum according to Kirchoff's law, it is explained the classification of the type of spectrum and its characteristics.

At the end of the study, a post-test was carried out to measure the final misconception after being given treatment in the form of a PBL model on black body radiation material. Comparison of pre-test and posttest results can be seen in the table. Based on the table, all sub-materials have decreased in percentage so that it can be seen that the PBL learning given can reduce the percentage of misconceptions.

Table 5. Result of pre-test, post-test dan N-Gain Score

	Pretest	Posttest	N-Gain
Mean	35.0588	71.0588	0.55

The effectiveness of using PBL is measured by looking at the N-Gain value obtained by calculating the average pre-test and post-test average values. The N-Gain value is 0.55. that is, the use of PBL is quite effective in reducing student misconceptions about black body radiation.

Conclusion

Based on the results of data analysis and discussion, it can be concluded that problem-based learning (PBL) can reduce student misconceptions. In addition, the use of PBL is also quite effective in overcoming misconceptions in students.

Acknowledgments

We thank to Physics Education Departemet University of Mataram which has provide astronomy course and to all lecturer who has guided us in completing this scientific work. May Allah bless every knowledge we got.

References

Al Munawwaarah, A.A., Arafah, K. (2018). Pengaruh Metode Diskusi Kelompok Terhadap Hasil Belajar Fisika Peserta Didik Kelas XI SMA Negeri 8 Makasar. *Jurnal Sains dan Pendidikan Fisika*. 14 (1). 11-15. Retrieved from https://media.neliti.com/media/publications/319210-pengaruh-metode-diskusi-kelompok-terhada-f2865830.pdf

Anggrayni, S., & Ermawati, F. U. (2019). The validity of Four-Tier's misconception diagnostic test for Work and Energy concepts. *Journal of Physics: Conference Series*, *1171*(1), 012037. https://doi.org/10.1088/1742-6596/1171/1/012037

Mursalin. (2019). Meminimalkan Miskonsepsi Pada Topik Gaya, Usaha dan Energi dengan Menggunakan Smartphone. *Jurnal Penelitian Bidang Pendidikan*. 25 (1). 41-48. Retrieved from https://jurnal.unimed.ac.id/2012/index.php/penelitian/article/download/15531/12297

Fadllan, A., Prawira, W. Y., Arsini, & Hartono. (2019). Analysis of students' misconceptions on mechanics using three-tier diagnostic test and clinical interview. *Journal of Physics: Conference Series*, *1170*(1), 012027. https://doi.org/10.1088/1742-6596/1170/1/012027

Fratiwi, N. J., Samsudin, A., Kaniawati, I., Suhendi, E., Suyana, I., Hidayat, S. R., Zulfikar, A., Sholihat, F. N., Setyadin, A. H., Amalia, S. A., Jubaedah, D. S., Muhaimin, M. H., Bhakti, S. S., Purwanto, M. G., Afif, N. F., & Coştu, B. (2019). Overcoming Senior High School Students' Misconceptions on Newton's Laws: A DSLM with Inquiry Learning based Computer Simulations. *Journal of Physics: Conference Series*, *1204*(1), 012023. https://doi.org/10.1088/1742-6596/1204/1/012023

Gunawan, G., Setiawan, A., & Widyantoro, D. H. (2014). Model Virtual Laboratory Fisika Modern untuk Meningkatkan Keterampilan Generik Sains Calon Guru. *Jurnal Pendidikan dan Pembelajaran (JPP)*, 20(1), 25-32. Retrived from http://journal.um.ac.id/index.php/pendidikan-dan-pembelajaran/article/view/3867

Hafizah, S. (2020). Penggunaan Dan Pengembangan Video Dalam Pembelajaran Fisika. *Jurnal Pendidikan Fisika*, *8*(2), 225. https://doi.org/10.24127/jpf.v8i2.2656

Haryadi, R., Oktarisa, Y., & Darman, D. R. (2016). Penerapan Konsep Fisika Dengan Menggunakan Food Storage Technique Suku Baduy. *Gravity: Jurnal Ilmiah Penelitian Dan Pembelajaran Fisika GRAVITY*, *2*(2). Retrieved from https://jurnal.untirta.ac.id/index.php/Gravity/article/view/1127/894

Hermansyah, H., Gunawan, G., & Herayanti, L. (2017). Pengaruh Penggunaan Laboratorium Virtual Terhadap Penguasaan Konsep dan Kemampuan Berpikir Kreatif Siswa pada Materi Getaran dan Gelombang. *Jurnal Pendidikan Fisika Dan Teknologi*, 1(2), 97–102. https://doi.org/10.29303/jpft.v1i2.242

Ridwan, Y.H., Zuhdi, M., & Sahidu, H. (2021). Pengembangan Media Pembelajaran Interaktif Berbasis Model Problem Based Learning Untuk Meningkatkan Kemampuan Berpikir Kreatif Fisika Peserta Didik. *ORBITA : Jurnal Kajian, Inovasi dan Aplikasi Pendidikan Fisika*. 7 (1). 103-108. https://doi.org/10.31764/orbita.v7i1.3832

Launde, D.Y., Pongoj, E.J., & Tuerah, J.M. (2020). Penggunaan Pembelajaran Problem Based Learning (PBL) untuk Mengurangi Miskonsepsi Pada Materi Asam Basa. *OXYGENIUS : Journal of Chemistery Education*. 2 (2). 34-40. https://doi.org/10.37033/ojce.v2i2.139

Lulut, J., Tandililing E., & Mursyid, S. (2019). Remidiasi Miskonsepsi Tentang Hukum Archimedes Menggunakan Model Discovery Learning Peserta Didik SMP. *Jurnal Pendidikan dan Pembelajaran Khatulistiwa*. 8 (9). 1-9. http://dx.doi.org/10.26418/jppk.v8i9.36081

Manalu, A. (2022). Pengaruh Model Pembelajaran Problem Based Learning Terhadap Pemahaman Konsep Fisika Siswa. *Jurnal Ilmiah Simantek*, 6 (2), 22-26. Retrieved from https://simantek.sciencemakarioz.org/index.php/JIK/article/view/335

Nafiah, Y.N., & Suyanto,W. (2014). Penerapan Model Problem Based Learning Untuk Meningkatkan Keterampila Berpikir Kritis dan Hasil Belajar Siswa. *Jurnal Pendidikan Vokasi*. 4 (1). 125-143. http://dx.doi.org/10.21831/jpv.v4i1.2540

Nurfadhillah, D. U., Elmiati, & Putri, D. M. (2022). Sintak Model Problem Based Learning Pada Rencana Pelaksanaan Pembelajaran Peneliti Di Sekolah Menengah Pertama. *EduCurio: Education Curiosity*, *1*(1), 28–34. Retrieved from http://qjurnal.my.id/index.php/educurio/article/view/19

Pitrah., Sutrio., & Taufik, M. (2018). Pengaruh Model Pembelajaran Berbasis Masalah Berbantuan Alat Peraga Tiga Dimensi Terhadap Hasil Belajar Fisika Peserta Didik Tahun Pelajaran 2017/2018. *Jurnal Pendidikan Fisika dan Teknologi*. 4(2). 283-290. https://doi.org/10.29303/jpft.v4i2.566

Robiyanto, A. (2021). Pengaruh Model Problem Based Learning terhadap Hasil Belajar Siswa. *Jurnal Pendidikan Peneliti Sekolah Dasar*. 2 (1). 114-121. Retrieved from https://ummaspul.e-journal.id/MGR/article/download/1752/575

Setyabudi, L. D., & Rosdiana, L. (2020). Identifikasi Miskonsepsi Materi Hukum Newton Menggunakan Certainty Of Response Index (CRI) Pada Siswa Kelas Viii SMP. *Pensa E-Jurnal : Pendidikan Sains, 8* (3), 340-345. Retrieved from https://ejournal.unesa.ac.id/index.php/pensa/article/view/38411

Sugiyono. (2021). *Metode Penelitian Kuantitatif, Kualitatif dan R&D*. Bandung : Alfabeta.

Trianto. (2010). *Model Pembelajaran Terpadu Konsep, Strategi, dan Implementasinya dalam Kurikulum Tingkat Satuan Pendidikan (KTSP).* Jakarta: Bumi Aksara.

Yanti, J., Istiqomah, N., & Indarini, E. (2021). Meta Analisis Efektivitas Model Problem Based Learning dan Problem Posing Terhadap Kemampuan Berpikir Kritis Siswa Sekolah Dasar Pada Pembealajaran Matematika. *Jurnal Cendekia : Jurnal Pendidikan Matematika.* 5 (1). 670-681. https://doi.org/10.31004/cendekia.v5i1.553