JPPIPA 9(9) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Analysis of Differentiate Learning with Classroom Action Research to Improve Physics Activities and Outcomes

Trapsilo Prihandono[1*], Agung Supriyono[1], Ujang Fahmi Abdillah[2], Sudarti[1]

[1] Physics Education Department, University of Jember, Jl. Kalimantan Tegalboto No. 37, Krajan Timur, Sumbersari, Jember, Indonesia.
[2] State Senior High School 3 Jember, Jl. Jend. Basuki Rachmad No. 26, Gumuksari, Tegal Besar, Jember, Indonesia.

Received: March 14, 2023
Revised: May 19, 2023
Accepted: September 25, 2023
Published: September 30, 2023

Corresponding Author:
Trapsilo Prihandono
trapsilo.fkip@unej.ac.id

DOI: 10.29303/jppipa.v9i9.3426

Abstract: Differentiated learning is a form of learning that is oriented to the needs of students. This research is a classroom action research which aims to determine the effect of implementing visual, auditory, and kinesthetic (VAK) learning style-based differentiation in the Problem Based Learning (PBL) model on students' physics learning activities and outcomes. The material used is global warming. This research was conducted in class X-2 of State High School 3 Jember for the 2022/2023 Academic Year. The subjects of this study were of 36 students who were divided into three VAK learning style profile categories. This research includes quantitative descriptive research. The research data collection method used a Likert scale learning style questionnaire, activity observation sheets and written tests to obtain students' physics learning outcomes. The design used in this study was the Tagart and Kemmis model cycles and the data obtained was analyzed using classical learning completeness. The results showed that there was an increase in student learning activities by 20.14% and an increase in student physics learning outcomes classically by 25% and the average level of mastery learning was above the minimum completeness criteria with an increase in the average score of 6.06. Based on the results of the study, it can be concluded that the application of the PBL learning model based on VAK learning style differentiation can increase student activity and learning outcomes.

Keywords: Differentiate learning; Learning outcomes; Student activity; VAK learning style

Introduction

The Government of the Republic of Indonesia has launched a new paradigm learning system to advance and restore national education after the Covid-19 pandemic by launching the Merdeka Curriculum. Implementation of this merdeka curriculum will later be able to realize students' rights and abilities to determine their learning process through setting learning objectives, reflecting on abilities, and taking steps proactively and responsibly for their own success (Fitriyah et al., 2022). The Merdeka Curriculum provides flexibility for teachers to develop learning according to the needs and characteristics of their students. The facts found at this time indicate that many processes of meeting student learning needs have not been fully implemented. One of the factors is the difference in student learning styles. Therefore, differentiated learning is one of the solutions.

Learning style is one of the characteristics of students which is one of the important variables in learning. Learning style is also defined as differences in individual tendencies to process certain types of information (Rahadian et al., 2023). Differentiated learning with an overview of learning styles can make it easier for students to represent their needs. Process meeting the learning needs of these students is in accordance with the humanistic learning theory developed by Abraham Maslow, namely viewing the learning process of students as an effort to achieve self-actualization and develop their potential (Almasri, 2022). Therefore the role of the teacher in developing differentiated learning with an overview of learning styles is needed to optimize the fulfillment of student learning.

How to Cite:
Prihandono, T., Supriyono, A., Abdillah, U. F., & Sudarti, S. (2023). Analysis of Differentiate Learning with Classroom Action Research to Improve Physics Activities and Outcomes. *Jurnal Penelitian Pendidikan IPA*, *9*(9), 7427–7433. https://doi.org/10.29303/jppipa.v9i9.3426

The learning process of distinguishing learning styles can be a solution to respond to students' needs, styles, interests, and learning potential. In general, there are three learning styles that many people have as stated by Bobbi DePorter, namely the VAK learning style (Visual, Auditory, and Kinesthetic). Visual learning style is a learning style in which people learn well when using their sense of sight. Auditory learning style is a learning style in which people learn better when they use their sense of hearing. Kinesthetic learning style is a learning style that involves movement, processing and experimenting (Dunn, 1993).

VAK learning is a teaching method that can be applied to all students. This method is expected to expedite the teaching and learning process because the teacher has reached all learning styles. students can learn with different learning styles at one time (Hidayatullah et al., 2022). The results of the study show that VAK-based differentiation learning have a relationship to learning outcomes or student achievement (Almomani, 2019; Bakri et al., 2019; Cimermanová, 2018; Devy et al., 2022; Khodabakhshzadeh et al., 2017; Magulod, 2019).

In addition to influencing learning outcomes, the implementation of the VAK model in learning actually affects students' learning motivation. There are differences in learning motivation between before and after learning based on visual, auditory, and kinesthetic learning methods (Istiqomah et al., 2023; Rahmi et al., 2023). The increase in learning desire increased from 66% to 87.5% (in moderate learning motivation), this can be observed in the Sig (2-tailed) output value of 0.382 (>0.05) (Yusnanto et al., 2021).

Problem solving is a necessary skill in the 21st century (Ince, 2018). Research on the relationship between the VAK learning style and the problem solving process shows that in high-level physics material it is better for the auditory learning style (Hakim et al., 2022). However, the kinesthetic learning style shows a scientific attitude in solving problems better (Nugraha et al., 2020).

Based on the results of these studies, it is necessary to conduct further research on learning style differentiation in physics learning to increase activity and learning outcomes students through the Problem Based Learning (PBL) model. The PBL model is a learning framework that encourages students to be in direct contact with authentic problems at school real environment. Through models PBL, students can construct their own knowledge, grow it problem solving skills with think critically, and get used to being independent and increase their confidence in learning (Docktor et al., 2016; Permatasary et al., 2018; Syarifah, 2022).

Teachers as planners and executors must be able to determine the strategy appropriate learning the needs of students and systematically. A systematic learning strategy will provide advantages when implementing learning (Chetty et al., 2019). Teachers must have a variety of teaching styles in order to meet the needs of students' learning styles so that students are motivated during the learning process (Ridwan et al., 2019; Wulandari et al., 2023; Yotta, 2023). The use of E-learning and virtual lab is expected to help teachers in managing classes. E-learning that supports student learning styles has a positive impact and is more effective in learning (Hermansyah et al., 2021; Khamparia et al., 2020; Yulianci et al., 2021).

Based on the description above, further research is needed to examine the application of differentiated learning strategies in the PBL model in terms of the VAK learning style to increase the activity and learning outcomes of physics class X (ten) on Global Warming.

Method

This type of research is Classroom Action Research. Classroom Action Research is research that aims to improve learning processes and outcomes (Parnawi, 2020). This research is done as many as two cycles that aim to determine the impact of learning differentiate on a PBL-based model VAK learning styles on physics learning activities and outcomes. The cycle model design uses the Tagart and Kemmis models which consist of four components, namely planning, action, observation and reflection which are depicted in Figure 1 below.

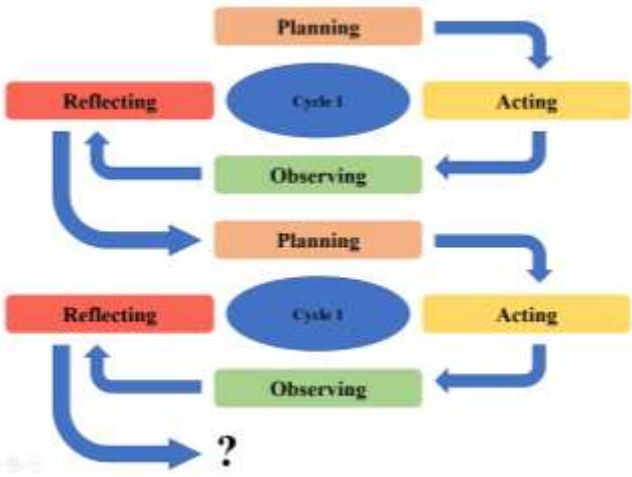

Figure 1. Tagart and kemmis research models

The subjects of this study were all students of class X-2 State Senior High School 3 Jember Academic Year 2022/2023 as many as 36 people. The research was conducted in the odd semester in January of the year

2023. Data collection techniques used include observation, tests, and documentation. Data collection refers to the Sugiyono model by reducing data, presenting data, and drawing conclusions (Sugiyono, 2019). Learning activities are obtained through observation sheets, while physics learning outcomes are obtained through post-test questions. Next data activities and learning outcomes were analyzed using the following techniques.

Teacher Activity Analysis

Observation sheet data teacher activity is analyzed using the following Equation 1.

$$S = \frac{R}{N} x\ 100\% \quad (1)$$

S : percent value sought
R : the number of teacher who do the activity
N : the total number of students

Table 1. Teacher Activity Criteria

Activity (%)	Criteria
86-100	Very Good
76-85	Good
60-75	Pretty Good
55-59	Not Good
<54	Not Good

Student Activity Analysis

The data obtained from the results of the student activity observation sheet during the learning process in the analysis using the following Equation 2.

$$AP = \frac{\sum P}{\sum p} x\ 100\% \quad (2)$$

AP : percent value sought
$\sum$P : the number of student who do the activity
$\sum$p : the total number of students

Table 2. Participant Activity

Activity (%)	Criteria
81-100	Very Active
61-80	Active
41-60	Quite Active
21-40	Less Active
0-20	Not Active

Analysis of Student Learning Outcomes

Data on student learning outcomes were obtained through tests conducted at end of each cycle. The data will be processed in classical completeness with minimum completeness criteria (score 76) ≥ using the following Equation 3.

$$NP = \frac{R}{SM} x\ 100\% \quad (3)$$

NP : percent value sought
R : total number of students who scored>76
SM : the total number of student

Table 3. Criteria for Completeness of Learning Outcomes

Completeness Learning (%)	Criteria
80-100	Very well
66-79	Good
56-65	Enough
40-55	Not Enough
<40	Very Less

Result and Discussion

The Problem Based Learning (PBL) model is a learning model that makes contextual problems a stimulus to acquire knowledge and concepts with critical thinking skills in solving problems. The application of the PBL model will involve students actively in solving problems so that they can foster their curiosity (Zaidah and Hidayatulloh, 2023). The initial step taken by the teacher is to carry out a diagnostic assessment noncognitive to determine learning styles each student. The results of the non-cognitive diagnostic assessment are shown in Figure 2 below.

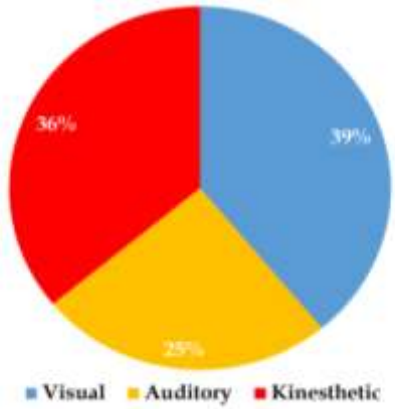

Figure 2. Non-cognitive diagnostic assessment results

Figure 2. Shows that there is 14 student with a visual learning style type (39%), 9 student (25%) with an auditory learning type, and 13 student with a kinesthetic type. Based on research data in the form of teacher activities, student activities, and physics learning outcomes are described as follows.

Teacher Activity

The results of the analysis of teacher activities in cycle I and cycle II in each implementation of learning activity steps are presented in Table 4.

Table 4. Activity Analysis Result

Data	Percentage (%)		Average
	Cycles I	Cycles II	
Teacher Activity	77.78	91.67	84.72
Category	Good	Very Good	Good

Based on the analysis results of Table 4, teacher activity in cycle I was classified as a good category with a percentage value 77.78%. This shows that the teacher's activity after using the model PBL with a learning strategy with VAK learning style differentiation has increased. Meanwhile, teacher activity in cycle II increased by 91.67% in the very good category. In cycle I, the teacher has started to master the learning model but there are several indicators that are not implemented properly such as the lack of organizing students so that they waste too much time and perceptions that are not relevant to the previous learning material. Meanwhile in cycle II, the teacher began to master and understand the syntax in the PBL model and experienced an increase in class management. The teacher motivates students by applying the PBL model and providing Student Worksheets based on Technological Pedagogical Content Knowledge (TPACK). The recapitulation of the average value of teacher activity on each indicator is presented through Figure 3.

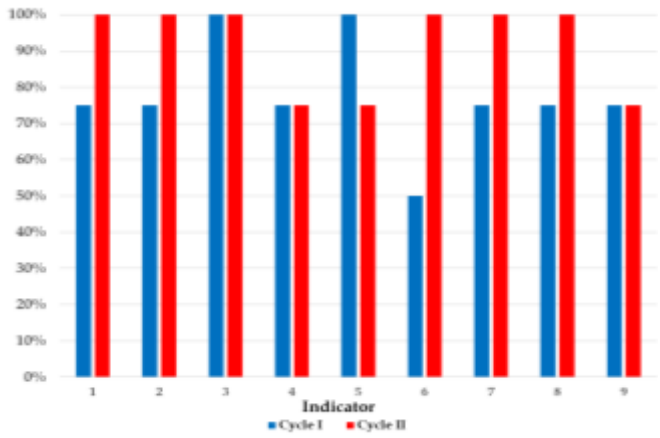

Figure 3. Average percentage of teacher activity each indicator

Figure 3. shows that teacher activity on each indicator has varying percentages. The lowest teacher activity in cycle I occurred in the 6th indicator, namely organizing students with a percentage of 50%. The lowest activity in cycle I is because the teacher has not mastered it differentiated learning strategies in terms of VAK learning style. Meanwhile, the highest percentage occurred in the fourth indicator. 3 and 5, namely providing motivation and using learning tools or media with a percentage of 100%. This matter because the teacher always motivates students to learn.

The results of the analysis of teacher activity in cycle II have increased, namely on the 1st, 2nd, 3rd, 6th, 7th and 8th indicators with a percentage value of 100%. Meanwhile, the 4th, 5th, and 9th activities with a percentage of 75% which shows that there are still three indicators sufficient criteria.

Student Activities

Before the action was taken, students were observed to have active activities less active. Based on the results of observations indicate that there are still many participants students who are less focused on the learning carried out by the teacher. Application of the PBL model with strategy differentiated learning in terms of VAK learning styles turned out to be capable improve student learning activities. The results of the analysis of student activity in cycle I and cycle II in each observed indicator is presented in Table 5.

Table 5. Result of Student Activity Analysis

Indicator	Percentage (%)		
	Cycles I	Cycles II	Increase
Student Activity	41.67	61.81	20.14
Category	Quite active	Active	

Based on Table 5, shows that there is an increase in the average percentage of observed activity by 20.14%. The average activity of students in cycle I is still quite sufficient active with an average percentage of 41.67%. Meanwhile, in cycle II has an average percentage value of learning activity of 61.81% and is in the active category. The recapitulation data for each indicator of student activity represented in Figure 4.

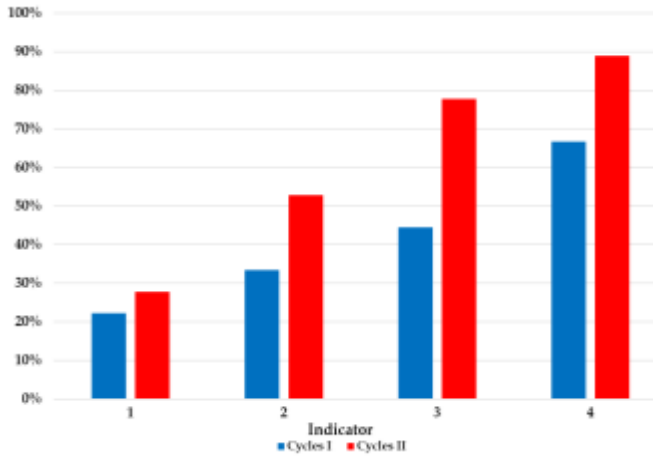

Figure 4. Student activities for each indicator

Figure 4. shows that for each activity indicator students have a variety of categories, namely less active, moderately active, and active. However, each indicator has increased. This is because students are getting used to and focused on learning using the PBL model with

differentiated learning based on VAK learning styles. The increase that occurred in each indicator was 5.56%; 19.44%; 33.33%; And 22.22%. The lowest student learning activity occurs in indicator 1, namely asking questions with an average percentage of 25%, while the highest activity occurs in indicator 4, namely communicating 77.78%. The results of increased student activity in the application of the PBL model with differentiated learning strategies based on VAK learning styles are in line with the results of research from Khairunisa et al. (2020) which states that the application of the PBL model is able to increase learning activities and student learning outcomes with a significance value of 0.028<0.05.

Learning Outcomes

The results of descriptive quantitative analysis of student learning outcomes after applying the PBL model with a style-based differentiation learning strategy learning VAK experienced an increase in classical mastery as presented in Table 6.

Table 6. Analysis of Student Learning Outcomes

Description	Cycle	
	I	II
Number of student	36	36
Completed student	26	35
Grade point average	79.44	85.50
Classical absorption	79.44%	85.50%
Classical terms	72.22%	97.22%

Based on the posttest scores in cycle I with a total of 36 students, the highest score was 100 while the lowest score was 40. The results of the posttest scores showed that 26 students completed (72. 22%) and 10 students did not complete (27.98%). This shows that the learning outcomes of students in cycle I already have a good category. Nevertheless, there were still 10 students who did not complete. This incompleteness was allegedly because students were not familiar with the learning system using the PBL model with the discussion method. This makes the fulfillment of the needs of students not optimal. In addition, there has not been good communication between teachers and students, so that students' learning motivation is still lacking.

On the other hand there are still students who have not focused on participating in learning, so that it is possible that not all students are actively involved in the learning process. Through reflection and evaluation of cycle I, follow-up was carried out to correct existing deficiencies starting from planning, implementation of Cycle II, and observation. In cycle II the learning outcomes of students were more improved compared to cycle I. The highest value is 94 while the lowest score was 74. Students who completed reached 35 people (97.22%) and who did not complete as many as 1 student (2.78%). Based on the posttest scores in cycle II, there is an increase in the average value class of 6.06 and so is the percentage of completeness of 25%.

In learning cycle II, the teacher directing students more and more intensively assisting participants students who are less active and encourage students who are afraid to present be brave to come in front of the class. After being given motivation and direction, students become more enthusiastic, active in discussions, and fighting over serial numbers to present work the group. Based on the percentage of classical completeness obtained in cycle II, the class is said to be complete. A class is said to be complete in learning (classical completeness) if there is ≥ 85% students who complete. Then the application of the PBL model with a differentiated learning strategy based learning style VAK able improve physics learning outcomes.

Conclusion

Based on the results of the analysis that has been carried out, it can be concluded that the application of differentiated learning strategies with classroom action research can increase the activity and learning outcomes of physics class X-2 of State Senior High School 3 Jember. Percentage increase in activity student learning by 20.14% and an average increase in the percentage of completeness of student learning outcomes by 25% with an average class score increased by 6.06. Almost all indicators observed in this study have increased. Differentiated learning can be developed more broadly by adjusting the needs of students such as the level of readiness and interest in learning so that the needs of students can be accommodated holistically.

Acknowledgements

The author would like to thank all parties and institutions who have been willing to contribute directly or indirectly to this research, starting from the preparation stage to the data collection process. For the cooperation and assistance provided, I hope this article can be useful for education in Indonesia.

Authors Contributions

Trapsilo Prihandono: Conceptualization, methodology, investigations, analysis, and writing. Agung Supriyono and Ujang Fahmi Abdillah: resource, editing and visualization. Sudarti: validations and review.

Funding

This researchreceived no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

References

Almasri, F. (2022). Simulations to Teach Science Subjects: Connections Among Students' Engagement, Self-Confidence, Satisfaction, and Learning Styles. *Education and Information Technologies*, *27*(5), 7161–7181. https://doi.org/10.1007/s10639-022-10940-w

Almomani, J. A. (2019). Preferred Cognitive Learning Patterns (VAK) Among Secondary Students Admitted to King Saud University and its Effect on their Academic Achievement in Physics. *International Education Studies*, *12*(6), 108. https://doi.org/10.5539/ies.v12n6p108

Bakri, R. A., Rahman, M. A., Jabu, B., & Jassruddin, J. (2019). Exploring the Impact of VAK Learning Style on Teenager Level Language Learners in Indonesia. *Journal of Language Teaching and Research*, *10*(4), 807. https://doi.org/10.17507/jltr.1004.17

Chetty, N. D. S., Handayani, L., Binti Sahabudin, N. A., Ali, Z., Hamzah, N., & Kasim, S. (2019). Learning styles and teaching styles determine students' academic performances. *International Journal of Evaluation and Research in Education (IJERE)*, *8*(4), 610. https://doi.org/10.11591/ijere.v8i4.20345

Cimermanová, I. (2018). The Effect of Learning Styles on Academic Achievement in Different Forms of Teaching. *International Journal of Instruction*, *11*(3), 219–232. https://doi.org/10.12973/iji.2018.11316a

Devy, N. K., Halim, A., Syukri, M., Yusrizal, Y., Nur, S., Khaldun, I., & Saminan, S. (2022). Analysis of Understanding Physics Concepts in terms of Students' Learning Styles and Thinking Styles. *Jurnal Penelitian Pendidikan IPA*, *8*(4), 2231–2237. https://doi.org/10.29303/jppipa.v8i4.1926

Docktor, J. L., Dornfeld, J., Frodermann, E., Heller, K., Hsu, L., Jackson, K. A., Mason, A., Ryan, Q. X., & Yang, J. (2016). Assessing student written problem solutions: A problem-solving rubric with application to introductory physics. *Physical Review Physics Education Research*, *12*(1), 010130. https://doi.org/10.1103/PhysRevPhysEducRes.12.010130

Dunn, R. da. K. J. D. (1993). *Teaching secondary students through their individual learning styles: Practical approaches forgrades 7-12*. Allyn and Bacon.

Fitriyah, C. Z., & Wardani, R. P. (2022). Paradigma Kurikulum Merdeka Bagi Guru Sekolah Dasar. *Scholaria Jurnal Pendidikan Dan Kebudayaan*, *12*(3), 236–243. https://doi.org/10.24246/j.js.2022.v12.i3.p236-243

Hakim, L., Lubis, P. H. M., Lefudin, L., & Sulistyowati, R. (2022). The Relationship between Learning Style toward Mastery of Concepts and Problem Solving Skill Introduction to Nuclear Physics for Pre-Service Teacher. *Jurnal Penelitian Pendidikan IPA*, *8*(2), 666–673. https://doi.org/10.29303/jppipa.v8i2.1176

Hermansyah, H., Nurhairunnisah, N., Sentaya, I. M., Sulindra, I. G. M., Andriani, N., & Gunawan, G. (2021). The Effect of Physics Virtual Experiments on Mastery Concept Based on Students Learning Style. *Journal of Physics: Conference Series*, *1933*(1), 012079. https://doi.org/10.1088/1742-6596/1933/1/012079

Hidayatullah, H., Munir, S., & Tawali. (2022). Enhancing Vocabulary Mastery through Applying Visual Auditory Kinesthetic (VAK): A Classroom Action. *JOLLS: Journal of Language and Literature Studies*, *2*(1), 43–52. https://doi.org/10.36312/jolls.v2i1.721

Ince, E. (2018). An Overview of Problem Solving Studies in Physics Education. *Journal of Education and Learning*, *7*(4), 191. https://doi.org/10.5539/jel.v7n4p191

Istiqomah, R., & Suryadarma, I. G. P. (2023). The effectiveness of the VAK (visualization, auditory, and kinesthetic) learning model on motivation and learning outcomes of biology on the reproductive system. *AIP Conference Proceedings*, *2556*(1), 030014. https://doi.org/10.1063/5.0111110

Khairunisa, A., Rohmadi, M., & Yuliani, H. (2020). Penerapan Problem Based Learning Berbasis Numbered Heads Together: Dampak Hubungan Aktivitas Dengan Hasil Belajar. *Kappa Journal*, *4*(2), 165–171. https://doi.org/10.29408/kpj.v4i2.2118

Khamparia, A., & Pandey, B. (2020). Association of learning styles with different e-learning problems: a systematic review and classification. *Education and Information Technologies*, *25*(2), 1303–1331. https://doi.org/10.1007/s10639-019-10028-y

Khodabakhshzadeh, H., Hosseinnia, M., & Rahimian, S. (2017). Learning Style, Metacognition and Creativity as Predictors of the Foreign Language Achievement: A Structural Equation Modeling Approach. *Psychological Studies*, *62*(4), 377–385. https://doi.org/10.1007/s12646-017-0427-5

Magulod, G. (2019). Learning styles, study habits and academic performance of Filipino University students in applied science courses: Implications for instruction. *Journal of Technology and Science Education*, *9*(2), 184. https://doi.org/10.3926/jotse.504

Nugraha, I., Putri, N. K., & Sholihin, H. (2020). An Analysis of the Relationship between Students' Scientific Attitude and Students' Learning Style in Junior High School. *Journal of Science Learning*, *3*(3),

185–195. https://doi.org/10.17509/jsl.v3i3.22873

Permatasary, Y., Purwoko, A. A., & Muntari, M. (2018). Pengaruh Model Pembelajaran Problem Based Instruction Terhadap Hasil Belajar Ditinjau dari Gaya Belajar Siswa. *Jurnal Penelitian Pendidikan IPA*, *4*(1), 57 61. https://doi.org/10.29303/jppipa.v4i1.104

Rahadian, R. B., & Budiningsih, C. A. (2023). Development of Classroom Management Based on Student Learning Style Database. *Multidisciplinary Scientific Journa for Innovative Research*, *1*(1), 1–8. https://doi.org/10.48550/arXiv.2302.04057

Rahmi, S., Sovayunanto, R., & Kusumawati. (2023). Identifying the Learning Style to Investigate Senior High School Students' Learning Loss Tarakan. *Proceedings of 1st Annual International Conference AICGC*, 134–140. https://doi.org/10.2991/978-2-38476-030-5_16

Ridwan, H., Sutresna, I., & Haryeti, P. (2019). Teaching styles of the teachers and learning styles of the students. *Journal of Physics: Conference Series*, *1318*(1), 012028. https://doi.org/10.1088/1742-6596/1318/1/012028

Sugiyono. (2019). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Alfabeta.

Syarifah. (2022). *Model Problem Based Learning & Pembentukan Kelompok Sosial*. Mikro Media Teknologi.

Wulandari, R. N., Kusairi, S., Purwaningsih, E., & Sutopo. (2023). The comparison of learning style on thermodynamic learning outcomes of public high school and Islamic boarding school. *AIP Conference Proceedings 2569*, 050020. https://doi.org/10.1063/5.0112243

Yotta, E. G. (2023). Accommodating students' learning styles differences in English language classroom. *Heliyon*, *9*(6), e17497. https://doi.org/10.1016/j.heliyon.2023.e17497

Yulianci, S., Nurjumiati, N., Asriyadin, A., & Adiansha, A. A. (2021). The Effect of Interactive Multimedia and Learning Styles on Students' Physics Creative Thinking Skills. *Jurnal Penelitian Pendidikan IPA*, *7*(1), 87–91. https://doi.org/10.29303/jppipa.v7i1.529

Yusnanto, R., & Rahayu, A. (2021). Application of Learning Video Based on Visual, Auditory, and Kinesthetic Learning Styles to Increase Thermodynamics Learning Motivation at Grade XI in High School. *Advances in Social Science, Education and Humanities Research*, *655*(3), 1715–1719. https://doi.org/10.2991/assehr.k.220404.278