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Research Article

The Effect of Problem-Based Learning Model on Problem Solving Ability in Terms of Academic Ability

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Abstract. This study is quasi-experimental research that aims to determine the effect of the application of Problem-Based Learning in improving problem solving skills in terms of different academic abilities. The population of this study were all students of class XI MIA in SMA Negeri 1 Jeneponto. The sampling technique used class-based sampling technique (simple random sampling) to select two equal classrooms from five classrooms. The research data were analyzed using descriptive and inferential statistics with two-way analysis of covariance (ANOVA). The results showed that there was an effect of Problem Based Learning model on the problem-solving ability of students in class XI MIA at SMA Negeri 1 Jeneponto. There is no effect of academic ability and no significant interaction between learning model and academic ability on problem solving ability.

Keywords: Problem Solving Ability, Academic Ability, Problem Based Learning

Introduction

The development of science and technology in the 21st century is progressing rapidly. Countries around the world are competing to prepare the next generation with character and competence in science and technology. Likewise, Indonesia, as a developing country with high human resource potential, needs to prepare its best breakthroughs, particularly in the field of education. This is essential to produce quality, adaptable, and competitive intellectuals on a global scale (Windy, 2013). Fadel (2008), as cited by Redhana (2019), adds that the framework of 21st-century skills consists of: (a) problem-solving and critical thinking; (b) inventive and creative thinking; (c) communication; and (d) teamwork.

According to Arnyana (2019), the four Cs are: 1) communication, 2) collaboration, 3) critical thinking and problem-solving, and 4) creativity and innovation. Sugiyarti et al. (2018) further state that the next generation will be greatly impacted by the adoption of the 4C learning concept in the 2013 Curriculum, which will prepare them to face the challenges of life in the twenty-first century. According to Redhana (2019), the four categories of the 21st century include tools for working and living in the world, ways of thinking, and ways of acting. Students in educational institutions are prepared to face various challenges in the future. One of the essential skills needed for students to confront current and future advancements is problem-solving ability. Critical thinking, creativity, collaboration, and communication are developed in students through problem-solving (Redhana, 2019). Nazayik (2017) adds that the core of education is problem-solving.

According to Supardi (2015), the low learning outcomes of students continue to be a significant issue faced by Indonesia in the realm of education. In the field of education, students play the primary role as subjects who are stimulated to engage actively in learning. Students' activity can be observed when they are able to solve problems presented by the teacher (Febrianto et al., 2019). Hoellwarth (2005) adds that learning in school's results in concept mastery but neglects problem-solving skills. Students are less actively involved in

Article info:
Received 05 September 2024; Received in revised form 05 November 2024; Accepted 06 November 2024

problem-solving. Students in the 21st century are also expected to have good collaboration skills with their peers and teachers, as this will create an active classroom atmosphere during the learning process (Saputri, 2017). Additionally, Sanjaya (2017) adds that good collaboration skills will contribute to forming an active classroom environment during lessons. Furthermore, with strong collaboration abilities, students will gain the capacity to understand themselves and others, enabling them to assist each other in achieving learning objectives.

According to Rahmatiah (2022), the role of teachers as educators is also crucial for the success of learning in the classroom, where teachers are required to possess knowledge and skills to provide information to their students that can be easily understood and comprehended in every lesson, especially in biology. Based on initial observations at SMA Negeri 1 Jeneponto, it was found that biology teachers implemented the cooperative learning model of Team Games Tournament. Team Games Tournament is a cooperative learning model designed to encourage collaboration and healthy competition among students. In this model, students are divided into small teams and participate in a series of games and tournaments to reinforce their understanding of biology subject matter (Wilsa, 2017). However, despite the many advantages of the cooperative learning model Team Games Tournament, such as increasing student motivation and strengthening teamwork, further observations have revealed several issues. According to Arikunto (2010), some students appear to be less active and motivated in learning, while others may feel intimidated by the competitive nature of this model. Additionally, there are indications that some students struggle to relate the concepts they are learning to real-life situations, resulting in a lack of understanding of the material.

To address these issues, an update to the learning process in schools is necessary. According to Imaduddina (2018), one renewal that can be made is to change the teaching methods used by teachers, implementing appropriate learning models that are expected to help students become more active in the classroom by enhancing collaboration among students during learning. This would create an active classroom environment and ultimately lead to improved learning outcomes and problem-solving abilities among students. Learning models should be relevant and support the achievement of teaching objectives (Apriyani, 2017). Nur (2011) adds that one way to engage students is by using the Problem Based Learning (PBL) model. According to Imaduddina (2018), learning models should be relevant and support the achievement of teaching goals. The purpose of teaching is to enable students to think actively and be given opportunities to test their abilities in various activities. One effective approach to engage students is through the Problem Based Learning (PBL) model. Nur (2011) further states that learning with the Problem Based Learning (PBL) model aligns with a teaching approach that presents challenges to students through real-world (open-ended) problems, both individually and in groups.

This is reinforced by Utami's (2013) theory, which states that, in principle, Problem Based Learning emphasizes the enhancement and improvement of learning methods aimed at increasing understanding in real-life situations, developing higher-order thinking skills, problem-solving abilities, enhancing student engagement in learning, developing decision-making skills, gathering information, and increasing confidence, responsibility, cooperation, and communication. Based on the above description, it is hoped that the Problem Based Learning model, tailored to academic ability, can positively influence the problem-solving abilities of students at SMA Negeri 1 Jeneponto, which has been observed. Previous researchers have shown that the Problem Based Learning model, when based on academic ability, has a positive impact on enhancing problem-solving skills. Therefore, the researcher

will conduct a study on the Influence of the Problem Based Learning Model on Problem-Solving Abilities Viewed from the Academic Ability of Class XI MIA at SMA Negeri 1 Jeneponto.

Material and Method

This type of research is quasi-experimental research using a 2 x 2 factorial design. This research involves 2 classes, one class as an experimental class and one class as a comparison or control class. The experimental class was given treatment, namely applying the Problem Based Learning model while the control class used the Team Games Tournament type cooperative learning model. The population in this study was the study group of SMA Negeri 1 Jeneponto which consisted of 5 rombel (study group) class XI MIA with a total of 143 students. The details of the population can be seen in Table 1.

Table 1
Research Population

No.	Class	Number of Students
1	XI MIA 1	29
2	XI MIA 2	28
3	XI MIA 3	28
4	XI MIA 4	29
5	XI MIA 5	29
Total		**143**

The research sample was students of class XI MIA SMA Negeri 1 Jeneponto who first tested equality. The sampling technique used a class-based sampling technique (simple random sampling) to select two equal classrooms from 5 classrooms. Determination of experimental class and control class randomly. The details of the population can be seen in Table 2.

Table 2
Research Sample

Class	Total
XI MIA 1 (Experiment)	29
XI MIA 5 (Control)	29
Total	**58**

The design used is a pretest-posttest nonequivalent control group design with a 2 x 2 factorial pattern because it uses independent learning variables (Problem Based Learning and Team Games Tournament) and moderator variables. The moderator variable is divided into 2 groups, namely students who have upper academic ability and lower academic ability as shown in Table 3.

Table 3
Research Design pretest-postest nonquivalent control group design

Academic Ability	Learning Strategy (S)	
	Problem Based Learning (S1)	Team Games Tornament (S2)
Upper (K1)	S1K1	S2K1
Lower (K2)	S1K2	S2K2

Description:
S = Learning Strategy
K = Academic Ability

The procedure for implementing the learning strategy treatment based on the research design is shown in Table 4.

Table 4
Treatment Class Based on Variables

Pretest	**Treatment**	***Posttest***
O1	S1K1	O2
O3	S1K2	O4
O5	S2K1	O6
O7	S2K2	O8

Description:
S1 = Problem-Based Learning strategies in the classroom
S2 = Team Games Tournament learning strategy class
O1,O3,O5,O7 = Pretest score
O2,O4,O6,O8 = Posttest score

This research uses quantitative data analysis techniques, namely data in the form of numbers obtained from research activities. Quantitative data analysis techniques in this study used two descriptive statistical techniques and inferential statistics. Before the data is analyzed, first conduct a prerequisite test, namely the normality test and homogeneity test.

Results and Discussion

Results

Descriptive Statistical Analysis

The frequency score distribution and the percentage score of students' problem-solving ability can be seen in Table 5. Based on Table 5, it can be concluded that in the class treated with the Problem Based Learning model, the pretest scores for problem-solving skills show that only 3 students (10.3%) were in the high category, 8 students (27.6%) were in the medium category, and 18 students (62.1%) were in the low category. However, after the implementation of the Problem Based Learning model, the posttest results show that out of 29 students, 23 students (79.3%) were in the high category, 5 students (17.2%) were in the medium category, and 1 student (3.4%) was in the low category.

Table 5
Frequency Distribution and Percentage of Pretest and Posttest Scores of Students' Problem-Solving Skills in the Problem Based Learning Class and Control Class

Score Interval	**Category**	**Problem Based Learning**				**Team Games Tournament**			
		Pretest		**Posttest**		**Pretest**		**Posttest**	
		f	**%**	**f**	**%**	**f**	**%**	**f**	**%**
65-100%	High	3	10,3	23	79,3	3	10,3	22	75,9
55-64%	Medium	8	27,6	5	17,2	8	27,6	2	6,9
0-54%	Low	18	62,1	1	3,4	18	62,1	5	17,2
Total		29	100	29	100	29	100	29	100

Whereas in the control class which was treated with the Team Games Tournament type cooperative learning model at the pretest stage, it can be said that only 3 students (10.3%)

were in the high category, 8 students (27.6%) were in the medium category and 18 students (62.1%) were in the low category. Meanwhile, in the posttest score of students, namely after the Team Games Tournament type cooperative treatment is applied in learning, a value is obtained where out of 29 students in the high category there are 22 students (75.9%), in the medium category there are 2 students (6.9%) and in the low category there are 5 students (17.2%).

As for the descriptive statistics of the score value of the problem-solving ability results in the class treated with the Problem Based Learning model and the control class treated with the Team Games Tournament type cooperative model in terms of high and low academic ability can be seen in Table 6.

Tabel 6

Distribution of Descriptive Statistics of the Results of Problem-Solving Ability of Students in Problem Based Learning Model and Team Games Tournament Type Learning Model Seen from Academic Ability

Learning Model	Academic Ability	Average	Standard Deviation	Sample Size
Problem Based Learning	High Academic	75,86	16,603	14
	Low Academic	74,13	18,349	15
	Total	74,97	17,237	29
Team Games Tournament	High Academic	67,29	13,056	17
	Low Academic	67,08	14,650	12
	Total	67,20	17,237	29
Overall	High Academic	71,16	15,137	31
	Low Academic	71,00	16,877	27
	Total	71,09	15,828	58

Based on Table 6, it can be described that the cognitive learning outcomes indicate that in the class treated with the Problem Based Learning model, the group of 14 students with high academic ability achieved an average score of 75.86, while the group of 15 students with low academic ability obtained an average score of 74.13. Meanwhile, in the control class treated with the cooperative learning model of Team Games Tournament, the group of 17 students with high academic ability achieved an average score of 67.29, while the group of 12 students with low academic ability obtained an average score of 67.08.

Inferential Statistics Analysis

Before conducting inferential statistical tests, several prerequisite tests were performed, namely the normality test and the homogeneity test.

Normality Test

The normality test serves as the first and essential prerequisite that must be conducted before performing hypothesis testing. The results of this test will determine whether the average problem-solving abilities of the students (pretest and posttest) come from a population group

that is normally distributed or not. The normality test conducted in this study utilized the Statistical Package for Social Science (SPSS) for Windows version 25.0, using the Kolmogorov-Smirnov test. The decision criteria for the analyzed data are based on the significance value: if the value of α > 0.05, then the research data is normally distributed; if the value of α < 0.05, then the research data is declared not normally distributed. The results of the normality test in this study can be seen in Table 7.

Table 7
Results of the Normality Test for Pretest and Posttest Problem-Solving Ability

Variable	Data	Sig	Significance Level (α)	Conclusion
Problem Solving Ability	Experimental Pretest	0,160	>0,05	Normal
	Experimental Posttest	0,200		Normal
	Control Pretest	0,200		Normal
	Control Posttest	0,200		Normal

Based on Table 7, it can be seen that the results of the normality test for the problem-solving ability of students from the pretest and posttest scores in both the experimental and control classes show significance values above 0.05. This indicates that the problem-solving abilities of the XI MIA class at SMA Negeri 1 Jeneponto, utilizing the Problem Based Learning model and the cooperative learning model of Team Games Tournament, have data that is normally distributed.

Homogeneity Test

The homogeneity test is conducted to determine whether the samples used, namely class XI MIA 1 as the experimental class and class XI MIA 5 as the control class, come from a population with homogeneous variance. This homogeneity test was carried out using the Statistical Package for Social Science (SPSS) for Windows version 25.0 with the One-Way ANOVA test. The decision criteria for the analyzed data are based on the significance value: if α > 0.05, then the research data is homogeneous; if α < 0.05, then the two sample groups come from different variances. The results of the homogeneity test in this study can be seen in Table 8.

Table 8
The Results of the Homogeneity Test of Pretest and Posttest Problem-Solving Abilities of Students in the Experimental Class and Control Class

Variable	Statistic	Pretest		Posttest	
		Experiment	Control	Experiment	Control
Problem Solving Ability	Sig.	0,317		1,00	
	Significance Level (α)	α>0,05			
	Conclusion	Homogeneous		Homogeneous	

Based on Table 8, it can be seen that all the results of the homogeneity analysis show a significance value greater than 0.05, which means that the problem-solving ability data of grade XI MIA students at SMA Negeri 1 Jeneponto, with the application of the Problem-Based Learning model in the experimental class and the Cooperative Learning model of Team Games Tournament in the control class, have homogeneous variances.

Hypothesis Testing

The hypothesis testing used is Two-Way ANCOVA with the assistance of computer software, namely the Statistical Package for Social Science (SPSS) for Windows 25.0. The decision-making criterion is sig > 0.05, meaning the implementation of the Problem-Based Learning model has no effect, but if the sig value is < 0.05, the implementation of the Problem-Based Learning model has an effect.

The data from the hypothesis testing on the research data, in the form of problem-solving abilities, reviewed from the academic abilities of grade XI MIA students at SMA Negeri 1 Jeneponto with the implementation of the Problem-Based Learning model, can be seen in Table 9.

Table 9

Results of Hypothesis Testing on Students' Problem-Solving Abilities

Test Of Between-Subjects Effect					
Source of Variance	**Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**
Pretest Problem-Solving Ability	1823,038	1	1823,038	37,435	0,000
Learning	309,073	1	309,073	6,347	0,015
Academic	9.263	1	9.263	0,190	0,665
Learning*Academic	65,677	1	65,677	1,349	0,251
Error	2581,027	53	48,699		
Corrected Total	8330,483	57			

Based on Table 9 above, the data shows that the significance value for the learning model is 0.015 < 0.05, which means there is a difference in problem-solving abilities between the Problem-Based Learning model and the control class, which was treated with the Cooperative Learning model of the Team Games Tournament type. Meanwhile, the significance value for academic ability is 0.665 > 0.05, indicating that there is no difference in problem-solving abilities between students with high academic ability and those with low academic ability. A similar situation occurs with the significance value of the interaction between the learning model and academic ability, which has a significance value of 0.251 > 0.05, meaning there is no interaction effect between the learning model and academic ability on the problem-solving abilities of the students.

Discussion

Based on the hypothesis test using Two-Way ANCOVA, it shows that there is an influence on problem-solving abilities between the Problem-Based Learning model and the control class treated with the Team Games Tournament model. Therefore, it can be concluded that the Problem-Based Learning model has an effect on students' problem-solving abilities. This is in line with the research by Suryani & Harjono (2019), which indicates that the Problem-Based Learning model is significantly more effective than the Team Games Tournament in improving students' problem-solving abilities.

Meanwhile, the significance value for academic ability shows that there is no influence on problem-solving abilities between students with high academic ability and those with low academic ability. This is consistent with the research by Lestari & Wijaya (2020), which found that there is no effect on problem-solving abilities between students with high and low academic ability. Handayani & Nugroho (2020) also support this finding, showing that both the Problem-Based Learning model and the Cooperative Learning model of Team Games Tournament can equally enhance problem-solving abilities among students with various levels of academic ability.

Similarly, the significance value for the interaction between the learning model and academic ability shows that there is no significant difference in the interaction between the learning model and academic ability on students' problem-solving abilities. Although the interaction between the learning model and academic ability is not significant, the corrected mean value indicates that there is an influence on problem-solving abilities based on the combination of the learning model and academic ability. This is consistent with the research by Prasetyo & Sari (2021), which shows that there is no significant interaction between the learning model and academic ability on students' problem-solving abilities. The research by Utami & Setiawan (2024) also confirms that the interaction between the learning model and academic ability does not have a significant effect on problem-solving abilities. They found that both Problem-Based Learning and Team Games Tournament can be effectively implemented in classrooms with heterogeneous academic abilities, as the interaction between these two variables does not affect students' problem-solving abilities.

Conclusion

This conclusion emphasizes the importance of implementing learning models in enhancing students' problem-solving abilities. This research shows that the Problem-Based Learning model has a significant effect on the problem-solving abilities of grade XI MIA students at SMA Negeri 1 Jeneponto. Thus, this research provides a sense of completeness to the essay, as it has analyzed and presented data showing that although the Problem-Based Learning model is effective, the level of students' academic ability does not influence the outcomes.

Finally, this conclusion leaves a strong final impression that to achieve optimal educational goals, the implementation of effective learning models must be a primary focus for educators. By understanding and implementing various teaching strategies, we can ensure that all students, regardless of their academic backgrounds, have equal opportunities to develop the crucial problem-solving skills needed for the future.

Acknowledgements

I would like to express my gratitude to all parties who have contributed to the completion of this research. First and foremost, I would like to thank my supervisors, Prof. Dr. Muhiddin P, S.Pd., M.Pd. and Prof. Dr. Firdaus Daud, for their invaluable guidance, support, and advice throughout the research process. Without their mentorship, this research would not have been completed. I would also like to thank the Principal and teaching staff of SMA Negeri 1 Jeneponto, especially the biology teachers, for their hospitality and cooperation in facilitating the implementation of this research at the school. Next, I would like to thank my colleagues who have provided valuable feedback and moral support throughout the research. The collaboration and discussions we engaged in greatly enriched the results of this study. Finally, I would like to thank my family and friends for their support and understanding throughout this process. Their encouragement has given me the motivation and strength to complete this research.

References

Adi, S. (2018). *Landasan Pengembangan Sekolah*. Malang: Wineka Media.

Amaludin., La. (2022). *Model Pembelajaran Problem Based Learning Penerapan Dan Pengaruhnya Terhadap Keterampilan Berpikir Kritis Dan Hasil Belajar*. Tangerang: Pascal Book.

Andriani, T., & Putri, W. (2020). Efektivitas Problem Based Learning dalam meningkatkan keterampilan kolaboratif peserta didik. *Jurnal Penelitian Pendidikan*, 28(4), 150-165.

Apriany, W.,Winarni, E. W & Muktadir, A. (2020). Pengaruh Penerapan Model Pembelajaran *Problem Based Learning* (*Problem Based Learning*) Terhadap Hasil Belajar Kognitif Peserta didik Pada Mata Pelajaran Biologi di Kelas XI SMA Negeri 5 Kota Bengkulu. *JP3D, 3* (1): 92-93.

Arikunto, S. (2010). *Prosedur Penelitian*. Jakarta: Rineka Cipta.

Chusni, M. M. dkk. (2021). *Strategi Belajar Inovatif*. Jakarta: Pradina Pustaka.

Dewi, A. P. dkk. 2020. Profil Keterampilan Kolaborasi Mahapeserta didik Rumpun Pendidikan MIPA. *Pendagogia Jurnal Ilmu Pendidikan*, 18 (1): 60.

Effendi., Sugiarti, M & Gunarto, W. (2019). Penerapan Model *Problem Based Learning* dan Model *Project Based Learning* terhadap Hasil Belajar Peserta didik pada Materi Perubahan Lingkungan. *Journal Biology*, 2(2): 42-51.

Febrianto, E., Hidayati, Y., Puspitahadi, W., Training, T., & Trunojoyo, U. (2019). Profile of Students ' Problem Solving Ability With Integrated Science Model Based On Disaster Mitigation. *Jurnal Penelitian Pendidikan IPA*, 4(2), 89–95.

Handayani, L., & Nugroho, A. (2020). Efektivitas Problem Based Learning dan Team Games Tournament dalam meningkatkan kemampuan pemecahan masalah peserta didik dengan berbagai tingkat kemampuan akademik. *Jurnal Pendidikan Inovatif*, 26(3), 189-202.

Handayani, S. (2021). *Anatomi dan Fisiologi Tubuh Manusia*. Bandung: Media Sains Indonesia.

Hidayat, R & Abdillah. (2019). *Ilmu Pendidikan "Konsep Teori dan Aplikasinya"*: Medan: LPPPI.

Hikmah, M. (2020). Penerapan Model *Problem Based Learning* Untuk Meningkatkan Hasil Belajar Peserta didik. *Jurnal Pendidikan*, 24(1): 25-36.

Hoellwarth, C., M. J. Moelter, & Knight, R. D. (2005). A Direct Comparison of Conceptual Learning and Problem-Solving Ability in Traditional and Studio Style Classrooms. *American Journal of Physics*, 73(5), 459.

Irwansyah., Muhammad., & Perkasa., Magfirah. (2022). *Scientific Approach dalam Pembelajaran Abad 21*. Pekalongan: Penerbit NEM.

Kementrian Pendidikan dan Kebudayaan. (2017). Direktorat Pembinaan SMA Ditjen Pendidikan Dasar dan Menengah

Kurniawan, B., & Sari, A. (2023). Pengaruh Problem Based Learning terhadap kemampuan pemecahan masalah peserta didik dibandingkan dengan Team Games Tournament. *Jurnal Pendidikan dan Pembelajaran*, 34(1), 98-112.

Lestari, I., & Wijaya, H. (2021). Pengaruh kemampuan akademik terhadap keterampilan kolaboratif dalam model Problem Based Learning dan Team Games Tournament. *Jurnal Pendidikan Kolaboratif*, 29(2), 134-148.

Nayazik, A. (2017). Pembentukan Keterampilan Pemecahan Masalah Melalui Model IDEAL Problem Solving Dengan Teori Sistem Pernapasan. *Jurnal Biologi Kreatif-Inovatif*, 8(2), 182– 190.

Presetya, D., & Sari, A. (2022). Interaksi model pembelajaran dan kemampuan akademik terhadap keterampilan kolaboratif peserta didik. *Jurnal Pendidikan*, 30(3), 140-155.

Rahayu, S., Pramiasih, E. E & Sritumini, B. A. (2019). Pengaruh Model *Problem Based Learning* terhadap Peningkatan Kemampuan Kolaborasi Peserta didik dalam Mata Pelajaran Biologi. *Jurnal Pendidikan dan Pembelajaran*, 5(2): 141.

Rahmatiah, & Besse Syukuroni Baso. (2022). Implementasi Model Problem Based Learning (*Problem based learning*) Dalam Meningkatkan Hasil Belajar Biologi X Upt SMA 11 Kabupaten Soppeng. *Jurnal Riset Rumpun Ilmu Biologi* , 1(2), 190– 112.

Rahmawati, N., & Hidayat, R. (2021). Problem Based Learning dan keterlibatan aktif peserta didik. *Jurnal Pendidikan Inovatif*, 30(2), 45-59.

Redhana, I. W. (2019). Mengembangkan Keterampilan Abad Ke-21 Dalam Pembelajaran Kimia. *Jurnal Inovasi Pendidikan Biologi*, 13(1).

Riduwan. (2014). *Dasar-Dasar Statistika*. Bandung: Alfabeta.

Ruqoyyah, S., Murni, S & Linda. (2020). Pengaruh Model *Problem Based Learning* terhadap Hasil Belajar Kognitif Peserta didik XI IPA SMA Negeri 1 Angsana pada Konsep Sistem Koordinasi. *Jurnal Pendidikan Hayati*, 6(4): 157-162.

Rusman. (2017). *Belajar dan Pembelajaran Beriorentasi Standar Proses Pendidikan*. Jakarta: Kencana.

Sahil, J. dkk. (2021). *Buku Panduan Guru Biologi Terintegrasi Nilai-Nilai Islam*. Jakarta: Deepublish.

Salman. dkk. (2020). Pengaruh *Problem Based Learning* (PBL) yang disertai dengan Peta Konsep Kelas XI TPHP SMK Negeri 2 Gorontalo pada Materi Sistem Koloid, *Jurnal Entropi,* 12(2): 199.

Santoso, A., & Handayani, L. (2022). Efektivitas Problem Based Learning dibandingkan Team Games Tournament terhadap keterampilan kolaboratif peserta didik dengan beragam kemampuan akademik. *Jurnal Penelitian Pendidikan*, 33(2), 123-138.

Santoso, A., & Rahmawati, L. (2020). Pengaruh model pembelajaran Problem Based Learning dan Team Games Tournament terhadap keterampilan kolaboratif peserta didik. *Jurnal Pendidikan Kolaboratif*, 22(3), 210-225.

Saputri AD. (2017). Pengaruh Model Problem Based Learning (PBL) Terhadap Kemampuan Pemecahan Masalah Peserta Didik Pada Mata Pelajaran Biologi Materi Pencemaran Lingkungan Kelas X Mia Sma N 6 Bandar Lampung. Biosfer. *Jurnal Tadris Pendidikan Biologi* Vol. 8 no.1 40-52.

Sari, A., & Prasetyo, R. (2022). Pengaruh kemampuan akademik terhadap peningkatan keterampilan kolaboratif peserta didik melalui Problem Based Learning dan Team Games Tournament. *Jurnal Pendidikan dan Pembelajaran*, 31(1), 75-89.

Sholekah, A. W. (2020). Peningkatan Motivasi dan Hasil Belajar IPA Materi Pencemaran Lingkungan Melalui Model *Problem Based Learning* Peserta didik Kelas VII SMPN 9 Salatiga. *Jurnal Pendidikan MIPA,* 4(1): 24-26.

Suardana, P. (2019). Penerapan Model Pembelajaran Problem Based Learning (PBL) dengan Metode Demonstrasi untuk Meningkatkan Hasil Belajar. *Journal of Education*, 3(1), 270–277.

Sujana, A & Sopandi, W. (2020). *Model-Model Pembelajaran Inovatif Teori dan Implementasinya*. Depok: Rajawali Press.

Sulfiana, B. (2021). Kemampuan Berkolaborasi dan Keterampilan Berfikir Kreatif Peserta didik: Pengaplikasiannya *Problem Based Learning*. *Jurnal Ilmu Biologi.*

Supardi. dkk. (2015). Pengaruh Media Pembelajaran dan Minat Belajar terhadap Hasil Belajar Biologi. *Jurnal Formatif*, 2(1): 72.

Suprapto, E.dkk. (2021). *Inovasi Pembelajaran Abad 21*. Magetan: Ae Media Grafika.

Suryani, T., & Harjono, A. (2019). Perbandingan hasil belajar kognitif antara model Problem Based Learning dan Team Games Tournament pada peserta didik dengan kemampuan akademik tinggi dan rendah. *Jurnal Pendidikan Inovatif*, 27(2), 67-80.

Sutiah. 2016. *Budaya Belajar dan Inovasi Pembelajaran Biologi*. Sidoarjo: Nizami Learning Center.

Umbara, U. 2017. *Psikologi Pembelajaran Biologi*. Yogyakarta: Deepublish.

Utami, L., & Setiawan, R. (2024). Efektivitas model pembelajaran terhadap berbagai tingkat kemampuan akademik peserta didik. *Jurnal Penelitian Pendidikan*, 35(1), 101-115.

Utami, R. (2013). Model Pembelajaran Berbasis Masalah Ditinjau dari Kreativitas Peserta didik. *Jurnal Ilmiah Pendidikan Biologi*, 1(1), 82–98.

Wahyuni, P. (2021). *Asaku di Rumah Kedua*. Sukabumi: Jejak.

Widoyoko, E. P. 2014. *Teknik Penyusunan Instrumen Penelitian*. Yogyakarta: Pustaka Pelajar.

Windy H, P. (2013). Integrative Science untuk Mewujudkan 21. *Seminar Nasional MIPA 2013*.

Wulandari, A., & Hartono, R. (2019). Perbedaan hasil belajar kognitif peserta didik dengan model Problem Based Learning dan Team Games Tournament. *Jurnal Pendidikan dan Pembelajaran*, 25(3), 123-135.