International Journal of Research and Review
[Indexed, Peer-Reviewed Journal]
Volume 12; Issue: 5; May 2025
Website: www.ijrrjournal.com
Research Paper *E-ISSN: 2349-9788; P-ISSN: 2454-2237*

The Influence of Problem-Based Learning Model with Science Data Integration on Critical Thinking and Biology Achievement

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DOI: https://doi.org/10.52403/ijrr.20250524

ABSTRACT

Critical thinking is one of the abilities students must have, especially in the 21st century. However, the results of PISA 2022 showed that the critical thinking abilities of Indonesian students were still low. Problem-Based Learning is a learning model that uses real problems to practice students' critical thinking abilities and improve student achievement. However, the PBL model still had disadvantages and to overcome this, the PBL model was integrated with science data. This study aimed to determine the effect of the PBL model with science data integration on students' critical thinking abilities and biology achievement of high school students. The research was conducted at Mumbulsari State High School. The type of research used was quasi-experimental study using a nonequivalent pretest posttest control group design. Data collection was done using observation, interview, test, and documentation methods. This study used 2 classes, namely the experimental class and the control class which were determined using the random sampling method. This study used the ANCOVA test to determine the effect of the treatment applied. Based on the results of the ANCOVA test on students' critical thinking abilities and Biology achievement showed a significant value (sig.) < 0.05, which meant that the PBL model had an effect on high school students' critical thinking abilities and biology achievement. The PBL model integrated with science data was expected to improve students' critical thinking abilities and learning outcomes. Then, this research is also expected to provide new benefits and innovations for other teachers and researchers.

Keywords: Problem-Based Learning, Science Data, Critical Thinking, Student Achievement

INTRODUCTION

Critical thinking refers to the ability of think deeply, which is closely related to the problem-solving process. This ability is an essential quality that Indonesian students need to possess, especially in the 21st century. However, the PISA results obtained in 2022 indicate that Indonesia's position remains relatively low, ranking 69th out of 81 countries. The PISA achievement proves the low critical thinking abilities of Indonesian students. [1] Education is critical to form a quality future generation of the nation, [2] and one of these qualities is good critical thinking abilities.

The ability to think critically is an important aspect for students to have to face and solve various problems. [3] In addition to being useful in the context of learning, this ability is very much needed in order to be able to

face challenges and problems in life. [4] Thus, the educational process carried out in schools must be able to train students' critical thinking abilities in various fields of study, including biology.

Biology is a science that requires good critical thinking abilities for its students. This is because of biology learning requires students to be actively involved in learning, formulate problems independently, and be able to solve problems. [5] In addition, in biology lessons, many graphs and data require critical thinking abilities so that students can understand the information contained therein. [6] To support students to have these abilities, teachers need to implement learning models that can facilitate and encourage the creation of an active critical thinking process. [7]

Problem-Based Learning (PBL) is one of the learning models that can be used to help improve students' critical thinking abilities. PBL is a learning model that confronts students with factual problems to stimulate their critical thinking abilities in overcoming these problems. [8] However, the PBL model also has the disadvantages, that is when the students are not interested in the problems presented, they will not try to solve the problem. [9] To overcome these disadvantages, the problems in PBL are presented in the form of valid and up-to-date scientific data.

Science data can attract students' attention because the information from the data is obtained from an event or research result and is factual so students will believe in the information in it and be motivated to solve the problems presented. In biology itself, scientific data is usually presented in the form of graphs to make it easier for students to analyze the contents of the data, making it easier to understand the information in it. [10] Problems presented in the form of scientific data, especially graphs, also tend to be easier to understand than problems presented in the form of sentences. [11] Use of data, such as graphs, in learning has been shown to have a positive impact on students' critical thinking abilities. [12] In this case, understanding the data presented in the form of graphs is expected to be an exercise for students to use their critical thinking abilities and have a significant impact on the achievement of student learning outcomes.

Learning outcomes are students' achievements in the cognitive field after completing assignments, exams, and activities that support these learning outcomes and are proven in the form of numbers or grades. [13] Implementing the PBL model has been proven to improve student learning outcomes. [14,15] In addition, there is also a good relationship between critical thinking abilities and learning outcomes. [16] This means that the higher the critical thinking abilities that students have, the higher the learning outcomes they will achieve. Based on this, the application of the PBL model with science data integration is expected to improve student's critical thinking abilities and have an impact on their learning outcomes, especially in the field of biology at the high school level.

MATERIALS & METHODS

The type of research used is a quasi-experiment with a nonequivalent pretest-posttest control group design as the research design. The research was conducted at Mumbulsari State High School, Jember. The class level used was class X in the odd semester of the 2024/2025 academic year. The population of this study included all students in class X, a total of seven classes. There were two classes used in the study, namely the control class and the experimental class, which were selected using a random sampling method. A total of 70 students participated in the study as the sample. The research design is presented in Table 1 below.

Table 1. Research Design

E	O_1	X	O_2
K	P_1	Y	P_2

E : experimental class
K : control class
O_1 : pretest in the experimental class
O_2 : posttest in the experimental class

P_1 : pretest in the control class
P_2 : posttest in the control class
X : learning using the PBL model with science data integration
Y : learning using the conventional models

The data collection process used observation, interview, test, and documentation methods. Critical thinking abilities are measured through essay results on pretest and posttest questions according to the critical thinking indicators proposed by Ennis, while biology achievement is measured through pretest and posttest results according to cognitive indicators. The data are then analyzed using the analysis of covariance (ANCOVA) test.
The formula for assessed critical thinking abilities, namely

$$\text{Score} = \frac{\text{obtained score}}{\text{maximum score}} \times 100\% \text{ [17]}$$

The critical thinking assessment intervals can be seen in Table 2 below.

Table 2. Critical Thinking Assessment Interval

Score (%)	Category
$80 \leq X \leq 100$	Very good
$70 \leq X \leq 79$	Good
$60 \leq X \leq 69$	Enough
$X < 60$	Low

Meanwhile, the formula for assessed students' cognitive achievement, namely

$$\text{Score} = \frac{\text{obtained score}}{\text{maximum score}} \times 100\% \text{ [18]}$$

RESULT

1. Critical Thinking Abilities

The essay test results referring to critical thinking indicators are used as data to measure students' critical thinking abilities. The following are the average scores of students' critical thinking abilities obtained, which have been presented in Tables 3 and 4.

Table 3. Average Value of Critical Thinking Abilities in The Experimental Class

No	Critical Thinking Ability Indicator	Pre Test		Post Test	
		Mean ± SD	Category	Mean ± SD	Category
1.	Provide a simple explanation	58.57 ± 17.089	Low	80.71 ± 13.674	Very good
2.	Build basic skills	56.43 ± 18.533	Low	76.43 ± 15.977	Good
3.	Conclude	47.86 ± 15.305	Low	66.43 ± 14.781	Enough
4.	Provide further explanation	45.00 ± 14.603	Low	62.14 ± 12.677	Enough
5.	Set strategy and tactics	49.29 ± 13.195	Low	68.21 ± 9.750	Enough
Mean		51.07 ± 10.615	Low	70.36 ± 8.007	Good

Table 4. Average Value of Critical Thinking Abilities in The Control Class

No	Critical Thinking Ability Indicator	Pre Test		Post Test	
		Mean ± SD	Category	Mean ± SD	Category
1.	Provide a simple explanation	52.14 ± 15.305	Low	66.43 ± 13.480	Enough
2.	Build basic skills	50.71 ± 17.663	Low	62.14 ± 14.053	Enough
3.	Conclude	45.00 ± 15.811	Low	53.57 ± 12.341	Low
4.	Provide further explanation	40.71 ± 12.256	Low	50.71 ± 7.391	Low
5.	Set strategy and tactics	46.43 ± 10.749	Low	55.00 ± 12.573	Low
Mean		46.90 ± 8.772	Low	57.14 ± 8.958	Low

Based on the average values in Tables 3 and 4, the average experimental pretest of 51.07 increased to 70.36 in the posttest, meaning the value increased by 19.29 points. Meanwhile, the average control pretest of 46.90 increased to 57.14 in the posttest, meaning the value increased by 10.24 points. Based on these results, it was concluded that the average increase in the experimental class was higher than in the control class. The results obtained were then analyzed using the analysis of covariance (ANCOVA) test. The results of the ANCOVA test are shown in Table 5 below.

Table 5. ANCOVA Test Results of Critical Thinking Abilities

Tests of Between-Subjects Effects					
Dependent Variable: Post Test Results					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	6606.614[a]	2	3303.307	163.05	0.000
Intercept	1941.774	1	1941.774	95.878	0.000
PreTest	3550.810	1	3550.810	175.326	0.000
Class	1712.322	1	1712.322	84.548	0.000
Error	1356,928	67	20.253		
Total	292447.917	70			
Corrected Total	7963.542	69			
a. R Squared = ,830 (Adjusted R Squared = ,825)					

Table 5 shows the significance value (sig.) of the ANCOVA test reaching 0.000, which means less than 0.05. These results prove that the treatment given has a significant effect. This means that the PBL model with science data integration affects the critical thinking abilities of high school students.

2. Students' Achievement

The results of the pretest and posttest referring to cognitive indicators are used as data to measure the achievement of student learning outcomes. The following are average values of students' biology achievement can be seen in Table 6 below.

Table 6. Average Value of Biology Achievement

Class	**Number of Students**	**Mean ± SD**		**Difference**
		Pre Test	**Post Test**	
Experiment	35	41.17 ± 9.196	63.20 ± 12.407	22.03
Control	35	40.09 ± 8.604	50.06 ± 11.347	9.97

Based on the average value in Table 6, it shows that the average experimental pretest of 41.17 increased to 63.20 in the posttest, meaning the value increased by 22.03 points. Meanwhile, the average control pretest of 40.09 increased to 50.06 in the posttest, meaning the value increased by 9.97 points. Based on these results, it can be concluded that the average increase in the experimental class is higher than in the control class. The results obtained were then analyzed using the analysis of covariance (ANCOVA) test. The results of the ANCOVA test are shown in Table 7 below.

Table 7. ANCOVA Test Results of Biology Achievement

Tests of Between-Subjects Effects					
Dependent Variable: Post Test Results					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	10709.292[a]	2	5354.646	186.365	0.000
Intercept	205.695	1	205.695	7.159	0.009
PreTest	7686.435	1	7686.435	267.521	0.000
Class	2446.594	1	2446.594	85.152	0.000
Error	1925.051	67	28.732		
Total	237110.000	70			
Corrected Total	12634.343	69			
a. R Squared = ,848 (Adjusted R Squared = ,843)					

Table 7 shows the significance value (sig.) of the ANCOVA test reaching 0.000, which means less than 0.05. These results prove that the treatment given has a significant effect. This means that the PBL model with science data integration affects the biology achievement.

DISCUSSION

1. The Influence of Problem-Based Learning Model with Science Data Integration on Critical Thinking

Based on Table 5, the results of the ANCOVA test on students' critical thinking abilities show a significance (sig.) of 0.000, which means < 0.05. This means that the application of the Problem-Based Learning (PBL) model with science data integration has a significant influence on the critical thinking abilities of high school students. These results align with research which states that the PBL model facilitates students to actively participate in learning activities, and the problems presented can train them to use critical thinking abilities in finding solutions to these problems, which ultimately students tend to experience an increase in critical thinking abilities. [3]

Overall, the data analysis shows that the class used as an experiment got a higher post-test average than the class used as a control. The different results are due to the application of the learning model used. The control class that still applies the conventional model tends to be dominated by the active role of the teacher compared to the students. In this model, the teacher plays an important role in conveying knowledge, while students are more passive in receiving information. [14] As a result, students' active involvement is low and they tend to focus on memorizing the material rather than training critical thinking abilities. [19] In other words, the use of conventional models is less than optimal in improving students' critical thinking abilities.

This study applies the Problem-Based Learning (PBL) model with science data integration in the classroom used as an experiment. The PBL model directs students to face factual problems that aim to stimulate their critical thinking abilities in overcoming these problems. [8] The syntax of the PBL model that is very influential in improving students' critical thinking abilities is the first syntax and the third syntax. The first syntax is the introduction of students to the problem. At this stage, the teacher presents problems that are related to real-life situations. In this study, the teacher showed videos and graphs about antibiotic resistance cases that occurred in Indonesia and asked questions related to the problems so that students were interested in the problems presented. In this syntax, students can build new knowledge from questions asked by the teacher. In addition to attracting students' attention, these questions can also stimulate them to use their critical thinking abilities in providing answers to the questions given, seeking more in-depth information about the problem, and formulating the most relevant and effective solutions to solve the problem. [20]

The third syntax in the PBL model, namely guidance in the investigation process individually or in groups also affects improving students' critical thinking abilities. Through this syntax, students play an active role in solving the problems they face so that their involvement in thinking and decision-making becomes deeper and more meaningful. They seek information through various sources related to the problem and discuss their findings with their group members. Through this syntax, students' ability to think critically can be developed, because they are actively involved in activities to collect information, analyze data, and draw conclusions based on data and information that has been studied. [20]

This study integrates the Problem-Based Learning (PBL) model with science data. The integration aims to encourage students to have the ability to think critically in more depth through the analysis of factual data. In its implementation, students are given science data, namely graphs containing factual problems. The material that is the focus of this study is the role of bacteria in life. This study uses the case of antibiotic resistance, which is a serious problem in Indonesia. To understand the problem in depth, students are allowed to analyze data on antibiotic resistance cases that occur in Indonesia.

This study uses data containing a problem presented in the form of a graph to illustrate the trend of increasing cases of antibiotic resistance in Indonesia over the past few years. Understanding data in the form of science data, such as graphs, can improve students' critical thinking abilities because understanding graphs requires good analytical abilities to make the right decisions and find effective solutions in solving problems based on the contents of the data. [12] Then, the presence of graphs can also train students to consider decisions in answering questions and think rationally to analyze decisions to be taken based on existing data, which contributes to improving students' critical thinking abilities. [21]

The PBL model trains students to solve a problem based on reliable evidence, so it is necessary to consider the accuracy and credibility of the information source to solve the problem. The science data presented in the study comes from accurate and reliable references, so students have the opportunity to practice their ability to analyze data while instilling awareness of the importance of accurate data to solve problems. Then, through the discussion in the PBL model, students can work together to analyze data and exchange knowledge to solve problems. This discussion process can help students understand the information in the science data and improve their critical thinking abilities. [22] Therefore, the integration of the PBL model with science data trains students in decision-making in solving problems based on the data analysis they have done, thus having an impact on improving critical thinking abilities.

2. The Influence of Problem-Based Learning Model with Science Data Integration on Biology Achievement

Based on Table 7, the results of the ANCOVA test on biology achievement show a significance (sig.) of 0.000, which means < 0.05. These results mean that the application of the Problem-Based Learning (PBL) model with science data integration contributes significantly to the biology achievement of high school students. These results align with the statement that the PBL model encourages active student involvement and is directly involved in connecting problems in life with the knowledge they have just acquired. [14] This makes the learning process more meaningful and has a positive impact on understanding the material and learning outcomes.

The selection of an appropriate and effective learning model plays a crucial role so that learning outcomes can be improved. [23] This study applies a conventional learning model to the class designated as a control, where the model is oriented towards the dominant role of the teacher, while students tend to be passive and only receive information without much active involvement in learning. [14] In addition, this model causes students' way of thinking to be less developed because students only focus on theory but are not trained to think critically, [24] then makes students feel bored, so they are less motivated to follow the learning. This can cause student learning outcomes to be less than optimal.

This study applies the Problem-Based Learning (PBL) model with science data integration for classes designated as experiments. The syntax of the PBL model consists of 5 stages, namely introducing students to the problem, organizing students in learning activities, guiding individual and group investigations, developing and presenting student work results, and ending with analysis and evaluation of the problem-solving process. [25] Through this PBL model, students have the opportunity to discuss, collaborate, share knowledge, and conduct evaluations to solve problems given in the form of science data. [26] Then, at the end of the learning process, each group member makes a presentation, allowing each student to share knowledge and together find the most appropriate way to solve the problem. [27]

This study integrates the Problem-Based Learning (PBL) model with science data.

This integration is carried out so that students are interested in solving problems in PBL. The science data used is in the form of real problems or cases that are relevant to everyday life and are presented in the form of graphs. The material used in this study is the role of bacteria in life. In this study, problems regarding antibiotic resistance cases are presented in the form of graphs that illustrate the increasing trend of antibiotic resistance cases in Indonesia over the past few years to make it easier for students to learn and understand the problems that are occurring.

Real problems can encourage students to be actively involved in finding solutions to problems. This happens because students who are faced with problems that happen in life will be more enthusiastic about participating in learning and trying to find the right solution to the problem. [3] The use of science data makes students more confident in the problems they face because the information in the data is obtained from an event or research results that are factual. In addition, problems presented in the form of scientific data, such as graphs, tend to be easier to understand than problems presented in the form of sentences. [11] Thus, the presentation of problems in the form of science data in the form of graphs can increase students' interest in being actively involved in the problem-solving process. The discussion process in the PBL model also provides an opportunity for students to discuss and collaborate in solving problems in science data, which can increase students' knowledge. [22] Therefore, the integration of the PBL model with science data makes students more interested in the problems given and actively involved in learning to find solutions to problems, which can affect students' knowledge.

CONCLUSION

Based on the results of the study, it could be concluded that the Problem-Based Learning model with science data integration affects the critical thinking and biology achievement, with the ANCOVA results showing a significance (sig.) of 0.000. The problems presented in science data require students to analyze data to understand information and find solutions, and discussions in the PBL model allow students to exchange knowledge in solving problems. This can train students to make decisions based on the results of data analysis correctly so that it affects their critical thinking abilities. In addition, real problems that are relevant to life and presented in the form of scientific data make students more interested and believe in the problem. This can encourage active student participation in learning to find solutions to problems so that student knowledge increases.

Declaration by Authors

Acknowledgement: The researcher would like to thank the supervisor who has guided this research until completion, the headmaster of Mumbulsari State High School who has allowed the researcher to carry out the study, the students of Mumbulsari State High School who have contributed to this research, and the parents who have always supported from the beginning of the study until the end.

Source of Funding: None

Conflict of Interest: No conflicts of interest declared.

REFERENCES

1. Yulianti EL, Alimah S. Developing learning design employing PBL with mind mapping to train critical and creative thinking ability for junior high school students. Journal of Biology Education. 2021; 10(2): 145-153.
2. Murdiyah S, Suratno S, Ardhan AFN. The effect of problem-based learning integrated with concept mapping technique on students' learning activities. JPBI (Jurnal Pendidikan Biologi Indonesia). 2020; 6(1): 39-46.
3. Kardoyo, Nurkhin A, Muhsin, et al. Problem-based learning strategy: Its impact on students' critical and creative thinking skills. European Journal of Educational Research. 2020; 9(3): 1141-1150.
4. Amin S, Utaya S, Bachri S, et al. Effect of problem-based learning on critical thinking

skills and environmental attitude. Journal for the Education of Gifted. 2020; 8(2): 743-755.
5. Alfiana F, Bachtiar I, Handayani BS. Pembelajaran Biologi cacing nyale melalui pendekatan saintifik untuk meningkatkan kemampuan berpikir kritis siswa SMA. Jurnal Ilmiah Profesi Pendidikan. 2022; 7(2b): 605-610.
6. Williamson B, Bayne S, Shay S. The datafication of teaching in Higher Education: Critical issues and perspectives. Teaching in Higher Education. 2020; 25(4): 351-365.
7. Siswati BH, Hariyadi S, Corebima AD. Hubungan antara berpikir kritits dan metakognitif terhadap hasil belajar mahasiswa biologi dengan penerapan model pembelajaran RWRS. Lensa (Lentera Sains): Jurnal Pendidikan IPA. 2020; 10(2): 74-82.
8. Fattahillah N, & Hariyadi S. Impementation of problem based learning with electronic media on student learning outcomes in Indonesia's – Philippines international class. Bioedukasi. 2019; 17(1): 30-34.
9. Hidayati RM, Wagiran. Implementation of Problem-Based Learning to improve problem-solving skills in vocational high school. Jurnal Pendidikan Vokasi. 2020; 10(2): 177-187.
10. Setiani NW, Suyitno A. Kemampuan membaca data dan rasa ingin tahu siswa terhadap kemampuan literasi statistik. QALAMUNA: Jurnal Pendidikan, Sosial, dan Agama. 2021; 13(2): 257-270.
11. Manalu A, Gultom J. Analisis kesulitan siswa dalam memecahkan masalah Fisika berbentuk grafik dengan tes diagnostik. Jurnal Ilmiah Maksitek. 2021; 6(2): 6-15.
12. Santoso EB. Mathematics classroom activities based on some topics in graph theory to develop critical thinking of primary and secondary school students. International Journal of Indonesian Education and Teaching. 2018; 2(2): 154-160.
13. Dakhi AS. Peningkatan hasil belajar siswa. *Jurnal Education and Development*. 2020; 8(2): 468-470.
14. Handayani RH, Muhammadi. Pengaruh model pembelajaran *Problem Based Learning* terhadap hasil belajar siswa dalam pembelajaran tematik terpadu di kelas V SD. E-Jurnal Inovasi Pembelajaran Sekolah Dasar. 2020; 8(5): 78-88.
15. Malmia W, Makatita SH, Lisaholit S, et al. Problem-based learning as an effort to improve student learning outcomes. International Journal of Scientific & Technology Research. 2019; 8(9): 1140-1143.
16. Dewi, NNSK, Arnyana IBP, Margunayasa IG. *Project based learning* berbasis STEM: Meningkatkan kemampuan berpikir kritis dan hasil belajar siswa. Jurnal Ilmiah Pendidikan Profesi Guru. 2023; 6(1): 133-143.
17. Sukaisih R, Muhali M, Asy'ari M. Meningkatkan keterampilan metakognisi dan berpikir kritis siswa melalui pembelajaran model pemecahan masalah dengan strategi konflik-kognitif. Empiricism Journal. 2020; 1(1): 37-50.
18. Sarwita W O, Tamaela K, Sopratu P. et al. Peningkatan hasil belajar Biologi melalui model pembelajaran rotating trio exchange (RTE) pada siswa kelas XI SMA Negeri 23 Maluku Tengah. Biodik: Jurnal Ilmiah Pendidikan Biologi. 2021; 7(1): 43-52.
19. Lami Y, Djalo A, & Missa H. Pengaruh *Problem Based Learning* terhadap hasil belajar peserta didik kelas VIII SMP Negeri 4 Kupang. JUPEIS: Jurnal Pendidikan dan Ilmu Sosial. 2022); 1(4): 13-20.
20. Miterianifa, Ashadi, Saputro S. et al. A conceptual framework for empowering students' critical thinking through problem based learning in chemistry. In Journal of Physics: Conference Series. 2021; 1842(1): 1-9.
21. Syafitri DA, Sumarno, Rumiarci E. Analisis kemampuan berpikir kritis siswa dalam materi diagram garis menggunakan model *Problem Based Learning.* Jurnal Inovasi, Evaluasi, dan Pengembangan Pembelajaran (JIEPP). 2024; 4(2): 188-193.
22. Dita PPS, Murtono, Utomo S. et al. Implementation of *Problem Based Learning* (PBL) on interactive learning media. Journal of Technology and Humanities. 2021; 2(2): 24-30.
23. Kawuri MYRT, Ishafit, Fayanto S. Efforts to improve the learning activity and learning outcomes of physics students with using a Problem-Based Learning model.

Indonesian Journal of Integrated Science Education. 2019; 1(2): 105-114.
24. Permatasari BD, Gunarhadi, Riyadi. The influence of problem based learning towards social science learning outcomes viewed from learning interest. International Journal of Evaluation and Research in Education (IJERE). 2019; 8(1): 39-46.
25. Simamora RE, Sidabutar DR, Surya E. Improving learning activity and students' problem solving skill through Problem Based Learning (PBL) in Junior High School. International Journal of Sciences: Basic and Applied Research. 2017; 33(2): 321-331.
26. Ariyani B, Kristin F. Model pembelajaran *Problem Based Learning* untuk meningkatkan hasil belajar IPS siswa SD. Jurnal Ilmiah Pendidikan dan Pembelajaran. 2021; 5(2): 353-361.
27. Simbolon R, Koeswanti HD. Comparison of PBL (Project Based Learning) models with PBL (Problem Based Learning) models to determine student learning outcomes and motivation. International Journal of Elementary Education. 2020; 4(4): 519-529.

How to cite this article: Afifah Faras Cyntiawati, Suratno, Slamet Hariyadi. The influence of problem-based learning model with science data integration on critical thinking and biology achievement. *International Journal of Research and Review*. 2025; 12(5): 199-207. DOI: *https://doi.org/10.52403/ijrr.20250524*

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