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Integrated STEM PBL Model on Ecology and Biodiversity Topics to Equip Students with Problem-Solving Skills

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Abstract
Problem solving skills need to be developed so that students can compete with the rapid advances in technology and science.The purpose of this study was to find the improvement and response of students after the application of the STEM-based Problem Based Learning (PBL) model on Ecology and Biodiversity material on students' problem solving skills. The research method used is quantitative with quasi experiment. The research subjects were students of class VII G as the experimental class and class VII H as the control class. The results of the study were STEM-based Problem Based Learning (PBL) on ecology and biodiversity material proved effective in improving students' problem solving skills, based on the results of the Mann-Whitney test which showed a significant difference between the experimental and control classes. The conclusion in this study is that the STEM-based Problem Based Learning (PBL) model effectively improves problem solving skills in ecology and biodiversity materials. Problem solving skills need to be developed so that students can compete with the rapid advances in technology and science.
Keywords: **Problem Solving; Problem Based Learning (PBL); STEM**

INTRODUCTION

The 21st century is characterized by rapid advances in science and technology that affect various aspects of life. In facing the challenges of this era, education plays an important role in shaping human resources who have 21st century skills, especially the 4C skills: critical thinking and problem solving, creativity, communication, and collaboration (Goo et al., 2024). Problem solving ability is one of the main skills that learners must have. This ability is not only important in learning, but also in everyday life because it encourages learners to think logically and make decisions based on proper analysis (Rahmawati & Ika, 2020). Facts in the field show that students' problem solving skills are still relatively low, especially in science learning. This low ability is caused by conventional learning approaches that are still teacher centered and minimal use of relevant learning media or technology (Permata et al., 2021).

Problem solving ability is a thinking process to identify, analyze, and solve a problem until a solution is found (Marzuki, 2023). Learning that only emphasizes lectures makes students less active, passive, and difficult to understand concepts. The lack of teachers ability to master technology and the lack of innovation in learning media are factors that inhibit students problem solving skills (Ratnasari et al., 2022). Learning that is not associated with real-life contexts also causes students to have difficulty linking theory with practice. Lack of practice in dealing with problems directly has an impact on the low confidence of students in solving problems independently (Dwi Astuti, 2023). A learning model that is contextual, relevant to the needs of the 21st century, and encourages active participation of students in the learning process is needed.

Problem Based Learning (PBL) model is an effective learning model to train problem solving skills. Problem Based Learning (PBL) emphasizes real problem-based learning that encourages students to think critically, creatively, and actively in finding solutions (Asyhari & Sifa'i, 2021). In

the process, the teacher acts as a facilitator who guides students in understanding the problem and developing solutions. The application of Problem Based Learning (PBL) is very relevant in science learning because science material has a close relationship with everyday life (Sutrisna & Sasmita, 2022). The combination of Problem Based Learning (PBL) with the STEM approach, which integrates science, technology, engineering, and mathematics, can strengthen the effectiveness of learning. This approach helps learners apply knowledge thoroughly, creatively, and innovatively in facing 21st century challenges (Zakiyah & Sudarmin, 2022).

The Problem Based Learning (PBL) model is a learning model that presents contextual problems that are relevant to real life. The goal is to encourage students to be actively involved in the learning process (Sudarmin, 2015 :48). The Problem Based Learning (PBL) model has a number of advantages in learning, including helping students understand the material more deeply, increasing activeness in the learning process, and providing opportunities to apply knowledge in real-world context (Rasto & Rego, 2021). The use of the Problem Based Learning (PBL) model in this study was chosen because students can be faced with problems that are relevant to everyday life, so that they have the potential to improve problem solving skills more effectively.

The STEM approach in science learning can train students to think at a higher level, collaborate, and utilize technology effectively. The STEM learning approach emphasizes the learning process through solving real problems and critical thinking in everyday life (Dare et al., 2021). The use of technology-based learning media such as e-modules, digital LKPD, or interactive videos supports this process. STEM not only develops cognitive abilities, but also fosters independence, responsibility, and readiness to face the world of work (Hoerunnisa et al., 2024). Thus, the integration of the Problem Based Learning (PBL) model and the STEM approach is the right solution in improving students' problem solving skills in science learning in the 21st century.

The STEM approach is an integration of four scientific fields, namely science, technology, engineering, and mathematics, which are focused on solving problems in everyday life (Awalin & Ismono, 2021). STEM-based learning is designed through project activities and hands-on activities, where learners learn theory while applying it in practice (Efriani & Arifin, 2024:17). Through the STEM approach, it is proven to have a positive influence on learner creativity. STEM encourages learners to think critically, innovatively, and creatively in solving problems (Cahyadi, 2020). Thus, learning becomes more meaningful because students understand the real benefits of the material in their lives.

The STEM approach in learning has a number of advantages, including helping students understand the interrelationships between science, technology, engineering, and mathematics (STEM), as well as their application in solving real problems. The STEM approach also encourages the development of 21st century skills such as critical thinking, problem solving, communication, collaboration, and creativity, while increasing learning motivation through interesting and fun activities (Cahyadi, 2020). This research integrates STEM with the PBL model because both have the same characteristics, namely problem based and linking learning with real situations. Linking learning problems with everyday life aims to create contextual and relevant learning experiences, so that students are encouraged to think critically and be able to find solutions (Bybee, 2013). The integration of PBL and STEM is believed to equip learners with more optimal problem solving skills.

The collaboration between the PBL model and the STEM approach allows learners to understand cross-disciplinary concepts in depth and apply them in solving complex problems. Problem solving skills involve important stages such as understanding the problem, developing a plan, implementing a solution, and evaluating the results (Susanto, 2015). This process requires the ability to think critically, creatively, and logically, and is an important provision in forming an adaptive and independent person in facing the challenges of life and the world of work (Ashabul et al., 2025). Through learning that integrates PBL and STEM, students not only gain conceptual knowledge, but are also trained in dealing with real problems systematically and innovatively.

The novelty in this research lies in the integration of the PBL- STEM model applied through product-making activities by students. The products are infographic posters and educational videos

developed by directly linking the components of science, technology, engineering and mathematics. Learners are actively involved in the learning process to design solutions and present them in a creative and contextual visual form. PBL-STEM learning provides learning experiences that are not only conceptual, but can also be applied in the context of everyday life.

This research offers learning with a different approach compared to previous studies that tend to only emphasize improving problem solving skills without involving the creation of products that combine various types of media. The products developed by learners are infographic posters and educational videos that combine text, images, sound and other visuals as a means of delivering solutions. The activity of making posters and videos makes learning more interesting because it involves learners actively. The process is also challenging as it demands in-depth concept understanding and creative thinking skills. This activity encourages learners to develop critical thinking, creativity, communication and collaboration skills simultaneously. Learning becomes more meaningful as learners gain concept understanding through hands-on practice that is in line with 21st century demands.

This research is motivated by the need for a learning model that can improve students' problem solving skills in science learning. The focus of the research is directed at the application of the Problem Based Learning (PBL) model based on STEM on Ecology and Biodiversity material. This model is designed to connect learning with real contexts so as to encourage students to think critically and find solutions to the problems faced. Product-based activities, such as making infographic posters and educational videos, are expected to increase students' active involvement, creativity, and conceptual understanding as a whole.

METODE PENELITIAN

This research is an experimental research using quantitative approach of quasi experimental design in the form of nonequivalent control group design. The research subjects were seventh grade students at SMP Negeri 26 Semarang, with samples of VII G as the experimental class and VII H as the control class which were randomly selected after the homogeneity test. The research procedure includes three stages, namely preparation (initial observation, homogeneity test, instrument validation), implementation (pretest, learning with STEM-based PBL model in experimental class and discovery learning in control class, product development, posttest, student response questionnaire), and data analysis. Instruments are analyzed using validity, reliability, difficulty level, and differentiability tests. Data were analyzed through homogeneity test, normality, N-gain test, and nonparametric test (Mann-Whitney).

RESULTS AND DISCUSSION

1. Results of the Analysis of the Problem-Solving Ability Improvement Test After Implementing the STEM-Based Problem Based Learning (PBL) Model

In this study, before knowing the increase in students' problem solving ability, a normality test was carried out first to determine whether the data obtained was normally distributed or not. After the normality results are known, it will later determine the data analysis to determine the effectiveness of the STEM-based Problem Based Learning (PBL) model using parametric or non-parametric tests. The analysis results of the normality test, homogeneity test, N-gain test, and non-parametric Mann-Whitney U Test can be seen in the following section.

Normality Test

The results of the normality test in the study after obtaining the sig value on the pretest and posttest of the experimental class were the same, namely 0.005. The results of the pretest sig value in the control class were 0.032 and posttest 0.140. Normality test count data using IBM SPSS

assistance can be accessed via the link https://shorturl.at/6fqWT, while the results of the normality test analysis are briefly presented in Table 1.

Table 1. Normality Test Results of Problem Solving Ability Data

Data	Class	Sig (count)	Sig (table)	Criteria
Pretest	Experiment	0,005	0,05	Not Normally Distributed
	Control	0,032	0,05	Not Normally Distributed
Posttest	Experimen	0,005	0,05	Not Normally Distributed
	Control	0,192	0,05	Normally Distributed

The analysis results of the normality test presented in Table 1 show that the pretest and posttest data in the experimental class as well as the posttest in the control class have a significance value of less than 0.05, which indicates that the data is not normally distributed. Only the pretest data in the control class was normally distributed because the significance value was more than 0.05. This condition requires the use of nonparametric techniques in data analysis, as the data distribution is not completely normal.

Homogeneity Test

The homogeneity test aims to determine a variance (diversity) of data from two or more groups is homogeneous (the same) or heterogeneous (not the same). Homogeneity test count data between experimental classes and control classes using IBM SPSS assistance can be accessed via the link https://shorturl.at/dTfvT, while the results of the homogeneity test analysis are briefly presented in Table 2.

Table 2 SPSS Results of Homogeneity Test for Experimental and Control Classes

		Levene Statistic	df1	df2	Sig.
Posttest Score	*Based on Mean*	3.092	1	61	0,084
	Based on Median	2.536	1	61	0,116
	Based on Median and with adjusted df	2.536	1	60.955	0,116
	Based on trimmed mean	3.225	1	61	0,077

The analysis results of the homogeneity test presented in Table 2 show that the significance value (sig) on Based on Mean is 0.084 so that *H*1 accepted significance value (sig) on Based on Mean > 0.05. These results indicate that the data have the same variant (homogeneous).

2. Results of N-gain Analysis on the Effect of PBL-STEM Model Implementation

The N-gain test is used to determine the magnitude of the increase in students' problem solving ability after being given treatment, namely the STEM-based Problem Based Learning (PBL) model on ecology and biodiversity material. N-gain test count data can be accessed at the link https://shorturl.at/erywF, while the N-gain analysis results are briefly presented in Table 3.

Tabel 3 N-gain Results of Students' Problem Solving Ability

Class	Average Score		*N-gain*	Category
	Pretest	*Posttest*		
Experiment	32,11	75,86	0,65	Sedang
Control	28,38	46,94	0,26	Rendah

Table 3 shows that the N-gain value of the experimental class is in the medium category, while the control class is in the low category. The application of the STEM-based Problem Based Learning (PBL) model is proven to be more effective in improving students' problem solving skills than learning in the control class. The calculation of N-gain for each indicator can be accessed at the link https://shorturl.at/DTSDy, while the results of N-gain for each indicator can be briefly presented in Figure 1.

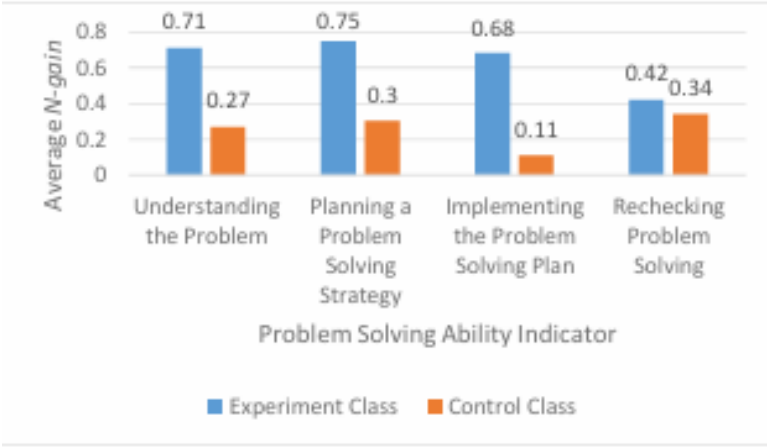

Figure 1. N-gain Test for each Indicator of Problem Solving Ability

The results of the analysis of the N-gain for each indicator presented in Figure 1 show that the lowest increase in the experimental class is in the indicator of re-examining problem solving because students are not used to evaluating the solutions made. The highest increase occurred in the indicator of planning a solution strategy, because students were more focused, familiar, and confident in determining the steps of problem solving. This happens because learners feel that the material studied is relevant to everyday life so that it increases interest and satisfaction in learning. Meanwhile, responsibility and environmental solutions tend to be low because they require personal awareness and reflection that have not been formed optimally. Examples of some test questions according to the indicators in the study are presented in Table 4.

Table 4. Test Questions per Indicator

Question No.	**Problem Solving Ability Indicator**	**Question Content**	**N-Gain Category**	**Description**
2	Understanding the Problem	Learners select the correct facts related to the overuse pesticide of fertilizers, and find solutions to overcome the problem. (Science)	High	This question trains problem-solving skills by encouraging learners to recognize the impact of human actions on the environment, analyze

				cause-and-effect relationships, and understand the context before determining a solution.
4	Planning Problem Solving Strategies	Learners give their assumptions or thoughts when they see garbage scattered around the school, and analyze the environmental impacts that will occur due to these problems. (Science)	High	This question helps learners identify environmental problems and design logical solutions, such as choosing green transportation or low-emission technologies.
10	Implementing the Problem Solving Plan	Learners sequence the correct steps to develop a problem solving plan conservation. (Engineering)	Medium	Learners are trained to think systematically and logically in designing an appropriate and efficient sequence of actions to solve problems.
9	Rechecking Problem Solving	Presented information, for with learners determine and double check which conservation method to use based on the information. (Technology)	Medium	This activity develops learners' ability to revisit solutions, by evaluating government policies and conservation strategies implemented.

Mann Whitney

The purpose of using the Mann-Whitney is to determine whether there is an effect on the application of the STEM-based Problem Based Learning (PBL) model on Ecology and Biodiversity material on students' problem solving skills. The Mann-Whitney U Test count data can be accessed at the link https://shorturl.at/m3u4J, while the results of the Mann-Whitney U Test analysis are briefly presented in Table 3.

Table 5 Mann Whitney U Test Analysis Results

Data	Sig (count)	Sig (table)	Criteria
Pretest	0,196	0,05	H_0 Retrieved
Posttest	0,000	0,05	H_0 Rejected

The analysis results of the Mann Whitney presented in Table 4 show that the Asymp. Sig. (2-tailed) pretest value of 0.196 > 0.05, so there is no significant difference between the experimental and control classes. Conversely, the posttest value of 0.000 ≤ 0.05 indicates a significant difference between the two classes.

3. Results of Students' Responses After Implementing the STEM-Based Problem Based Learning (PBL) Model on Ecology and Biodiversity Material

The statements in the learner response questionnaire are grouped into six indicators, namely: Interest and Learning Satisfaction (no. 1, 2, 10, 13), Activeness and Cooperation (no. 3, 6, 8, 16, 17), Communication and Respect for Opinions (no. 4, 5, 18), Motivation and Learning Initiatives (no. 7, 9, 19), Understanding STEM Concepts (no. 11, 12), and Responsibility and Environmental Solutions (no. 14, 15, 20). The calculation of the results of the learner response questionnaire can be accessed at the link https://shorturl.at/zedDO, while the results of the average value of each indicator are briefly presented in Figure 2.

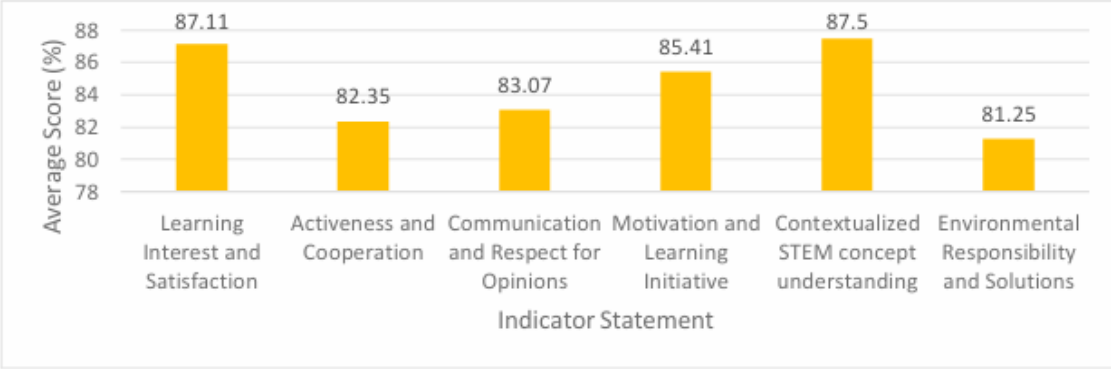

Figure 2. Average results of student response questionnaires based on each

The analysis of the average results of the learner response questionnaire based on each indicator presented in Figure 2 shows that the highest average is in the aspect of relevance and satisfaction of learning because the material is considered relevant, while the lowest score is in the aspect of responsibility and environmental solutions that require awareness and self-reflection which is still low.

4. Effectiveness of STEM-Based Problem Based Learning (PBL) Model on Improving Students' Problem Solving Ability

The use of the STEM-based Problem Based Learning (PBL) model is one of the causes of the difference in the average score of students' problem solving ability in the experimental and control classes. The improvement of problem solving ability in the experimental class is described according to the following indicators of problem solving ability.

Understanding the Problem

The STEM-based Problem Based Learning (PBL) model is applied through a problem orientation phase to improve the ability to understand the problem. Learners are given triggering questions and contextual images to get them interested and focused on the topic. Problem numbers 1, 2, 5, and 6 train learners to analyze real phenomena, identify facts, and understand cause-and-effect relationships. Each problem is integrated with STEM components such as science, technology, engineering, and mathematics according to the context of the problem.

The application of STEM-based Problem Based Learning (PBL) significantly improved the ability to understand problems in the experimental class. Contextual problems encourage learners to think critically and develop solutions based on proper understanding. Learning becomes more meaningful because learners relate the material to everyday life. This strategy helps learners develop the ability to think logically and systematically in solving problems. Learners are also trained to review the solution steps critically and thoroughly (Karnel & Purnomo, 2024).

Planning a Problem Solving Strategy

The increase in indicators of planning problem-solving strategies is supported through the application of the Problem Based Learning (PBL) model in phase 2, namely organizing students to learn in groups. Learners form small groups and access liveworksheets-based E-LKPDs that are interactively designed and integrated with technology. The use of E-LKPD is proven to increase the active involvement of learners and facilitate discussion in designing solutions (Sholihah et al., 2024).Research (Widiastuti & Kania, 2021) is in line with these findings that group discussions provide space for students to exchange ideas, develop a solution plan, and develop logical and effective strategies. The Problem Based Learning (PBL) model is proven to be able to improve the ability to design strategies as well as motivate students in learning science.

The E-LKPD used in learning is designed to contain Problem Based Learning (PBL) steps integrated with the STEM approach. This approach helps learners formulate a solution strategy through investigation activities and realize it in the form of a product as a problem solution (Fauziyah & Wijayanti, 2024). This is reflected in questions number 4 and 7 which emphasize the ability of learners to formulate solution strategies to environmental problems. Problem number 4 relates to vehicle emissions and encourages learners to design low-emission technology-based solutions, while problem number 7 emphasizes the application of the 3R principle in waste management. Both questions show a connection with the technology component in the STEM approach because it involves the use of methods or technology in solving real problems.

Implementing the Problem Solving Plan

The strategy of conducting a problem-solving plan is applied in the third meeting, when learners create products that are integrated with STEM components. This activity helps learners find solutions systematically through problem identification, information gathering, and solution design. Product creation involves learners actively and is proven to increase creativity and problem-solving skills (Hazana, 2024). The STEM approach in phase 3 of the Problem Based Learning (PBL) model supports the development of these abilities by combining elements of science, technology, engineering, and mathematics in the learning process (Muttaqiin, 2023). The resulting products in the form of posters and videos show links to STEM elements, where learners use scientific data, utilize design applications, design problem-solving techniques, and link solutions with number-based information.

The ability to carry out a problem solving plan was tested through questions number 3 and 10 in the pretest and posttest. Problem number 3 asks learners to come up with assumptions when looking at environmental problems and analyze their impact, which trains them to think logically and develop initial ideas for solutions (Wafom et al., 2024). In problem number 10, learners are asked to sequence the steps of a solution related to conservation efforts, which emphasizes the importance of systematic and structured thinking. These two questions show the connection with the science and engineering components in the STEM approach because they emphasize scientific concept-based analysis and technical design in developing solutions to environmental problems. STEM based learning through the Problem Based Learning (PBL) model provides space for students to design real solutions that are measurable and contextual.

Re-examining Problem Solving

An increase in the indicator of re-examining problem solving occurs through the application of phases 4 and 5 in the Problem Based Learning (PBL) model. In phase 4, students presented the results of group discussions on environmental issues such as garbage, waste, and pollution. Each group member is actively involved in the delivery of solutions that demonstrate understanding of the material. Other groups provide responses in the form of questions or suggestions to evaluate the results of the presentation. This process trains students to think critically and get used to evaluating solutions objectively. Research by Runi (2021) proves that the Problem Based Learning (PBL) model

increases learning activeness, concept understanding, and the ability to evaluate problem solving results.

Improvement was also seen in questions number 8 and 9 which measured the indicator of re-examining problem solving. Problem number 8 challenged learners to evaluate the conservation policy from the picture of the tourist forest, while problem number 9 invited them to connect the benefits of conservation to the economic aspect. Both train learners to think logically and systematically in reviewing the effectiveness of solutions. The questions are closely related to the science and technology components in the STEM approach. The posttest results showed that the majority of learners were in the good to excellent category. This finding is supported by Iolanessa et al., (2020) that the STEM-based Problem Based Learning (PBL) model is effective in improving overall problem solving skills.

5. Discussion of the Advantages and Limitations of the STEM-Based Problem Based Learning (PBL) Model Based on the Results of Student Responses on Ecology and Biodiversity Materials on Problem Solving Skills

The advantages and limitations of the STEM-based Problem Based Learning (PBL) model based on the results of students' responses on ecology and biodiversity material on problem solving skills are explained in the following section.

The advantages of the STEM-based Problem Based Learning (PBL) model based on the results of students' responses to problem solving skills

The questionnaire results show that the application of the STEM-based Problem Based Learning (PBL) model has a positive impact on improving students' problem solving skills. The superiority of this model can be seen from the high positive response of students to statements related to critical thinking skills, information retrieval, and concept understanding. This positive response indicates that a learning approach that demands active involvement provides a meaningful learning experience. Research by Putri et al., (2024) reinforces these findings, that STEM-based modules received very good responses because they were able to increase learner involvement in the learning process. The STEM based Problem Based Learning (PBL) model also proved effective in encouraging learners to think critically, creatively, and collaboratively in solving problems (Putri et al., 2020).

The high agreement with the statement "I am motivated to seek information from various sources" indicates that learners have a strong drive to explore information independently. Factors that influence this enthusiasm include relevant and interesting discussion topics, and the availability of access to information such as books and the internet. This activity strengthens students' learning independence in understanding the material in depth. Research by Ningrum & Wulandari (2020) shows that independent exploration and the availability of digital media encourage learners to be more active in finding information to support learning. In addition, the demands in discussion activities also encourage them to understand the material more deeply in order to actively participate in the learning process (Gylank et al., 2021).

The statement "It is easier for me to understand concepts because of contextual and real problem-based learning" obtained a high percentage, indicating the effectiveness of the approach. Linking the material to the context of everyday life makes it easier for learners to understand abstract concepts concretely. This encourages them to think actively and develop relevant solutions. Research by Budiyatno et al., (2024) states that real context based learning helps accelerate concept understanding. In addition, problem-based learning not only increases motivation but also encourages the development of students' critical and creative thinking skills (Purwanti et al., 2021).

Limitations of the STEM-based Problem Based Learning (PBL) model based on the results of students' responses to problem solving skills

The application of the STEM-based Problem Based Learning (PBL) model shows excellence in improving problem solving skills, but the questionnaire results reveal limitations in the aspects of self-confidence and responsibility of students. The statement "I feel confident in expressing my opinion during discussions" obtained the lowest percentage of agreement, indicating that some students are still reluctant to express their opinions verbally. Research (Andriani et al., 2022) shows that these obstacles are influenced by shyness, fear of making mistakes, social pressure, and domination of discussions by more active participants. Teachers have an important role in building a safe and inclusive classroom atmosphere, dividing roles in discussions, and rewarding participation so that all learners feel valued (Sukmasetya & Dwihantoro, 2024).

The questionnaire results also show that learners' responsibility in preparing the report is still low, especially in the statement regarding the importance of assessment in motivating preparation. Learners tend to consider assessment as a formality because they do not understand its function in learning (Azzizzah & Supahar, 2021). Research by (Subekti et al., 2022) shows that the cause of students' responsibility in preparing reports is still low because the unclear assessment system and the lack of feedback from teachers cause them to be less encouraged to compile reports seriously. Teachers need to provide clear assessment rubrics and constructive feedback to increase students' seriousness (Oktarini et al., 2021). Additional strategies such as self- and peer-assessment are also effective in fostering a sense of responsibility, especially if the tasks are relevant to real life.

The success of the STEM-based Problem Based Learning (PBL) model is highly dependent on the active involvement of students and teacher support in providing appropriate learning resources. Teachers must act as facilitators who are able to guide learners' critical and creative thinking processes through meaningful projects and discussions (Kusumaningtyas et al., 2024). Continuous evaluation, including self assessment and peer evaluation, has been shown to increase motivation and collaborative skills (Hasanah et al., 2021). Kualitas pembelajaran juga dipengaruhi oleh kesiapan lingkungan belajar, seperti ketersediaan waktu, fasilitas, dan media pendukung. The quality of learning is also influenced by the readiness of the learning environment, such as the availability of time, facilities, and supporting media. The application of the STEM-based Problem Based Learning (PBL) model will be optimal if all these elements run synergistically and are supported by the active role of the teacher as a guide and provider of relevant learning (Octaviani, 2022).

The successful implementation of the STEM-based Problem Based Learning (PBL) model is not only influenced by the method used, but also by the role of the teacher and the readiness of the learning environment. Research conducted by Kusumaningtyas et al., (2024) shows that teachers must play an active role as facilitators who are able to guide students in critical and creative thinking through projects and discussions. Self-evaluation and peer assessment can increase learners' motivation as well as collaborative skills. A supportive learning environment, such as sufficient time and appropriate learning media, greatly influences the success of learning. research Octaviani (2022) emphasizes that the availability of facilities and individual evaluation provided by teachers have a direct impact on the quality of learners' learning outcomes. These findings confirm that the success of the STEM-based Problem Based Learning (PBL) model depends on the synergy between learning strategies, the role of teachers and environmental support.

CONCLUSION

The STEM-based Problem Based Learning (PBL) learning model on Ecology and Biodiversity material is proven effective in improving students' problem solving skills. This effectiveness is supported by the results of the Mann-Whitney test which shows a significant difference between the experimental class and the control class, thus indicating that the learning model has a positive effect on improving students' abilities. In addition, students' responses to the application of the STEM-based Problem Based Learning (PBL) model are also very good, which is reflected in the

questionnaire results which show enthusiasm for learning, active involvement, and high motivation during the learning process.

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