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Analysis of Students' Reflective Thinking Skills Through Problem Based Learning on Introduction to Cell Material for Grade VIII SMP Sriwedari Malang

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Abstract

This study was motivated by the still-low level of students' reflective thinking skills in science learning, particularly in understanding their learning experiences, connecting prior knowledge with new information, and reflecting on the learning process. Problem-based learning (PBL) was chosen because it provides students with opportunities to actively engage in problem-solving, discussion, and reflection on their learning. This study aims to analyze the reflective thinking skills of eighth-grade students at Sriwedari Junior High School in Malang through the application of the problem-based learning model to the topic of cell introduction. The study employed a qualitative approach using the case study method. The research subjects consisted of seven eighth-grade students at Sriwedari Junior High School in Malang. Data were collected through observation, student reflection sheets, and documentation. Data analysis was conducted using the miles and huberman model, which includes data reduction, data presentation, and drawing conclusions. The results of the study indicate that students' reflective thinking skills developed gradually during the implementation of PBL. The *"reacting"* indicator emerged most prominently because students were able to respond to learning experiences and connect them to their prior knowledge. the Reacting indicator increased from 75.00% to 85.71% The *"comparing"* indicator was developed through discussion and inquiry activities that allowed students to compare new information with their previous learning experiences. Comparing" increased from 60.71% to 71.43%. Meanwhile, the *"contemplating"* indicator began to emerge through presentation and reflection, although it still showed lower achievement compared to the other indicators.

Keywords: *Reflective thinking skills; Problem based learning; Cell introduction; Science*

Abstrak

Penelitian ini dilatarbelakangi oleh masih rendahnya kemampuan berpikir reflektif siswa dalam pembelajaran sains, khususnya dalam memahami pengalaman belajar, mengaitkan pengetahuan awal dengan informasi baru, serta merefleksikan proses pembelajaran. Model pembelajaran berbasis masalah (*Problem-Based Learning* atau PBL) dipilih karena memberikan kesempatan kepada siswa untuk terlibat aktif dalam pemecahan masalah, diskusi, dan refleksi terhadap pembelajaran mereka. Penelitian ini bertujuan untuk menganalisis kemampuan berpikir reflektif siswa kelas VIII di SMP Sriwedari Malang melalui penerapan model PBL pada topik pengenalan sel. Penelitian ini menggunakan pendekatan kualitatif dengan metode studi kasus. Subjek penelitian terdiri dari tujuh orang siswa kelas VIII SMP Sriwedari Malang. Pengumpulan data dilakukan melalui observasi, lembar refleksi siswa, dan dokumentasi. Analisis data dilakukan menggunakan model Miles dan Huberman, yang mencakup reduksi data, penyajian data, dan penarikan kesimpulan. Hasil penelitian menunjukkan bahwa kemampuan berpikir reflektif siswa berkembang secara bertahap selama penerapan PBL. Indikator "bereaksi" (*reacting*) muncul paling menonjol karena siswa mampu merespons pengalaman belajar dan mengaitkannya dengan pengetahuan awal mereka; capaian indikator ini meningkat dari 75,00% menjadi 85,71%. Indikator "membandingkan" (*comparing*) berkembang melalui kegiatan diskusi dan inkuiri yang memungkinkan siswa membandingkan informasi baru dengan pengalaman belajar sebelumnya; capaian indikator ini meningkat dari 60,71% menjadi 71,43%. Sementara itu, indikator "merenung" (*contemplating*) mulai muncul melalui kegiatan presentasi dan refleksi, meskipun tingkat pencapaiannya masih lebih rendah dibandingkan indikator lainnya.

Kata Kunci: *Keterampilan berpikir reflektif; Pembelajaran berbasis masalah; Pengenalan topik; Sains*

1. INTRODUCTION

Science learning in the Independent Curriculum is directed at developing 21st-century competencies, focusing not only on conceptual mastery but also on higher-order thinking skills. Reflective thinking is a crucial skill to develop in education. Reflective thinking skills enable students to review past learning experiences, evaluate their thinking processes, and develop a more meaningful understanding of the concepts they learn. This ability is crucial because it can help students solve problems, make decisions, and develop in-depth conceptual understanding (Fuady, 2017). Reflective thinking skills don't develop automatically. Students need learning experiences that provide opportunities to confront problems, express opinions, connect information, and evaluate answers or solutions. Research on reflective thinking shows that students' abilities can develop through learning activities that provide space for connecting previous experiences with new learning experiences. (Ningrum *et al.*, 2024), for example, shows that the problem-centered characteristics of PBL can support the development of reflective thinking skills through problem-solving activities, discussions, and reflection.

Initial observations of eighth-grade students at Sriwedari Middle School in Malang indicate that they still have difficulty connecting the concepts they are learning to prior experiences or knowledge. They are also not yet accustomed to providing reasons for their answers and re-evaluating their understanding. This situation suggests that learning needs to provide more active and structured experiences to provide students with opportunities to develop reflective thinking skills. One learning model that has characteristics that meet these needs is Problem-Based Learning (PBL). PBL places problems as the starting point of learning, encouraging students to understand the problem, gather information, conduct investigations, discuss alternative solutions, and evaluate the results obtained. This process can encourage students to be actively involved in knowledge formation. Studies (Dolmans *et al.*, 2016) show that PBL can support a more in-depth learning approach because students are involved in the process of understanding and integrating knowledge through problems.

Previous research has also shown a relationship between the implementation of PBL and the development of higher-order thinking skills. (Anwar *et al.*, 2023) showed that the implementation of PBL in science learning can have a significant impact on the critical thinking skills of junior high school students. Research (Hayati *et al.*, 2023) also shows that reflective thinking skills in biology learning can develop through problem-solving activities involving problem identification, information analysis, and reflection on learning experiences. In the context of biology learning, introductory cell material has characteristics that allow students to be confronted with various contextual problems. Students not only learn the structure and function of cells but also need to relate these structures to the functions and characteristics of organisms. Therefore, problem-based learning can be used to provide learning experiences that encourage students to observe, compare, connect, and evaluate the information they acquire (Flower et al., 2023).

Although research on PBL and higher-order thinking skills has been extensively conducted, research specifically analyzing the development of reflective thinking skills based on the Reacting, Comparing, and Contemplating indicators in cell introduction material at the junior high school level is still limited. Therefore, this study aims to analyze the reflective thinking skills of eighth-grade students of Sriwedari Junior High School, Malang through the application of the Problem Based Learning model in cell introduction material.

2. METHOD

This study uses a qualitative approach with a case study method to obtain an in-depth description of students' reflective thinking skills during the implementation of Problem Based Learning on cell introduction material. The study was conducted at Sriwedari Junior High School, Malang in the odd semester of the 2025/2026 academic year. The research subjects consisted of

seven eighth-grade students selected using a total sampling technique because the number of students in the class was relatively small.

The research instruments consisted of observation sheets and student reflection sheets compiled based on indicators of reflective thinking skills, namely Reacting, Comparing, and Contemplating. Observation data were used to describe the implementation of Problem Based Learning syntax and students' reflective thinking processes during learning. The reflection sheets served to strengthen observation data on students' reflective thinking skills based on the Reacting, Comparing, and Contemplating indicators. Documentation was used as a supporting data source to support the research findings.

Data on students' reflective thinking skills obtained through observation sheets and reflection sheets were then processed into percentages for each indicator: Reacting, Comparing, and Contemplating. The percentage of achievement for each indicator was calculated by comparing the obtained score with the maximum score, then multiplying by 100%. The results of these calculations were used to describe the level of achievement of students' reflective thinking skills at each meeting and to observe trends in their development during the implementation of Problem-Based Learning.

Qualitative data analysis refers to the Miles and Huberman model, which includes data reduction, data presentation, and drawing conclusions or verification. In the reduction stage, data from observations and reflection sheets are selected and focused on information related to students' reflective thinking skills. Next, the reduced data is presented based on the Reacting, Comparing, and Contemplating indicators to facilitate the identification of developmental patterns at each meeting. The final stage is carried out by drawing conclusions based on data trends and findings obtained during the learning process. Data validity was verified through technical triangulation by comparing information obtained from observations, student reflection sheets, and documentation. The use of multiple data collection techniques was intended to obtain a more comprehensive picture of the development of students' reflective thinking skills during the implementation of Problem-Based Learning.

$$Percentage\ of\ Reflective\ Thinking\ Skills\ = \frac{Score\ obtained}{Maximum\ score}\ x\ 100\%$$

3. RESULT AND DISCUSSION

The results of the research during three meetings showed an increase in the three indicators of reflective thinking skills, namely *Reacting*, *Comparing* and *Contemplating.* This improvement indicates that learning that is implemented continuously and accompanied by reflection at the end of each structured lesson is able to encourage the gradual development of students' reflective thinking skills.

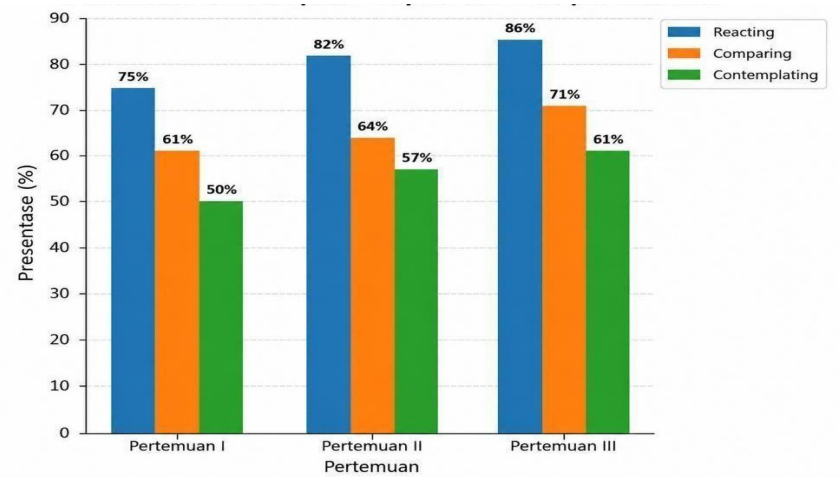

Figure 1. Percentage of Reflective Thinking Skills by Indicator

Based on the percentage of students' reflective thinking skills, it is known that all indicators of students' reflective thinking skills showed an increase during the three research meetings.

3.1. Reacting Indicators

The reacting indicator achieved a percentage of 75.00% in the first meeting, 82.14% in the second meeting, and 85.71% in the third meeting. These results indicate that students are able to respond to the problems given. The high achievement of this indicator is thought to be because the problem orientation stage in PBL provides students with the opportunity to identify problems and express initial opinions. According to Mirzaei *et al.* (2014), Reacting is the initial stage of reflective thinking characterized by the ability to respond to learning experiences. This finding is in line with research (Hanria & Fauzan, 2023) which shows that PBL can improve students' ability to actively respond to and identify problems. Therefore, the use of PBL has the potential to develop students' reflective thinking skills, especially in the reacting aspect.

The increase in the Reacting indicator at each meeting indicates that students are becoming more accustomed to dealing with the problems presented in the lesson. In the first meeting, some students still had difficulty identifying important information from the problems presented. However, in the second and third meetings, students began to be able to express initial opinions and provide more appropriate responses to the issues discussed. This condition indicates that problem-based learning provides a learning experience that encourages students to be more active in observing, identifying, and understanding a problem before seeking an appropriate solution.

The development of problem-solving skills is inseparable from the characteristics of PBL, which places problems as the starting point of learning. In the problem-oriented stage, students are confronted with phenomena related to the cell introduction material, encouraging them to connect their prior knowledge with new information acquired during the lesson. This activity helps students build a baseline understanding of the material being studied and fosters curiosity to find answers to the problems presented. Thus, students are not merely passive recipients of information but are actively engaged in the learning process from the beginning.

The high achievement of the Reacting indicator also indicates that students find it easier to provide an initial response to a problem than to conduct an in-depth evaluation of their thinking process. This condition is related to the characteristics of the initial stage of Problem-Based Learning, which directly confronts students with contextual problems. Through this stage, students receive the stimulus to identify problems and express prior knowledge. This finding is in line with the journal (Hayati *et al.*, 2023) which reported that the application of problem-based learning can improve students' reflective thinking skills, especially in the initial stage of reflection, because students are given the opportunity to identify problems, express opinions, and connect learning experiences with the situation at hand. Similar findings were also reported by (Ningrum *et al.*, 2024) who stated that the use of contextual problems in learning can encourage students' active involvement in the thinking process, thereby developing their ability to respond to a problem more optimally.

Based on these results, it can be concluded that the increase in the Reacting indicator demonstrates the effectiveness of the implementation of Problem-Based Learning in facilitating the development of students' reflective thinking skills at an early stage. The more frequently students are involved in problem identification and analysis activities, the more their ability to respond to the learning experiences they have acquired develops.

3.2. Comparing Indicators

The Comparing indicator achieved a percentage of 60.71% in the first meeting, 64.29% in the second meeting, and 71.43% in the third meeting. These results indicate that students are beginning to be able to connect new information with previously acquired knowledge. This ability is seen when students compare the structure and function of cell organelles,

identify similarities and differences between animal and plant cells, and relate learned concepts to phenomena found in everyday life. Comparing is a stage of reflective thinking that involves the ability to compare new experiences with previous experiences to gain a deeper understanding. These findings indicate that the application of Problem Based Learning is able to help students build connections between existing knowledge and information obtained during learning. The improvement in the Comparing indicator at each meeting indicates that students are becoming more skilled at analyzing and connecting various pieces of information obtained during the learning process. In the first meeting, some students still tended to receive information in isolation without connecting it to previously learned concepts. However, in the second and third meetings, students began to be able to connect discussion results, information from learning resources, and previous learning experiences to understand the concept of cells more comprehensively. This indicates that the ongoing learning process provides opportunities for students to develop reflective thinking skills at the Comparing stage.

The development of these skills is supported by the stages of organizing students and guiding investigations in the PBL model. At this stage, students work in groups to gather information, discuss findings, and compare alternative answers to given problems. These activities enable students to analyze and interpret information, thereby enhancing their understanding. Through discussions and investigations, students not only receive information from the teacher but also actively construct knowledge based on interactions with peers and the learning resources they use. Despite the improvement, the Comparing indicator remains below the Reacting indicator. This indicates that the ability to compare and connect various pieces of information requires a more complex thinking process than simply responding to a problem. At this stage, students are required to identify relationships between concepts, find similarities and differences, and integrate various pieces of information into a coherent understanding. Therefore, developing the Comparing indicator requires more intensive practice and learning experiences.

This finding aligns with research by Ningrum *et al.*, 2024, which states that problem-based learning can improve students' reflective thinking skills through investigative activities and group discussions that encourage students to compare various pieces of information before determining a solution to a problem. Similar findings were also reported by Hayati *et al.*, 2023, which showed that analysis and problem-solving activities in learning can help students connect prior knowledge with new learning experiences, thus optimally developing reflective skills at the Comparing stage. Based on these results, it can be concluded that the implementation of Problem-Based Learning can facilitate the development of Comparing indicators through discussion, investigation, and information analysis. The more frequently students engage in the process of comparing various information and learning experiences, the more their ability to develop a deeper understanding of the concepts being studied will develop.

3.3. Contemplating Indicator

The Contemplating indicator achieved a percentage of 50.00% in the first meeting, 57.14% in the second meeting, and 60.71% in the third meeting. These results indicate that students' ability to conduct in-depth reflection on the thought processes that have been carried out has increased throughout the learning process. Contemplating is the highest stage of reflective thinking that involves the ability to analyze, evaluate, and draw conclusions based on the learning experience that has been obtained. At this stage, students not only understand a concept but are also able to assess the strengths and weaknesses of the thought process that has been carried out to determine improvements in subsequent learning. The improvement in the Contemplating indicator indicates that students are becoming accustomed to evaluating their learning outcomes. In the first session, most students still struggled to articulate their reasoning, evaluate their own understanding, and explain the shortcomings of their chosen solutions. However, in the second and third sessions, students

began to demonstrate the ability to review their thinking processes, identify errors, and propose more appropriate alternative solutions based on their reflection.

The development of these skills is influenced by the stages of developing and presenting work results, as well as analyzing and evaluating the problem-solving process in the PBL model. At this stage, students are given the opportunity to present discussion results, receive input from other groups, and evaluate the solutions they have obtained. These activities encourage students to think more deeply about the learning process they have undergone, allowing for the gradual development of high-level reflective skills. Furthermore, reflection activities at the end of the lesson help students identify strengths and weaknesses in their understanding, making the learning process more meaningful. Despite improvements at each meeting, the Contemplating indicator still achieved the lowest percentage compared to other indicators. This indicates that high-level reflection skills remain a challenge for some students. The ability to evaluate thought processes require more complex metacognitive skills than the ability to respond or compare information. Therefore, students need more time and practice to reach the optimal Contemplating stage.

This finding aligns with research by Hayati *et al.* (2023), which reported that high-level reflection skills develop gradually because students require continuous practice to analyze and evaluate their learning experiences. This finding also aligns with research by Hanria & Fauzan (2023), which shows that the implementation of Problem-Based Learning can improve students' reflective thinking skills. However, the development of high-level reflection aspects requires a longer time than basic reflection aspects. Based on these results, it can be concluded that the implementation of Problem-Based Learning can develop students' contemplating skills through presentation activities, evaluation, and reflection on the problem-solving process. Although the percentage is still lower than other indicators, the increase in each meeting indicates that PBL makes a positive contribution to training students' high-level reflection skills on cell recognition material.

The development of these three indicators is inseparable from the implementation of Problem-Based Learning syntax during the learning process. The problem-orientation stage plays a role in the emergence of the Reacting indicator because students are encouraged to respond to the given problems. The stages of organizing students and guiding investigations support the development of the Comparing indicator through discussion activities, information gathering, and data analysis. Meanwhile, the stages of developing and presenting work results and analyzing and evaluating the problem-solving process contribute to the development of the Contemplating indicator because students are given the opportunity to reflect on their learning outcomes.

The findings of this study indicate that Problem Based Learning not only increases student engagement during learning but also facilitates the gradual development of reflective thinking skills. These results are in line with research (Hanria & Fauzan, 2023), which found that the implementation of Problem Based Learning (PBL) through e-modules can improve students' reflective thinking skills because students are actively involved in the problem-solving process, discussions, and evaluation of learning outcomes obtained. The study showed that the developed PBL-based learning tools were declared valid, practical, and effective in improving students' reflective thinking skills. (Ningrum *et al.*, 2024) who, through a systematic literature review, concluded that the PBL model consistently has a positive influence on students' reflective thinking skills. The learning process that begins with the presentation of authentic problems, investigations, group discussions, and reflections allows students to develop the ability to analyze learning experiences and connect them with prior knowledge. Thus, PBL can be an alternative effective learning model for developing students' reflective thinking skills in science learning, especially cell material.

3.4. The Relationship between the Problem Based Learning Model and Reflective Thinking Skills

The development of students' reflective thinking skills in this study was inseparable from the implementation of Problem-Based Learning (PBL) syntax during the learning process. Each stage in the PBL model contributed differently to the development of the Reacting, Comparing, and Contemplating indicators. This indicates that the improvement in students' reflective thinking skills occurred as a result of their active involvement in each learning stage, which focused on problem-solving. The problem-orientation stage contributes to the development of the Reacting indicator. At this stage, students are confronted with contextual problems related to the introduction to cells material, encouraging them to observe phenomena, identify problems, and express initial opinions based on their existing knowledge. This activity allows students to respond to their learning experiences, allowing Reacting skills to develop more rapidly than other indicators.

The stage of organizing students for learning and guiding investigations contributes to the development of the Comparing indicator. In this stage, students work in groups to gather information, discuss various alternative answers, and compare the information obtained with prior knowledge. This activity encourages students to build relationships between concepts and evaluate the appropriateness of the information obtained, resulting in a more meaningful understanding. The process of comparing and connecting new experiences with previous ones is a key characteristic of the Comparing stage of reflective thinking. Meanwhile, the stages of developing and presenting work results, as well as analyzing and evaluating the problem-solving process, contribute to the development of the Contemplating indicator. At this stage, students not only convey the results of their discussions but also evaluate their thinking processes, review their chosen solutions, and identify any remaining shortcomings. These activities involve more complex metacognitive skills because students are required to analyze and evaluate their learning process. Therefore, the Contemplating indicator received a lower percentage than the other indicators because it requires high-level reflection skills that develop gradually.

The results of this study indicate that the syntax of Problem Based Learning can systematically facilitate the development of students' reflective thinking skills starting from the stage of responding to problems (Reacting), connecting and comparing information (Comparing), to evaluating the thought process that has been carried out (Contemplating). This finding strengthens the view that problem-based learning is not only oriented towards mastering concepts, but also able to develop higher-order thinking skills that students need in understanding and solving problems reflectively.

The findings of this study align with various studies reporting that Problem-Based Learning is effective in developing students' reflective thinking skills. (Hanria & Fauzan, 2023) state that problem-based learning provides opportunities for students to be actively involved in the process of problem identification, investigation, discussion, and reflection, thus optimally developing reflective thinking skills. Furthermore, (Nindiasari & Syamsuri, 2023) explain that the characteristics of PBL, which centers on authentic problems, can encourage students to connect prior knowledge with new learning experiences and evaluate the problem-solving process. Thus, the application of PBL to cell introduction material has been proven to facilitate the gradual development of students' reflective thinking skills in each measured indicator.

The findings of this study are supported by various studies published in the Scientific Periodical of Biology Education (BioEdu). (Sahadah & Yuliani, 2024) reported that the implementation of Problem-Based Learning through interactive E-LKPD can train students' higher-order thinking skills because students are actively involved in identifying problems, analyzing information, and developing solutions based on the results of the investigation. These activities provide opportunities for students to develop deeper thinking skills through the process of investigation and group discussion. This condition is in line with the results of this study, which showed an increase in reflective thinking skills in the Reacting, Comparing, and Contemplating indicators during the implementation of Problem-Based Learning.

The results of this study are also supported by (Anggraini & Trimulyono, 2025) who stated that Problem Based Learning can train high-level thinking skills because students are required to analyze information, evaluate various alternative answers, and draw conclusions based on the evidence obtained. These activities are related to the reflective thinking process, especially in the Comparing and Contemplating indicators that require students to connect new information with existing knowledge and evaluate the thinking process carried out.

Another study conducted by (Sani & Ambarwati, 2024) found that the use of Problem-Based Learning (PBL) learning tools is effective in training higher-order thinking skills because students are encouraged to solve real-world problems through investigations and group discussions. These activities enable students to develop their ability to analyze, compare, and evaluate information obtained during learning. These findings support the results of this study, which showed that the Comparing indicator experienced a gradual increase from the first to the third meeting as a result of student involvement in the investigation process and group discussions during the learning process.

Furthermore, (Munawaroh & Budijastuti, 2024) reported that the application of Problem-Based Learning (LKPD) to the respiratory system can train critical thinking skills through problem identification, data analysis, solution development, and evaluation of learning outcomes. These stages are similar to the Problem-Based Learning syntax applied in this study. Therefore, the improvement in students' reflective thinking skills in this study is suspected to occur because students have the opportunity to be actively involved in all learning stages, from problem orientation to evaluation of the problem-solving process.

Overall, the results of this study reinforce various research findings published in the BioEdu journal that Problem Based Learning is an effective learning model for developing students' higher-order thinking skills (Endaryati *et al.*, 2025). In this study, reflective thinking skills developed gradually, starting from the ability to respond to problems (Reacting), connecting and comparing various pieces of information (Comparing), to the ability to evaluate the thought process that has been carried out (Contemplating). Thus, the application of Problem Based Learning to the introduction to cells material not only helps students understand biological concepts but also contributes to developing reflective thinking skills, which are one of the important competencies in 21st-century learning.

Pedagogically, the results of this study indicate that Problem-Based Learning (PBL) is an effective learning model for developing students' reflective thinking skills in cell recognition material (Ningrum *et al.*, 2024). The improvements in the Reacting, Comparing, and Contemplating indicators indicate that problem-solving-centered learning can encourage students to be actively involved in identifying problems, connecting new information with existing knowledge, and evaluating their thinking processes. These findings support various studies in the BioEdu journal that report that the application of PBL can train higher-order thinking skills through investigation, discussion, information analysis, and collaborative problem-solving activities.

The highest improvement found in the Reacting indicator indicates that students relatively easily develop the ability to respond to given problems. Meanwhile, the achievement in the Contemplating indicator, which is still lower than the other indicators, indicates that high-level reflection skills require more intensive practice and habituation. This condition indicates that the development of reflective thinking skills does not occur instantly, but rather develops gradually through continuous learning experiences. Therefore, teachers need to provide learning activities that allow students to systematically reflect on the learning process and outcomes obtained (Oktafiani *et al.*, 2023).

The findings of this study also imply that the application of PBL in science learning is not only oriented towards mastering concepts, but also contributes to the development of 21st-century skills needed by students in facing various real-life problems. The characteristics of PBL, which begins with the presentation of contextual problems, followed by investigation activities, group discussions, presentations of results, and evaluation of solutions, provide opportunities for students to construct knowledge independently while

developing reflective thinking skills. These results are in line with BioEdu's research which states that problem-based learning can create a learning environment that encourages students to think more critically, analytically, and reflectively in solving problems they face.

Thus, Problem-Based Learning can be recommended as an alternative learning model that science teachers can use to develop students' reflective thinking skills (Indriyana *et al.*, 2025). To optimize the development of the Contemplating indicator, teachers are advised to integrate written reflection activities, reflection journals, metacognitive questions, and self-evaluation at the end of each lesson. This strategy is expected to help students develop the ability to analyze and evaluate their thinking processes more deeply, so that reflective thinking skills can develop optimally.

4. CONCLUSION

Based on the analysis results, the reflective thinking skills of eighth-grade students of Sriwedari Junior High School Malang on cell material showed development in three indicators, namely Reacting, Comparing, and Contemplating. The Reacting indicator achieved the highest achievement, which indicates that students are better able to provide responses to problems given during learning. The Comparing and Contemplating indicators also showed development although with relatively lower achievements, indicating that students' abilities in comparing information and conducting in-depth reflection still need to be improved. The results of this analysis indicate that students' reflective thinking skills develop gradually during the learning process with Problem Based Learning, so that the model can support the development of reflective thinking skills in science learning. Further research is recommended to examine reflective thinking skills in other science materials with a longer implementation time so that the development of the Contemplating indicator can be observed more deeply.

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