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Integrating Problem-Based Learning and the Teaching at the Right Level Approach to Improve Students' Collaboration Skills

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Abstract: This study aimed to enhance Grade VIII students' collaboration skills by integrating the Teaching at the Right Level (TaRL) methodology with the Problem-Based Learning (PBL) model. Conducted as classroom action research (CAR) involving 32 students from Class VIII F at SMP Negeri 1 Magelang, the study was implemented over two cycles, each comprising the stages of planning, implementation, observation, and reflection. Data were collected through observation sheets, questionnaires, and interviews, and analyzed using descriptive quantitative techniques. The findings revealed consistent improvement across five indicators of collaboration skills, with increases of 15%, 19%, 17%, 22%, and 18% after two cycles. The overall average score rose from 61% in the pre-cycle to 72% in Cycle I and 91% in Cycle II. These results indicate that the integration of PBL and TaRL effectively fostered students' teamwork competencies. The study contributes to the growing body of evidence on how learner-centered and level-based instructional approaches can synergistically promote active engagement, peer collaboration, and the development of 21st-century skills in middle school education.

INTRODUCTION

The Independent Curriculum, which promotes an adaptable and independent learning system, is the Indonesian government's strategic response to contemporary educational challenges. The 4Cs critical thinking, communication, collaboration, and creativity are crucial for global competitiveness, and this curriculum aims to give students the 21st-century competencies they need (Wulansari & Sunarya, 2023; Muliana, Nufus, & Khusna, 2023; Wulandari, Darmansyah, Yeni, & Yusri, 2023). This framework ensures meaningful and individualized educational experiences by giving students the freedom to guide their own learning while teachers act as facilitators. According to research, students' academic and social outcomes are greatly improved when they master the 4C skills (Ode et al., 2017; & Dias-Oliveira, 2024). However, many classrooms still struggle to promote true teamwork and equal participation among students, even with its emphasis on collaboration.

The Teaching at the Right Level (TaRL) approach, which focuses on assigning students to ability-based groups, and Problem-Based Learning (PBL), which stresses inquiry and real-world problem solving, can be combined to close this gap and provide a creative way to improve collaboration in science education (Kaffenberger & Pritchett,

2021; Kumar et al., 2024; Hmelo-Silver, 2004). It is anticipated that this combination will result in more effective, interesting, and equitable learning environments that support the objectives of the Independent Curriculum.

The development of problem-solving skills and teamwork, which are necessary for meaningful learning, are also important aspects of science education (Sufajar & Qosyim, 2022). Students can share ideas, build knowledge together, and use higher-order thinking skills when they collaborate (Gillies, 2016). It has been demonstrated that students who actively engage in group-based problem-solving improve their social interaction and teamwork abilities, two critical 21st-century learning skills. However, the researchers found that not all students showed sufficient teamwork during a lesson on the circulatory system in a Grade VIII F science class at SMP Negeri 1 Magelang. During group activities, a number of students demonstrated a lack of responsibility and made minimal contributions. Inactive students not only hampered peer progress but also missed opportunities to develop responsibility and problem-solving skills, which resulted in suboptimal learning outcomes and decreased group productivity (Syahdan et al., 2023). Despite the frequent use of group learning strategies, additional interviews with the science teacher confirmed that students' collaboration skills were still lacking.

The findings of a non-cognitive diagnostic survey also showed that 22 of 32 students (67%) liked working in groups, indicating a favorable attitude toward teamwork but a lack of proficiency in using it successfully. A prevalent problem in cooperative learning environments, some students tended to rely on their more experienced peers, which decreased equitable participation within groups (Bergamin et al., 2019). This study uses the Teaching at the Right Level (TaRL) methodology in conjunction with the Problem-Based Learning (PBL) model to address these issues. PBL encourages collaboration by involving students in inquiry and reflection, and it facilitates active learning through real-world problem-solving (Hmelo-Silver, 2004). By assigning students to groups based on their actual learning levels, TaRL offers differentiated instruction and enables them to work on tasks that are suitably difficult. In science learning contexts, it is anticipated that the combination of PBL and TaRL will foster more equitable participation, increase accountability, and fortify teamwork among students with different skill levels.

Even when they have high intellectual ability, students who lack collaboration skills frequently struggle to express their ideas and opinions in the classroom and later in the workplace. This emphasizes how crucial it is to develop collaborative competence early on. Using interactive learning models like Problem-Based Learning (PBL), which has been demonstrated to improve students' capacity for teamwork while resolving challenging, real-world issues, is one efficient way to accomplish this (Mulyani et al., 2024). PBL encourages students to use higher-order thinking abilities, participate in active inquiry, and work together to create solutions that are pertinent, contextual, and meaningful. This model fosters critical thinking, communication, respect, and shared responsibility in the learning process by involving students in group-based problem-solving. PBL gives all students the chance to actively participate and take charge of their education, which is especially important at SMP Negeri 1 Magelang, where unequal participation and an excessive dependence on some group members have been noted. But given that students have

different comprehension and learning readiness levels, PBL might not be enough to account for these variations. Thus, it is anticipated that combining PBL with the Teaching at the Right Level (TaRL) methodology will improve the effectiveness and equity of group learning. TaRL facilitates more balanced participation and maximizes the advantages of collaboration among diverse learners by ensuring that students are given tasks that are appropriate for their actual proficiency levels.

Nine students needed assistance, twelve were in the developing category, and eleven were in the advanced category, according to a cognitive diagnostic test that showed a range of learning outcomes among the students. By classifying students based on their present skill levels rather than age or grade, the Teaching at the Right Level (TaRL) approach takes into account this diversity and enables teachers to modify their lessons to fit the needs of their students (Banerjee et al., 2017; Mubarokah, 2022). TaRL guarantees that students are given tasks that are suitable for their readiness levels when paired with Problem-Based Learning (PBL), which places an emphasis on group problem-solving through relevant and real-world contexts (Hmelo-Silver, 2004). This integrated model allows for balanced participation and fosters students' cognitive development and teamwork skills by assigning differentiated problem-solving tasks based on diagnostic results (Gillies, 2016; Johnson & Johnson, 2019).

This study attempts to address the gaps in students' collaboration skills and the diversity of learning levels seen in Class VIII F at SMP Negeri 1 Magelang, based on the background information provided. The study specifically aims to improve students' teamwork in science classes by combining the Teaching at the Right Level (TaRL) methodology with the Problem-Based Learning (PBL) model. By offering differentiated yet collaborative learning experiences, the combination of these two approaches is anticipated to support students' diverse cognitive abilities while also promoting cooperation, communication, and shared responsibility (Kaffenberger & Pritchett, 2021; Hmelo-Silver, 2004; Dias-Oliveira et al., 2024). By providing empirical evidence on how combining PBL and TaRL can result in more inclusive and productive science learning environments, this study makes a theoretical and practical contribution by assisting students in developing 21st-century skills (Trilling & Fadel, 2009). It is expected that educators will use the findings as a guide when creating instructional strategies that encourage equitable participation and active engagement in diverse classrooms.

METHOD

This study uses a classroom action research (CAR) design and was carried out with 32 students in Class VIII F at SMP Negeri 1 Magelang during the even semester of the 2024–2025 school year. The research consists of two cycles, each following the Problem-Based Learning (PBL) syntax, which includes the stages of planning, implementation, observation, and reflection, as illustrated in Figure 1. By applying and assessing the learning model iteratively, each cycle seeks to enhance students' teamwork abilities. Both quantitative and qualitative indicators are used to determine the success criteria: (1) a rise in the average percentage of collaboration skill achievement to at least 80%, which is considered "good," and (2) discernible gains in student involvement, accountability, and

teamwork during group learning exercises. The second cycle will be carried out with modifications based on the reflection results from Cycle I if the first cycle fails to satisfy these requirements. To better fit students' learning levels, these modifications include changing problem contexts, improving group compositions, and updating learning scenarios. Thus, the information gathered from every cycle is used as a foundation for introspection and ongoing development, guaranteeing that the intervention successfully improves students' teamwork abilities.

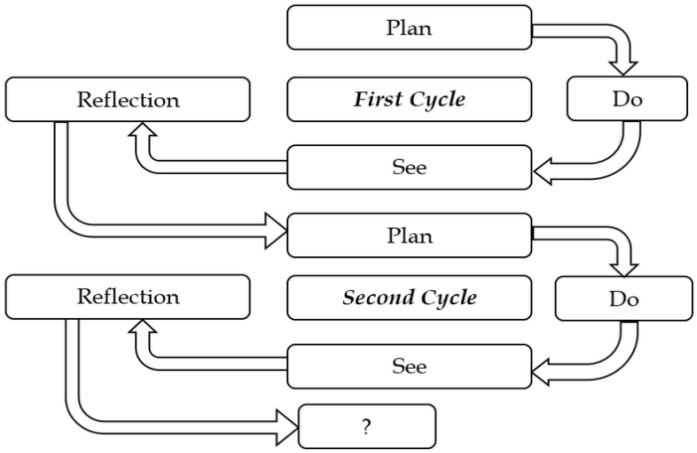

Figure 1. Classroom Action Research Stage Model Scheme **(**Fitriani, I., et al., 2023)

This study employed a qualitative descriptive approach using questionnaires, observations, and interviews as the main data collection techniques. The questionnaire served as a supporting instrument to capture an overview of students' collaboration tendencies, while observations and interviews provided in-depth qualitative data on students' engagement, communication patterns, and interactions during group learning activities. Observation sheets were used to systematically record behaviors reflecting teamwork and participation, whereas semi-structured interviews allowed the researcher to explore students' reflections, challenges, and perceptions of collaborative learning. To ensure the credibility and trustworthiness of the findings, data triangulation was conducted across all instruments. The collected qualitative data were analyzed descriptively through data reduction, data display, and conclusion drawing, allowing for the identification of recurring themes and progressive changes across the action research cycles. This process provided a comprehensive understanding of how the integration of the *Teaching at the Right Level* (TaRL) methodology and the *Problem-Based Learning* (PBL) model enhanced students' collaboration skills in the classroom.

The questionnaire, administered through Google Forms, consisted of ten statements developed from established indicators of collaboration skills, as shown in Table 2. Each statement employed a five-point Likert scale ranging from "strongly disagree" to "strongly agree," enabling students to self-assess their perceived level of collaboration within group learning contexts. This instrument was used primarily to complement qualitative data obtained through observations and interviews by providing a general overview of students'

self-perceptions. The overall flow of the Classroom Action Research (CAR) process used in this study is presented in Figure 1, illustrating the two iterative cycles of planning, action, observation, and reflection aligned with the *Problem-Based Learning* (PBL) syntax. During the planning stage, learning activities were designed to integrate the *Teaching at the Right Level* (TaRL) methodology into the PBL framework. The action stage involved implementing these learning activities in real classroom settings, while the observation stage focused on recording students' participation, communication, and collaboration during group tasks. Finally, the reflection stage involved analyzing and interpreting data from the questionnaires, observations, and interviews to identify areas for improvement and to refine subsequent instructional strategies. The iterative process ensured that each cycle informed the next, leading to continuous enhancement of students' collaboration skills and a deeper understanding of how learner-centered, level-based, and problem-oriented approaches can synergize effectively in classroom practice. The Student Collaboration Questionnaire Grid can be seen in table 1.

Table 1. Student Collaboration Questionnaire Grid (Meilinawati, 2018)

Number	Indicators	Aspects observed	Item Number
1.	Positive interdependence	Work on the basis of tasks and interdependence rather than doing it alone	3
		Using learning resources (internet or books) in doing assignments	5
2.	Face-to-face interaction	Blend in well with group friends during discussions	6
		Playing *mobile phones* (opening *youtube* or playing *games*) during group work	8*
3.	Individual personal accountability and responsibility	Be responsible for the timely completion of tasks	1
		Trying your best to do the assigned tasks on time	9
4.	Communication skills	Discuss with your group mates in carrying out tasks	2
		Ask a friend when they find a problem	7
5.	Skills of working in a group	Actively participate in completing tasks	4
		Complete tasks according to SOPs	10

Table 2 presents the grid of the Student Collaboration Questionnaire, which was adapted from Meilinawati (2018) and developed to assess students' collaboration skills across five key indicators: positive interdependence, face-to-face interaction, individual accountability and responsibility, communication skills, and group work competence. Each indicator consists of two observable aspects represented by specific questionnaire items designed to capture both behavioral and attitudinal dimensions of collaboration. One item (Item 8) was intentionally formulated as a negatively worded statement to reduce response bias and ensure the reliability of students' responses. The inclusion of these indicators reflects the multidimensional nature of collaboration, encompassing interpersonal interaction, responsibility, communication, and cooperative problem-solving within group learning contexts.

Positive interdependence, face-to-face interaction, individual accountability and responsibility, communication skills, and teamwork ability are the five main indicators that were used to develop the questionnaire on students' collaboration skills, which is displayed

in Table 1 (Meilinawati, 2018). Two items that reflect observable aspects of collaboration during group activities were used to represent each indicator. To guarantee balanced responses, some items (designated with an asterisk) were negatively worded, while others were positively worded. To measure students' collaboration performance objectively, each statement in the questionnaire was rated according to the scoring guidelines in Table 2. These guidelines provide a consistent framework for data interpretation and analysis by quantifying the frequency of students' collaborative behaviors using a four-point Likert scale, which goes from "Very Frequent" (4) to "Never" (1).

Table 2. Scoring Guidelines.

Score	Answer	Description
4	SS	Very Frequent
3	S	Often
2	KK	Sometimes
1	TP	Never

Analyzing quantitative data from student collaboration skill questionnaires and qualitative data from interviews and observations allowed for the determination of the study's success. Using the scoring criteria listed in Table 2, the percentage of students who met each collaboration indicator was determined from the questionnaire results. The overall degree of collaboration skills was assessed by converting the mean scores from each indicator into percentages. To confirm validity and reliability, these findings were then cross-checked against observational and interview data. As shown in Table 3, success was determined by whether the proportion of students who achieved the required degree of collaboration fulfilled the preset goals. This method of integrated data analysis made sure that the assessment of improvement was supported by evidence and appropriately represented the real learning objectives.

Table 3. Collaboration Skills Criteria (Riduwan, 2013)

Number	Criterion	Present (%)
1	Very High	81- 100
2	Tall	61- 80
3	Keeping	41- 60
4	Low	21- 40
5	Very low	0 – 20

Table 3 outlines the criteria for evaluating students' collaboration skills adapted from Riduwan (2013), which categorize performance levels into five ranges: very low (0–20%), low (21–40%), moderate (41–60%), high (61–80%), and very high (81–100%). The findings revealed that the students demonstrated substantial improvement in all five indicators of collaboration positive interdependence, face-to-face interaction, individual accountability, communication, and group work competence after the implementation of the Teaching at the Right Level (TaRL) and Problem-Based Learning (PBL) approaches. The minimum achievement percentages of 71%, 73%, 68%, 73%, and 76% respectively indicate that most students reached the "high" category, with some approaching the "very high" level of collaboration proficiency. These results suggest that the integration of

learner-centered and level-based instructional strategies effectively fostered students' active engagement, responsibility, and teamwork within the classroom context, reflecting measurable progress in developing essential 21st-century collaboration competencies.

RESULTS AND DISCUSSION

Prior to the learning process, preliminary data was gathered during the first meeting to evaluate the students' capacity for teamwork. Diagnostic tests were performed both cognitively and non-cognitively. While the cognitive assessment gauged students' comprehension of the material, the non-cognitive assessment looked at their attitudes, sense of responsibility, and collaborative tendencies. In order to facilitate productive collaboration, diverse groups were formed based on cognitive findings. Questionnaires, observations, and interviews were used to triangulate the data. The results demonstrated that students' initial collaboration skills were lacking: many relied heavily on peers, preferred working alone, struggled to share ideas, and were not accountable for tasks. Pre-cycle questionnaire results in Table 4, confirm that scores did not meet the target. A clear baseline was established by combining test results (cognitive) with scoring rubrics for participation, task responsibility, and discussion contribution (non-cognitive). The design of group formation and later instructional strategies to improve collaboration skills were influenced by these findings.

Table 4. Pre-cycle collaboration skills indicators

Number	Indicators	Baseline	Target
1	Positive interdependence	56%	71%
2	Face-to-face interaction in the learning process	61%	73%
3	Individual personal accountability and responsibility	63%	68%
4	Communication skills	66%	73%
5	Skills of working in a group	58%	76%

The information in Table 4 makes it clear that none of the metrics used to evaluate students' teamwork abilities met the established goals. The expected benchmarks, which ranged from 68% to 76%, were higher than the baseline percentages for all five indicators: positive interdependence (56%), face-to-face interaction (61%), individual accountability (63%), communication skills (66%), and group work skills (58%). These results show that students had not yet shown the best collaborative behaviors during the learning process prior to any intervention. Many students were less accountable for group assignments, worked alone most of the time, and interacted little in group discussions. These circumstances point to a lack of mutual support and balanced participation in groups, two essential components of productive teamwork. While students' poor performance in group work skills suggests a lack of coordination when completing assignments, the especially low score in positive interdependence reflects little cooperation and shared responsibility. These gaps thus demonstrate the pressing need for educational initiatives that improve accountability, teamwork, and communication. In order to address these shortcomings, two improvement cycles Cycle I and Cycle II were methodically created and put into action.

The outcomes of these interventions are shown in Table 5, which shows a steady improvement in students' teamwork abilities across all metrics.

Table 5. Recapitulation of Collaboration Skills Data in Cycle I and Cycle II

Number	Indicators	Data Results			
		Success Indicator Targets	Pre-Cycle	Cycle I	Cycle II
1	Positive interdependence	71%	56%	73%	88%
2	Face-to-face interaction in the learning process	73%	61%	75%	94%
3	Individual personal accountability and responsibility	68%	63%	73%	90%
4	Communication skills	73%	66%	68% (< indicator target)	90%
5	Skills of working in a group	76%	58%	73% (< indicator target)	91%
	Average	72%	61%	72%	91%

Five indicators were found to evaluate students' collaboration skills based on the findings in Table 5. Two of these indicators, group work skills and communication skills, fell short of the goal in Cycle I, suggesting that Cycle II will need to be improved. Students' lack of active participation in discussions, heavy reliance on group members, opening applications other than those supplied by teachers, reluctance to voice thoughts and opinions, and lack of active problem-solving during discussions were among the problems noted in Cycle I. The below-average performance in the previously mentioned indicators was a result of these actions. In Cycle II, changes were made to address these issues, most notably a reduction in group size from four to two members per group. Smaller groups have been shown to promote more active participation and improve individual accountability. For instance, studies have shown that dyadic groups (two-person groups) tend to exhibit more communication and interaction during the learning process, potentially leading to improved collaborative experiences and outcomes (Wang et al., 2023). This finding underscores the importance of structuring group activities in ways that promote balanced participation and mutual accountability among members. In the context of this study, such insights align with the principles of *Teaching at the Right Level* (TaRL) and *Problem-Based Learning* (PBL), both of which emphasize differentiated instruction and active learner engagement. By fostering smaller, more interactive groups, teachers can create learning environments that encourage meaningful dialogue, equitable task distribution, and deeper cognitive involvement key factors that contribute to the enhancement of students' collaboration skills and overall learning performance

By incorporating these refinements, Cycle II was designed to strengthen students' communication and teamwork skills while fostering a more engaging, accountable, and collaborative learning environment. Several key adjustments were implemented, including clearer task distribution, structured guidance during group discussions, and the integration

of reflective sessions to encourage students to evaluate their own participation and contributions. These improvements allowed students to interact more meaningfully with their peers, demonstrate greater responsibility in completing group tasks, and express their ideas with confidence. As a result, the classroom atmosphere became more dynamic, with students showing increased initiative, mutual support, and awareness of collective goals. Figure 2 presents documentation from both Cycle I and Cycle II, visually capturing this transformation in student collaboration. The photographs illustrate not only higher levels of participation and engagement but also a shift toward more cohesive teamwork and constructive communication patterns. Overall, the second cycle confirmed that iterative refinement within the *Teaching at the Right Level* (TaRL) and *Problem-Based Learning* (PBL) framework can significantly enhance the quality of peer collaboration and promote a more active, student-centered learning culture.

(a). Cycle I Learning Process (b). Cycle II Learning Process

Figure 2. Documentation of student collaboration activities

Cycle I averaged 73% in the first indicator, positive interdependence. The majority of students showed that they understood the value of sharing tasks and relying on one another, both with classmates and with the educational materials used for assignments. Some students, nevertheless, continued to rely entirely on their peers and failed to finish their assignments. In Cycle II, these problems were noted as areas that needed improvement. Changes were made to address these issues in Cycle II. By reducing the number of participants from four to two per group, a more personal and responsible collaborative setting was created. Smaller groups have been shown to promote more active participation and improve individual accountability. For example, research indicates that two-person groups, or dyadic groups, typically communicate and interact more during the learning process, which may result in better collaborative experiences and outcomes (Dean et al., 2023). The Problem-Based Learning (PBL) methodology, which prioritizes cooperative inquiry and real-world problem-solving, was also used. PBL fosters constructive interdependence by encouraging students to recognize and address issues both individually and in groups (Ni'mah, A. et al., 2024). It has been discovered that this teaching method enhances students' collaborative behaviors, problem-solving skills, and communication abilities. As a result of these interventions, students' collaboration skills in

the first indicator increased to 88% in Cycle II. This improvement reflects the effectiveness of the adjustments made and underscores the importance of fostering positive interdependence in collaborative learning environments.

In the second indicator, namely face-to-face interaction in the learning process, cycle I obtained an average of 75%. Distractions like using irrelevant apps and having off-topic conversations caused some students to become distracted, put off doing assignments, and not actively participate in group discussions, according to observations. Some students continued to rely significantly on their peers even after the first indicator's task division. Cycle II put a number of strategies into place to deal with these problems. Two people instead of four made up the group, which encouraged more open communication and accountability. Smaller groups can improve individual accountability and promote more active participation, according to research (Wang et al., 2023). Additionally, the Problem-Based Learning (PBL) methodology which prioritizes group problem-solving was used. With this method, students conduct both individual and group research while debating and resolving issues collectively. It has been demonstrated that this approach helps students become more proficient communicators and team players (Ningsih, T. Z. et al., 2025). The average score for in-person interactions rose to 94% in Cycle II as a result of these interventions, demonstrating important improvements in student cooperation and engagement will greatly influence better learning outcomes.

The third indicator is individual accountability and personal responsibility. Individual accountability and responsibility received an average score of 73% in Cycle I. During discussions, a few disengaged students relied on their more engaged peers. More individual responsibility resulted from Cycle II's smaller group sizes since each student played a bigger part in finishing assignments. This was made possible by the PBL model, which increased students' sense of accountability by promoting autonomous collaboration. Furthermore, students were grouped according to their abilities using the Teaching at the Right Level (TaRL) approach, which made sure that everyone felt obligated to help the group succeed (Mustafa, S. et al., 2024). As a result of increased student involvement and ownership of tasks, the average individual accountability and responsibility score increased to 90% in Cycle II, and likewise for several other indicators.

The research results process also has an impact on the fourth indicator, namely communication skills. In cycle I, this indicator was the lowest compared to other indicators, with an average percentage of 68%. This value is below the target of the communication skills success indicator of 73%, so the required skills have not been achieved. Based on the data obtained, the cause of this failure is that some students do not contribute to the discussion. Based on the results of the assessment research given by peers, some students felt that there were group members who did not take part in sharing their ideas and did not want to convey the differences in the results of the discussion during the presentation. This happens because some students are still awkward, do not dare to express their ideas, and still depend on their classmates. However, with the improved treatment in cycle II, the communication skill indicator increased to 90%. The assessment of this fourth indicator can be seen from the learning activities in the Problem-Based Learning syntax, namely

orientation to learning, independent and group investigation, communicate the results of their findings, and carry out the analysis and synthesis process.

In this learning syntax, students were actively encouraged to engage in collaborative discussions and articulate their ideas and perspectives during classroom interactions with both peers and educators. They were also invited to present the outcomes of their group discussions before the class and to provide constructive feedback on their peers' presentations, fostering a reciprocal and reflective learning environment. Such dialogic peer engagement has been shown to enhance students' critical reflection and collaborative awareness through structured communication exchanges (Van Hoe, Wiebe, Slotta, Rotsaert, & Schellens, 2024). In addition, teacher student dialogues were purposefully integrated to strengthen conceptual understanding, providing opportunities for learners to pose questions, clarify misconceptions, and express their viewpoints confidently. This aligns with the principles of Problem-Based Learning (PBL), which emphasizes the principles of inquiry, interaction, and communication as the core processes of knowledge construction (Hmelo-Silver, 2004).

Through these dialogic and participatory learning experiences, indicators of communication competence such as clarity of expression, active listening, and responsiveness were effectively achieved. The observed improvements in Cycle II demonstrated that students became more confident, collaborative, and accountable in group settings. These findings affirm that integrating the Teaching at the Right Level (TaRL) methodology with the Problem-Based Learning (PBL) model, supported by smaller and ability-based groups, promotes equitable participation and deeper learning engagement. These results are consistent with prior research indicating that structured group collaboration and feedback-oriented interactions enhance students' teamwork, communication, and engagement in science learning environments (De Caux et al., 2024; Van Hoe, Wiebe, Slotta, Rotsaert, & Schellens, 2024). Moreover, similar studies have emphasized that dialogic and problem-based instructional designs foster metacognitive awareness and self-directed learning, which are essential components of 21st-century competencies (Johnson, Johnson, & Smith, 2014).

Group work skills were evaluated as the final indicator of collaboration. In Cycle I, the average score reached 73%, which fell slightly below the desired benchmark of 76%. This shortfall was primarily attributed to students' limited communication skills, which hindered effective teamwork and mutual support. Some students tended to work independently rather than engaging collaboratively, while others showed minimal participation in group discussions. To address these issues, targeted interventions were implemented in Cycle II, emphasizing clearer role distribution, explicit accountability within groups, and structured guidance from the teacher to ensure balanced participation. As a result, the average score significantly increased to 91%, indicating a marked improvement in students' ability to work cooperatively. This advancement can be linked to the integration of the *Problem-Based Learning* (PBL) framework, which promotes interdependence, joint problem-solving, and shared responsibility among learners. Students were encouraged to engage in critical debates, exchange ideas, and assist one another in completing assigned tasks, fostering a sense of collective ownership and

cohesion within each group. Overall, these findings illustrate that when learning strategies prioritize collaboration and reflective role assignment, students develop stronger interpersonal skills, improved teamwork dynamics, and deeper engagement in the learning process thereby shaping high-quality future learning.

These results are consistent with recent research showing that PBL improves group work performance and cultivates collaborative skills. For example, a 2024 study found that PBL successfully enhances students' teamwork, creativity, and communication (Dias-Oliveira, E. et al., 2024). Additionally, a 2025 study showed that PBL greatly improves students' collaborative abilities when paired with cooperative learning techniques (Ningsih, T. Z. et al., 2025). Several rubrics have been created to evaluate group work abilities. In conclusion, the increase in group work abilities from Cycle I to Cycle II highlights how successful the interventions were, especially the incorporation of PBL and reflective assessments. The systematic evaluation and growth of students' collaborative skills are further supported by the application of established rubrics. The overall improvement of collaboration skills for each indicator can be seen in Figure 3.

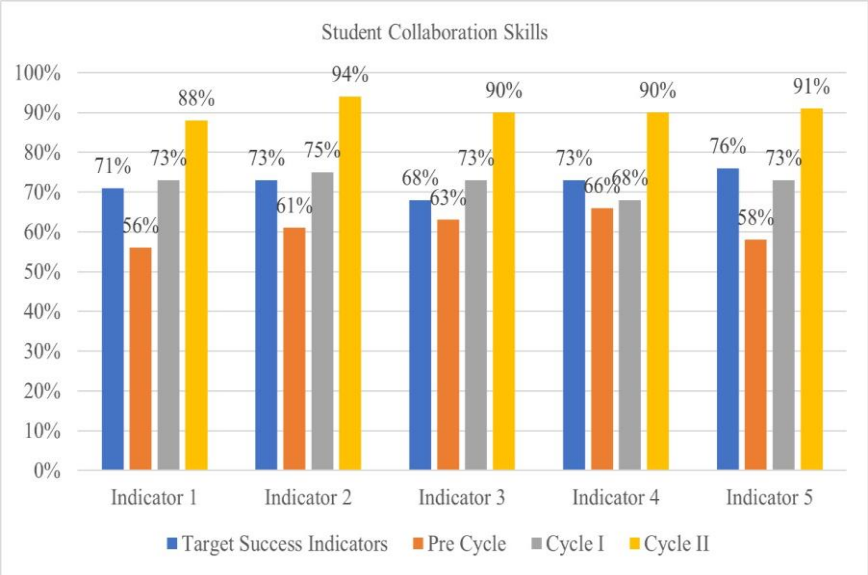

Figure 3. Results of Student Collaboration Skills Questionnaire Data

From the pre-cycle to Cycle II, students' teamwork skills showed continuous and measurable improvement across all five assessed dimensions. Specifically, positive interdependence, face-to-face interaction, individual accountability, communication, and group work skills increased by 15%, 19%, 17%, 22%, and 18%, respectively. By Cycle II, all indicators had surpassed the predetermined success benchmarks, as illustrated in Figure 3. This steady progression underscores the effectiveness of a pedagogical design that merges Teaching at the Right Level (TaRL) and Problem-Based Learning (PBL). The TaRL approach allowed students to be grouped based on their learning readiness and cognitive ability, ensuring that each member could contribute meaningfully and learn at an appropriate pace. Meanwhile, PBL provided authentic and inquiry-driven tasks that required learners to engage in cooperative exploration, discussion, and reflection to solve

contextualized problems. Together, these approaches created a balanced learning ecosystem that supported both individual growth and collective accountability. Students not only learned to negotiate meaning and distribute responsibilities equitably but also developed metacognitive awareness of how collaboration contributes to deeper understanding. This integration aligns with the constructivist view that social interaction and shared inquiry enhance cognitive development and engagement (Johnson & Johnson, 2017; Durlak, Weissberg, & Pachan, 2011; Gillies, 2016).

Recent studies have confirmed that structured PBL interventions in ability-based groups enhance students' engagement, metacognitive awareness, and collaboration quality (Ismail, Zakaria, & Abidin, 2024; Slotta, Rotsaert, & Schellens, 2024). When students are organized into groups that align with their readiness and cognitive levels, they are more likely to experience meaningful interactions that foster both individual accountability and group synergy. These instructional designs empower learners to assume diverse and complementary roles such as coordinators, questioners, and evaluators thus cultivating equitable participation and sustained critical dialogue. Such arrangements also encourage the co-construction of knowledge, where students jointly reflect on strategies, negotiate understanding, and monitor their progress toward shared goals. Consistent with the findings of De Caux et al. (2024), dialogic and reflective collaboration fosters deeper learning ownership, enhances cognitive presence, and strengthens students' ability to articulate scientific reasoning within inquiry-based contexts. The observed improvements across performance metrics therefore provide compelling evidence for the pedagogical value of integrating differentiated learning with problem-centered inquiry, particularly in promoting higher-order thinking and sustained engagement in science education.

Although this study was limited to descriptive analysis without inferential statistics or effect size computation, the results nonetheless indicate substantial pedagogical benefits and observable behavioral transformations among students. Initial challenges such as students' overreliance on peers, minimal participation, and hesitancy to express opinions were successfully mitigated through structured facilitation, guided reflection, and clearly defined group roles. The iterative cycles of feedback and reflection not only fostered accountability but also promoted greater self-regulation and ownership of learning. These findings are consistent with Rahmawati, Mutiara, and Santoso (2025), who reported that scaffolding and formative feedback are critical mechanisms for sustaining students' collaborative engagement and communication fluency within inquiry-based classrooms.

Furthermore, these outcomes echo broader evidence suggesting that structured metacognitive scaffolding, when integrated with problem-centered learning frameworks, enhances students' social interaction, negotiation, and task coordination skills (Lotta, Rotsaert, & Schellens, 2024). Such pedagogical designs create a participatory environment that supports both cognitive and socio-emotional development key dimensions of 21st-century learning. To improve generalizability and empirical rigor, future studies are encouraged to adopt mixed-methods designs, utilize standardized collaboration rubrics, and implement larger multi-class samples that allow for statistical validation and cross-contextual comparison. Overall, the findings contribute to the growing body of research supporting the integration of Teaching at the Right Level (TaRL) and Problem-Based

Learning (PBL) as an evidence-based strategy for fostering equitable participation, adaptive communication, and enhanced collaboration in science education.

CONCLUSION

The findings of this study demonstrate that integrating the *Teaching at the Right Level* (TaRL) approach with the *Problem-Based Learning* (PBL) model can effectively enhance students' collaboration skills in science learning. Substantial improvements were observed across all five indicators of collaboration positive interdependence, face-to-face interaction, individual accountability, communication, and group work supported by quantitative evidence showing an increase in average performance from 61% in the pre-cycle to 72% in Cycle I and 91% in Cycle II. This consistent progress suggests that structured, level-based grouping and problem-centered learning activities can create more equitable participation, foster peer accountability, and cultivate authentic teamwork dynamics. Pedagogically, the results highlight the importance of combining learner-centered approaches that consider students' readiness levels with constructivist learning environments that promote active engagement and reflection. Such integration allows educators to tailor instruction more effectively to students' diverse abilities while simultaneously nurturing essential 21st-century competencies such as collaboration, communication, and problem-solving. Furthermore, the study underscores the potential for applying the TaRL–PBL framework beyond science education to other subjects that rely heavily on teamwork and inquiry-based learning.

Nevertheless, as this classroom action research was limited to a single class with a relatively small number of participants and relied primarily on descriptive analysis, caution must be exercised in generalizing the results. Future research should therefore involve larger and more diverse samples, employ mixed-method or experimental designs, and utilize validated assessment rubrics to ensure the reliability and generalizability of findings. Expanding this line of inquiry could contribute to the broader discourse on differentiated and collaborative pedagogies, offers empirical support for a scalable model that can improve student engagement and collective learning outcomes across educational contexts, especially education in Indonesia.

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