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AN ANALYSIS OF THE COLLABORATIVE SKILLS OF YEAR 10 PUPILS THROUGH A PROBLEM-BASED LEARNING (PBL) MODEL SUPPORTED BY EDUCATIONAL BOARD GAMES AT SMAK SINT CAROLUS, KUPANG

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ABSTRACT

Collaborative skills are essential for pupils to master in 21st-century learning; however, their application in classroom practice has not yet been optimised. This study aims to describe the collaborative skills of Year 10 pupils through the implementation of a Problem-Based Learning (PBL) model supported by an educational board game at SMAK Sint Carolus Kupang. This is a descriptive study employing data collection techniques such as observation, interviews and documentation. Data analysis was conducted using triangulation to ensure data validity, utilising an interactive analysis model comprising data reduction, data presentation and drawing conclusions. The results of the study indicate that the students' collaborative skills improved. In the first session, the students' collaborative skills fell within the range of 50–100, with some still in the 'fair' category, whilst in the second session, they predominantly improved to the 'good' to 'very good' categories (71–100), characterised by increased engagement, a more equitable division of roles, and improved joint decision-making skills. Group observation results also showed an increase in scores from the range of 80–92 in the first session to 88–100 in the second session. It can therefore be concluded that the implementation of the PBL model, supported by educational board games, has a positive impact on improving pupils' collaborative skills at SMAK Sint Carolus Kupang.

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INTRODUCTION

The 21st-century education demands a paradigm shift from teacher-centered learning towards learner-centered learning, in which learners are active participants in constructing knowledge through interaction, discussion and problem-solving (Sitorus et al., 2025). In this context, collaborative skills are an essential competence that needs to be developed as they play a role in fostering effective cooperation, the division of roles and responsibilities, and dynamic interaction within groups (Ruslandi et al., 2025). Collaboration also involves communication, negotiation and joint decision-making that support the collective achievement of learning objectives (Sembiring, 2023).

However, the reality in the classroom shows that pupils' collaborative skills have not yet developed optimally. Group discussions are often dominated by a few pupils, whilst others tend to be passive, with unclear task allocation and limited interaction (Nurhidayah, 2024). Initial observations in Year 10 at SMAK Sint Carolus Kupang also indicate that pupils' cooperation during group discussions remains low. This situation underscores the need for learning innovations capable of fostering active engagement and effective cooperation.

One alternative that can be utilised is the Problem-Based Learning (PBL) model, which emphasises collaborative contextual problem-solving (Risandy et al., 2023). The effectiveness of PBL can be enhanced through the use of educational board games, which can increase engagement, interaction and group dynamics through game mechanics (Mahmubi, 2025). Previous research has shown that PBL and educational board games can encourage learners to engage in problem-solving within groups (Cahyanto et al., 2024). Ardiansyah et al. (2025) also state that PBL is effective in enhancing interaction and cooperation within groups. Furthermore, the use of educational board games demonstrates that this medium is capable of enhancing engagement and team dynamics in learning (Wahyudi R et al., 2025). Several studies have even combined PBL with educational board games and shown an increase in learning activity (Arifani et al., 2023). However, these studies are still predominantly focused on measuring learning outcomes and motivation, whilst research specifically analysing collaborative skills as a process within group discussions remains limited, particularly in the context of biology teaching at senior secondary school level.

Based on this, the research question for this study is: how do the collaborative skills of Year 10 pupils develop through the implementation of the Problem-Based Learning (PBL) model supported by educational board games? This study aims to describe in depth the collaborative abilities of pupils as a process within the learning of the topic of bacteria. Scientifically, this study contributes by filling a gap in the literature by focusing more on the analysis of the collaborative process, whilst also providing practical implications for teachers in designing innovative, interactive lessons that meet the demands of 21st-century skills.

METHOD

This study employed a descriptive approach with the aim of describing pupils' collaborative skills through the application of the Problem-Based Learning (PBL) model aided by an educational board game. The study was conducted at SMAK Sint Carolus Kupang in April 2026.

The research subjects were Year 10 pupils, with the sample selected using purposive sampling based on the following criteria: they were currently studying bacteria, were accustomed to group discussions, and were participating in PBL supported by educational board games. The sample consisted of a single class, namely Class XA. The research focused on the students' collaborative skills, which included the division of roles, responsibilities, mutual assistance, joint decision-making, and participation in problem-solving.

Data collection was carried out through direct observation, interviews (with student representatives and the teacher), and documentation. Observations were conducted to directly observe the students' collaborative skills during the learning process. Interviews were conducted with students and the teacher to obtain more in-depth information regarding their learning experiences and the changes that occurred. Documentation in the form of video recordings was used to corroborate the data from the observations and interviews.

The research instruments comprised observation sheets, interview guidelines, and documentation in the form of learning videos. The observation sheets were based on indicators of collaborative skills, such as the division of roles, responsibilities, mutual assistance, decision-making and participation in problem-solving. To clarify the observation results, a 1–5 Likert scale was used as follows:

Score	Category
5	Very Good
4	Good
3	Fair
2	Poor
1	Very Poor

(Source: Oktafiyana & Septiana, 2021)

Each indicator was scored on a scale of 1–5, and the total score was calculated using the formula:

$$\text{Score} = I_1 + I_2 + I_3 + I_4 + I_5$$

Notes:

I_1 = Division of Roles
I_2 = Responsibility
I_3 = Mutual Support
I_4 = Decision-making
I_5 = Participation

To facilitate interpretation, the score is converted to a 100-point scale using the formula:Total Score = Score/25 × 100. Assessment Categories (Scale of 100)

Score Range	Category
86–100	Very Good
71–85	Good
56–70	Satisfactory
41–55	Poor
≤40	Very Poor

(Source: Syahrita & Assidik, 2024)

The observation results are not only presented in the form of scores but are also described to illustrate the dynamics of pupils' cooperation during learning.

Interviews were conducted with pupils and teachers, focusing on the following aspects: how they cooperate within groups, the division of tasks within groups, the challenges faced in collaboration, and the role of educational board games in enhancing cooperation. Video was used as supporting data in the form of indirect observation, with video analysis indicators including the division of roles, responsibilities, mutual assistance, decision-making, and participation. To clarify the results of the video analysis, a 1–5 Likert scale was used as follows:

Score	Category
1	Very Good
2	Good
3	Fair
4	Poor
5	Very Poor

(Source: Oktafiyana & Septiana, 2021)

Each indicator was scored on a scale of 1–5, and the total score was calculated using the formula:

$$\text{Score} = V_1 + V_2 + V_3 + V_4 + V_5$$

Notes:

V_1 = Division of Roles
V_2 = Responsibilities
V_3 = Mutual Assistance
V_4 = Decision-Making
V_5 = Participation

To facilitate interpretation, the score is converted to a scale of 100 using the formula:Final Score = (Score Obtained) / 25 × 100. Assessment Categories (Scale of 100)

Score Range	Category
86–100	Very Good
71–85	Good
56–70	Satisfactory
41–55	Poor
≤40	Very Poor

(Source: Syahrita & Assidik, 2024)

Each group is awarded a score of 1–5 for each indicator; the total score is then calculated and converted to a scale of 0–100.

The data obtained were analysed using an interactive qualitative analysis model comprising the stages of data reduction, presentation of data in the form of narratives and indicator matrices, and the drawing of conclusions. Data validity was ensured through triangulation of methods by comparing the results of observations, interviews and documentation to ensure the consistency of findings in the field.

RESULTS AND DISCUSSION

The research findings indicate that the pupils' collaborative skills improved following the implementation of the Problem-Based Learning (PBL) model supported by an educational board game. Observations of 26 pupils showed that their collaborative skills improved from the first session to the second. The results of the observations of the pupils' collaborative skills during the first session are shown in Table 1.

Table 1. Results of Observations on Learners' Collaborative Skills – Session 1

No	Learner's Name	Score	Total Score	Category
1	Adriana Vasa Doren	22	88	Very good
2	Agustinus A. Tongge	22	88	Very good
3	Apliana Enjela Kolo	20	80	Good
4	Astin Sofia Prilia Fenais	23	92	Very good
5	Chelsy Margarita Bones	22	88	Very good
6	Clara Angela Sife	24	96	Very good
7	Dan Vano Tantaru	17	68	Fair
8	Elisabeth Nengguisa	22	88	Very good
9	Frikenza R. Tlonaen	20	80	Good
10	Giacinta Kesya Metak	21	84	Good
11	Jeni Nitbani	25	100	Very good

12	Maria M. Haki Kafun	21	84	Good
13	Maria Srywinarti Bhekty	20	80	Good
14	Mario Gregorisel Petrus	19	76	Good
15	Marvel E. Nubatonis	22	88	Very good
16	Melisa Gracia Banunaek	25	100	Very good
17	Monika Ehot	25	100	Very good
18	Oktovianus Hendro Bau	21	84	Good
19	Reinaldi Kase	19	76	Good
20	Steven Yunus Boimau	22	88	Very good
21	Trisna Wulandari Lema	21	84	Good
22	Vikthoria Bones	16	64	Fair
23	Vorges Talaen	17	68	Fair
24	Yohanes Eksel Koa	20	80	Good
25	Yustinus Dappa Tallu	25	100	Very good
26	Faustino Ndewi Rada	22	88	Very good

Based on Table 1, at the initial stage (the first session), collaborative skills still varied from the 'fair' (56–70), 'good' (71–85) to 'very good' (86–100) categories, with some pupils not yet participating optimally, particularly in decision-making and engagement in discussions. This situation indicates that the pupils are still in the process of adapting to a learning model that demands active involvement and intensive cooperation (Nafilata et al., 2025).

In the second session, an improvement in the pupils' collaborative skills was evident, as shown in Table 2.

Table 2. Results of the Observation of Pupils' Collaborative Skills in Session 2

No	Learner's Name	Score	Total Score	Category
1	Adriana Vasa Doren	24	96	Very good
2	Agustinus A. Tongge	23	92	Very good
3	Apliana Enjela Kolo	22	88	Very good
4	Astin Sofia Prilia Fenais	25	100	Very good
5	Chelsy Margarita Bones	24	96	Very good
6	Clara Angela Sife	20	80	Good
7	Dan Vano Tantaru	19	76	Good
8	Elisabeth Nengguisa	20	80	Good
9	Frikenza R. Tlonaen	24	96	Very good

10	Giacinta Kesya Metak	21	84	Good
11	Jeni Nitbani	25	100	Very good
12	Maria M. Haki Kafun	23	92	Very good
13	Maria Srywinarti Bhekty	21	84	Good
14	Mario Gregorisel Petrus	19	76	Good
15	Marvel E. Nubatonis	24	96	Very good
16	Melisa Gracia Banunaek	25	100	Very good
17	Monika Ehot	23	92	Very good
18	Oktovianus Hendro Bau	21	84	Good
19	Reinaldi Kase	19	76	Good
20	Steven Yunus Boimau	24	96	Very good
21	Trisna Wulandari Lema	21	84	Good
22	Vikthoria Bones	19	76	Good
23	Vorges Talaen	21	84	Good
24	Yohanes Eksel Koa	20	80	Good
25	Yustinus Dappa Tallu	25	100	Very good
26	Faustino Ndewi Rada	24	96	Very good

Based on Table 2, there was a significant improvement, characterised by the dominance of the ‘good’ (71–85) and ‘very good’ (86–100) categories, as well as more even participation amongst the pupils within the group. This improvement indicates that repeated learning experiences within a collaborative environment are capable of strengthening pupils’ social skills and cooperation (Putriwan & Palennari, 2025). Theoretically, these findings are consistent with the principles of PBL, which emphasise problem-based learning as a means of fostering social interaction, the negotiation of meaning, and the collective construction of knowledge (Albab & Khoiriyah, 2026).

Furthermore, the use of educational board games acts as a stimulus that accelerates this adaptation process. The game elements not only enhance engagement but also create situations that demand active participation from every group member. Thus, the increase in collaboration is not solely attributable to the PBL model but also to the integration of contextual and interactive learning media (A’yun et al., 2026).

Interview findings revealed that learners found the learning process more interesting, enjoyable and motivating, making it easier for them to work together in groups. Task allocation was carried out by mutual agreement, and each member had clearly defined responsibilities. This indicates that the collaboration formed was not merely structural in nature, but also developed socially through communication and interaction (Hanum & Fadhilah, 2025).

From the perspective of social constructivism, these findings suggest that knowledge is constructed through interpersonal interaction. Group discussions, the exchange of views, and joint decision-making serve as the primary mechanisms for building understanding (Salsabila & Gumiandari, 2024). In this context, educational board games function as mediating tools that

facilitate such interactions, thereby making the collaborative process feel more natural and less forced (Putu et al., 2026).

However, this study also identified challenges in the form of differing opinions and variations in pupils' levels of understanding. Interestingly, these challenges did not constitute a major obstacle but rather became an integral part of the collaborative learning process. Learners overcame them through discussion and mutual support, demonstrating the development of social skills such as tolerance and negotiation skills. This reinforces the argument that cognitive conflict in group learning can serve as a catalyst for the development of deeper understanding (Maisarah et al., 2025).

The results of interviews with teachers corroborated the findings from observations and interviews with pupils, indicating that there had been a positive change in collaboration patterns. Pupils who had previously tended to work individually began to collaborate effectively, demonstrating increased interaction, participation and responsibility within their groups. Teachers also assessed that the PBL model, supported by educational board games, was effective in creating an active and collaborative learning environment.

Analysis of the video documentation further confirms these findings. During the first session, interactions were still dominated by a few pupils within each group, as shown in Table 3.

Table 3. Results of Observations on Pupils' Collaboration Skills – Session 1

No	Group	Score Obtained	Final Score	Category
1.	1	21	84	Good
2.	2	20	80	Good
3.	3	23	92	Very good
4.	4	21	84	Good
5.	5	25	100	Very good

The results of the video analysis of the first session indicate that the pupils' collaborative skills fell within the 'good' to 'very good' categories. Group 5 achieved the highest score, namely 100 (the 'very good' category), whilst the other groups scored between 80 and 92. This indicates that the majority of groups were already able to collaborate effectively, although there were still variations in the effectiveness of role allocation and the involvement of group members. However, in the subsequent stage, there was more even participation and livelier discussion dynamics, as shown in Table 4.

Table 4. Results of the Observation of Learners' Collaboration Skills in Session 2

No	Group	Score Obtained	Final Score	Category
1.	1	24	96	Very good
2.	2	22	88	Very good
3.	3	23	92	Very good
4.	4	25	100	Very good
5.	5	25	100	Very good

Based on Table 4, it is evident that the pupils' collaborative skills in the second session showed a significant improvement. Almost all groups achieved the 'very good' category with scores ranging from 92 to 100. This indicates that the pupils were able to adapt to the PBL learning model supported by educational board games, particularly in terms of cooperation, responsibility, joint decision-making and collaboration—skills that develop gradually and require a process of familiarisation (Rohman & Khaliza, 2025).

Overall, the findings of this study provide empirical evidence that the integration of the PBL model with educational board games not only enhances learning engagement but also significantly develops students' collaborative skills. These findings enrich the literature on collaborative learning by demonstrating that the use of game-based media can serve as a strategy to address low levels of participation and interaction in group learning (Yamin, 2025). Thus, this study underscores the importance of learning innovations that focus not only on cognitive aspects but also on the development of 21st-century skills, particularly collaboration.

CONCLUSION

The conclusions of this study indicate that the implementation of a Problem-Based Learning (PBL) model supported by educational board games is capable of enhancing learners' collaborative skills. This is demonstrated by an increase in observation scores from the first session—which fell within the 'good' to 'very good' categories—to a predominance of 'very good' scores in the second session. These findings also address the research objectives and research questions, confirming that the use of the PBL model supported by educational board games is effective in fostering collaboration, as reflected in increased student engagement, interaction, a more equitable distribution of roles, and the students' ability to work together and make joint decisions within their groups. Theoretically, the results of this study reinforce the notion that the integration of the PBL model with interactive learning media can support the development of students' collaborative skills. In practical terms, this model can serve as an effective alternative learning strategy to enhance interaction and cooperation in the classroom. However, this study has limitations in the form of differences in the level of understanding amongst pupils, which affect the speed at which tasks are completed within groups. Therefore, further research is recommended to examine more adaptive support strategies to accommodate differences in pupils' abilities so that the implementation of the learning model can run more optimally.

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