



Implementation of The Project Based Learning Model to Support Students' Collaboration Skills and Learning Motivation

Rizki Fauzan

SMA Negeri 1 Moga

e-mail: rizkifauzan997@gmail.com.

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Abstract

This research is motivated by the decline in the quality of learning on the mutual cooperation indicator based on the results of the educational report in 2025 and the low interest of students in Physics subjects at SMA Negeri 1 Moga. The study aims to describe and analyze the extent to which the implementation of the Project Based Learning (PjBL) model supports collaboration skills and learning motivation of class XII A-C students. The research method is descriptive-quantitative with a sampling technique that is a saturated sample with a total of 108 students. Data were collected through a Likert scale questionnaire that has been tested for validity and reliability and analyzed using descriptive statistics. The results showed an average score of collaboration skills of 105.21 in the high category with the highest score indicator on interdependence with an average of 21.96 and the lowest score on group processing with an average of 19.72. Learning motivation reached an average of 73.1 in the moderate category, the highest score indicator by choice or interest in tasks with an average of 28.00 and the lowest score indicator by the aspect of perseverance or tenacity with an average of 11.70. The implementation of PjBL can support students' collaboration skills and learning motivation, but it is necessary to strengthen learning strategies to improve group processing and persistence in completing projects.

Keywords: Project Based Learning, Learning Quality, Mutual Cooperation, Collaboration, Learning Motivation, Physics Learning

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Introduction

Based on the 2025 education report data for SMA Negeri 1 Moga, there was a decline in one of the indicators, namely the quality of learning. The learning quality achievement of SMA Negeri 1 Moga fell 7.81 from 2024. If we look at one of the dimensions of learning quality that has the lowest score, namely the learning method dimension with a score of 64. The Learning Method achievement value fell 5.57 from 2024. The learning method can be interpreted as a teaching practice that aims to guide and support students in building new understanding or knowledge (Iswara et al., 2024). Furthermore, from the results of the education report of SMA Negeri 1 Moga in 2025, the character indicator achievement decreased 4.74 from 2024. If we look at the character dimension that experienced the largest decline, it was the mutual cooperation dimension. The mutual cooperation achievement value was 68.12, down 8.55 from 2024 (76.67). Mutual cooperation can be understood as a real collaborative practice in the educational context, this is seen when students coordinate, help each other, and share roles to achieve collective learning goals (Rukmana & Samsuri, 2025).

Then based on the data of the results of the selection of elective subjects for the academic ability test of class XII students of SMA Negeri 1 Moga, it was obtained that only 11 students chose physics subjects from 3 classes XII.A, XII.B, and XII.C with a total of 108 students, in other words, only 10.18% of students were interested in physics subjects. This indicates that students are less motivated in learning physics. Based on the results of observations, students see physics as a difficult subject and less relevant to their career goals, experiencing less interesting learning experiences, minimal practice, few collaborative projects.

Schools act as educational institutions tasked with guiding students to achieve learning objectives through various teaching and learning activities (Sudiatmika, 2020). Therefore, various learning approaches and models have been designed to support the effectiveness of the teaching process, both in the classroom and in tutorial sessions. Selecting appropriate learning strategies and models aligned with competency standards is a crucial factor in improving students' abilities and interest in learning. Proper implementation will positively impact the overall quality of learning (Amsikan, 2022).

Project-based learning can bridge this problem because it offers authentic and contextual tasks that increase the relevance of physics subjects to real problems, supports student collaboration working in teams, encourages experimental practice and product creation so that the learning experience becomes more interesting, and provides opportunities for peer feedback and performance-based assessments that increase self-efficacy and motivation (Zhang & Ma, 2023; Samsudin et al., 2020).

The project-based learning model is an approach that begins with identifying a problem, followed by the process of searching for and applying new information related to real-life situations (Setiawan et al., 2021). According to Sumardiyono et al. (2016), the project-based learning model has six essential stages that form the basis of its implementation. These stages include: starting with fundamental questions relevant to the student's context, designing a project plan collaboratively between teachers and students, developing an implementation schedule, monitoring project progress with teacher guidance, assessing results through evaluation and feedback, and conducting collaborative reflection to improve the learning process and outcomes.

Collaboration is a crucial skill that reflects an individual's ability to work effectively with other group members to achieve common goals. Collaboration requires active participation, good communication, mutual respect for differences of opinion, responsibility for each person's role, and a willingness to integrate ideas to achieve optimal results (Noviana et al., 2019; Ibrahim & Rashid, 2022). According to Noviana et al. (2019), collaboration is not

just about working together but also involves meaningful interactions, shared decision-making, and collective problem-solving. Meanwhile, Ibrahim & Rashid (2022) emphasize that collaboration skills are a 21st-century competency that must be systematically honed in educational settings to prepare students to face the demands of the workplace and global society.

Collaboration skill indicators include: (1) positive interdependence, the belief that shared contributions are mutually beneficial, thus encouraging cooperation without destructive competition; (2) individual and group accountability, the division of responsibilities that prevents social loafing and improves the quality of discussions and outcomes; (3) promotive interactions, ongoing discussions, mutual support, and a willingness to exchange ideas to deepen understanding and problem solving; (4) social skills, the ability to communicate, manage conflict, and build trust so that member roles are carried out effectively; and (5) group processing, reflection, monitoring, evaluation, and feedback to improve task implementation according to the joint plan (Noviana et al., 2019; Ibrahim & Rashid, 2022). Noviana et al. (2019) showed that project-based learning is a strategic vehicle for assessing and developing collaboration skills through activities that require joint planning, implementation, and evaluation in the context of real problems. Ibrahim & Rashid (2022) found that consistent implementation of project-based learning can improve students' collaboration skills, especially when each team member has a clear role, mutually agreed-upon goals, and the opportunity to reflect on the teamwork process.

Motivation is a stimulating process that directs individual behavior to act. In the realm of learning, learning motivation is seen as an essential component that determines success, because motivated students tend to apply advanced cognitive strategies that support the achievement of material understanding more effectively (Sudibyo et al., 2016; Bin Dayel et al., 2018). According to Sudibyo et al. (2016), motivation to learn physics consists of four main aspects: task choice, effort, persistence, and self-confidence. The four aspects of motivation, namely task choice, effort, persistence, and self-confidence, are reflected in specific student behaviors such as interest, cognitive strategies, resilience to difficulties, and self-confidence in facing tasks and evaluations. According to Bin Dayel et al. (2018), learning motivation can be understood as a combination of internal and external factors that influence a person's direction, intensity, and persistence in learning activities. This motivation plays an important role in determining the extent to which students are able to maintain focus, overcome challenges, and achieve academic goals.

The project-based learning model places students in real-world problem-solving situations that require planning, collaboration, and responsibility, which in turn increases their sense of ownership of the learning process and strengthens their drive to succeed. According to the findings of Bin Dayel et al. (2018), autonomy and task relevance can strengthen students' intrinsic motivation, while the findings of Sudibyo et al. (2016) show that indicators such as persistence and self-confidence can develop through well-structured project-based learning experiences. Thus, the application of the project-based learning model in the classroom, including in physics, has great potential to not only improve learning outcomes but also foster sustainable learning motivation.

Research by Ermin & Hidayat (2024) shows that the implementation of Project-Based Learning (PjBL) in high school can improve students' collaboration skills, especially in aspects of communication, shared responsibility, and team coordination. A similar finding was found by Pendit et al. (2024) in elementary school students in science learning, where PjBL facilitates active interaction, cooperation, and the ability to solve problems together. These two studies confirm that PjBL is an effective approach to developing the social skills needed by students in the 21st century, including collaboration skills, which are one of the focuses of the Independent Curriculum. Meanwhile, research focusing on learning motivation shows consistent results. Putri & Jamaluddin (2025) found that the implementation of PjBL can

increase students' learning interest, active participation, and internal drive. Chaniago et al. (2024) also proved that PjBL not only increases motivation to learn Indonesian but also has a positive impact on academic achievement. Therefore, these previous studies generally support the relevance of PjBL in improving collaboration skills and learning motivation.

The novelty of this research lies in the simultaneous integration of collaborative skills and student learning motivation within a single Project-Based Learning (PjBL) framework. Previous research has generally focused on only one aspect, either collaboration (Ermin & Hidayat, 2024; Pendit et al., 2024) or learning motivation (Putri & Jamaluddin, 2025; Chaniago et al., 2024). This research also seeks to uncover the reciprocal relationship between collaborative skills and learning motivation in the context of project-based learning, a topic that has not been extensively studied. Furthermore, this study was conducted in an educational context aligned with the Independent Curriculum, which emphasizes strengthening soft skills while simultaneously achieving academic learning objectives. Therefore, this research approach contributes to broadening the understanding of how Project-Based Learning (PjBL) can be optimized to produce a dual effect on students' social skills and learning motivation.

The urgency of this research is based on the needs of 21st-century education, which demands students possess strong collaborative skills and high learning motivation to face global challenges. The implementation of the Independent Curriculum mandates project-based learning as the primary strategy for fostering these skills. However, although previous research has demonstrated the benefits of Project-Based Learning (PjBL) on one variable, studies integrating the two are still rare. This research is expected to provide practical benefits for teachers in designing learning that integrates academic competency mastery with collaborative character development and students' intrinsic motivation. Specifically, this study aims to describe and analyze the application of the Project-Based Learning (PjBL) model in supporting collaborative skills and learning motivation in grades XII A–C at SMA Negeri 1 Moga, Pemalang Regency. Therefore, this research is relevant to supporting learning innovations that have a direct impact on learning quality.

Method

Descriptive research with a quantitative approach was chosen in this study, which is characterized by the absence of intervention, manipulation, or changes in independent variables, but rather simply presenting a description of empirical conditions as they are (Ermin & Hidayat, 2024). This research was conducted at SMA Negeri 1 Moga, Pemalang Regency. This research was conducted from August to September 2025. The population in this study were all students of grades XII.A, XII.B, and XII.C of SMA Negeri 1 Moga, totaling 108 students. The sampling technique in this study was saturated sampling with a total of 108 student samples.

The instrument used in this study was a quantitative data instrument in the form of a questionnaire responding to students' collaboration skills and learning motivation. This questionnaire was adapted to indicators of collaboration skills and student learning motivation, compiled based on a Likert scale, with a measurement method used to evaluate students' attitudes, opinions, and perceptions both individually and in groups. The data collection technique used was a questionnaire administered to students.

Table 1. Collaboration Skills Indicators

No	Indicator	Questionnaire Statement Number
1	Positive interdependence	1, 2, 3, 4, 5
2	Individual and group accountability	6, 7, 8, 9, 10

No	Indicator	Questionnaire Statement Number
3	Promotional interactions in groups	11,12,13,14,15
4	Social skills in groups	16, 17, 18, 19, 20
5	Group processing	21, 22, 23, 24, 25

Table 2. Learning Motivation Indicators

No	Indicator	Questionnaire Statement Number
1	Interest in selecting tasks or activities of interest	1-10
2	Efforts taken to achieve success	11-16
3	Perseverance or persistence in using time to complete tasks	17-20
4	Self-confidence when participating in activities	21-25

Data processing in this study was carried out on the results of filling out a quantitative questionnaire that measures students' collaboration skills and learning motivation. The questionnaire instrument was compiled based on predetermined indicators and used a Likert scale as a measurement method, thus allowing researchers to evaluate students' attitudes, opinions, and perceptions, both individually and in groups. The Likert scale used consists of five answer categories, namely Strongly Agree (score 5), Agree (score 4), Quite Agree (score 3), Disagree (score 2), and Strongly Disagree (score 1).

The research instrument, in the form of a questionnaire, was tested through validity and reliability tests. A questionnaire is considered valid if the statements or questions in the instrument, both conceptually and empirically, accurately represent and are able to measure the construct or variable that is the focus of the research. The validity test of the questionnaire instrument uses Pearson correlations with the help of IBM SPSS 26. If the calculated correlation coefficient value is greater than the critical value from the Pearson correlation table, it is valid. This means that the questions in the questionnaire are able to reveal something that will be measured (Indartini & Mutmainah, 2024).

The next step in the questionnaire instrument testing was reliability testing. A questionnaire is considered reliable if respondents' answers to the questions demonstrate consistency and stability over time, resulting in similar scores when repeated measurements under comparable conditions. The questionnaire reliability test used Cronbach's Alpha with IBM SPSS 26. A questionnaire is considered reliable if the Cronbach's Alpha value is greater than 0.6 (Indartini & Mutmainah, 2024).

The research data were analyzed using quantitative descriptive statistics, including the presentation of the average score, standard deviation, highest score, and lowest score. The analysis of collaboration skills and learning motivation was conducted using IBM SPSS Statistics 26 software. The results of the five-point scale questionnaire were then converted into qualitative data through interval calculations based on Sturges' rules, thus facilitating the interpretation of the achievement level of the studied indicators (Sugiyono, 2022).

Results and Discussion

Results

Results of the Validity and Reliability Test of the Questionnaire

The validity test was conducted with item-total correlation using Pearson coefficient to assess the relationship of each item to the overall score of the instrument, this method was chosen because it directly shows the statistical contribution of each item to the construct being measured. The decision threshold was set at a critical value from the correlation table, namely 0.361 at the significance level $\alpha = 0.05$. This value was calculated based on a sample size of 30 student respondents and a critical value table from the correlation. The following are the results of the validity test of the research questionnaire instrument to measure students' collaboration skills and student learning motivation in project-based learning.

Table 3. Results of the Validity Test of the Collaboration Skills Questionnaire

No	Calculated correlation value	Critical values of the Pearson correlation table	Decision
1.	0.422	0.361	Valid
2.	0.492	0.361	Valid
3.	0.581	0.361	Valid
4.	0.366	0.361	Valid
5.	0.598	0.361	Valid
6.	0.649	0.361	Valid
7.	0.626	0.361	Valid
8.	0.591	0.361	Valid
9.	0.610	0.361	Valid
10.	0.503	0.361	Valid
11.	0.673	0.361	Valid
12.	0.554	0.361	Valid
13.	0.658	0.361	Valid
14.	0.611	0.361	Valid
15.	0.729	0.361	Valid
16.	0.530	0.361	Valid
17.	0.506	0.361	Valid
18.	0.522	0.361	Valid
19.	0.710	0.361	Valid
20.	0.790	0.361	Valid
21.	0.707	0.361	Valid
22.	0.651	0.361	Valid
23.	0.651	0.361	Valid
24.	0.678	0.361	Valid
25.	0.782	0.361	Valid

Based on Table 3 on the collaboration skills instrument, all 25 questionnaire statement items meet the validity criteria because the calculated correlation value is greater than the critical value from the Pearson correlation table (0.361) so it is retained.

Table 4. Results of the Validity Test of the Student Learning Motivation Questionnaire

No	Calculated correlation value	Critical values of the Pearson correlation table	Decision
1.	0.618	0.361	Valid
2.	0.754	0.361	Valid
3.	0.328	0.361	Invalid
4.	0.693	0.361	Valid
5.	0.219	0.361	Invalid
6.	0.582	0.361	Valid
7.	0.610	0.361	Valid
8.	0.780	0.361	Valid
9.	0.565	0.361	Valid
10.	0.729	0.361	Valid
11.	0.643	0.361	Valid

No	Calculated correlation value	Critical values of the Pearson correlation table	Decision
12.	0.771	0.361	Valid
13.	0.714	0.361	Valid
14.	0.824	0.361	Valid
15.	0.714	0.361	Valid
16.	0.714	0.361	Valid
17.	0.714	0.361	Valid
18.	0.622	0.361	Valid
19.	0.872	0.361	Valid
20.	0.559	0.361	Valid
21.	0.780	0.361	Valid
22.	0.493	0.361	Valid
23.	0.535	0.361	Valid
24.	0.445	0.361	Valid
25.	0.692	0.361	Valid

Based on Thickness 4 on the learning motivation instrument, two items showed a correlation below the threshold, namely item number with a calculated correlation value of 0.328 and item number 5 with a calculated correlation value of 0.219. These two items were declared invalid and deleted, so that the learning motivation instrument consisted of 23 items. The decision to delete was taken because the item-total correlation value was far below the threshold indicating a weak statistical relationship with the measured construct, a review of the content of the deleted items also found indications of content ambiguity so that revisions were not seen as guaranteeing improvements in questionnaire items number 3 and 5.

The reliability test (Cronbach's Alpha, SPSS v.26) produced $\alpha = 0.918$ for the collaboration skills variable and $\alpha = 0.938$ for the learning motivation variable. With a general interpretation threshold ($\alpha > 0.60$ is acceptable, while $\alpha \geq 0.90$ is excellent), both instruments showed high internal consistency.

Description of Student Collaboration Skills Data

Data on students' collaboration skills in this study were measured using a questionnaire containing 25 statements. Descriptive statistical results for the collaboration skills variable are presented in Table 5 below.

Table 5. Descriptive Statistics of Students' Collaboration Skills

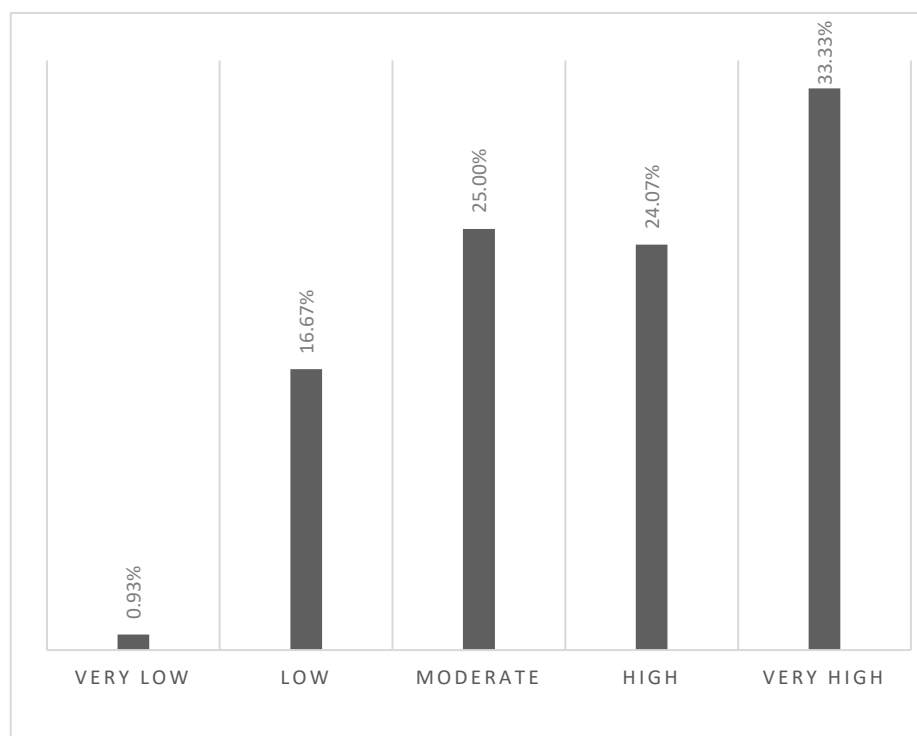
Variables	N	Min	Max	Mean	Std. deviation
Collaboration Skills	108	67	125	105.21	13.67

Based on the results of data analysis and statistical calculations, the maximum score was 125, the minimum score was 67, the mean was 105.21, and the standard deviation was 13.67. Then, after the maximum and minimum scores were known, they were used to determine the tendency of the student collaboration skills variable. Respondents' perceptions of student collaboration skills were grouped into five categories, namely very high, high, medium, low, and very low, using interval calculations based on Sturges' rules. Based on the calculation results, a range of 24 was obtained. Furthermore, the range value was divided into five categories, namely $58: 5 = 11.6$ which was then rounded to 12. Thus, the class interval used to determine the category of respondents' perceptions of student collaboration skills was 5, so that each category reflects a certain score range that can be used to interpret data trends more systematically. Based on these calculations, the response tendency criteria for the student collaboration skills variable can be obtained, presented in Table 6 as follows.

Table 6. Distribution of Students' Collaboration Skills

No	Interval	Category	Frequency	Percentage
1	115 – 125	Very High	36	33,33%
2	103 – 114	High	26	24,07%
3	91 – 102	Moderate	27	25,00%
4	79 – 90	Low	18	16,67%
5	67 – 78	Very Low	1	0,93%

Student collaboration skills data can also be presented in the form of a diagram as follows.

**Figure 1.** Respondents' Perceptions of Collaboration Skills

Based on Figure 1, of the 108 respondents who have completed the questionnaire regarding collaboration skills, 33.33% are included in the very high category; 24.07% in the high category; 25.00% in the medium category; 16.67% in the low category, and 0.93% in the very low category. Considering that the average collaboration skill score of 105.21 is in the range of 103-114, which is included in the high criteria, it can be concluded that collaboration skills in physics lessons for grades XII.A-XII.C at SMA Negeri 1 Moga are classified as high overall. An explanation of several indicators of students' collaboration skills can be seen in Table 7 and Figure 2 below.

Table 7. Analysis of Collaboration Skills Indicators

Indicator	Mean	Standard Deviation
Positive interdependence	21.96	3.07
Individual and group accountability	21.56	2.94
Promotional interactions in groups	20.86	3.21
Social skills in groups	21.10	3.02
Group processing	19.72	3.69

Data analysis of student collaboration skills indicators can also be presented in the form of a diagram as follows.

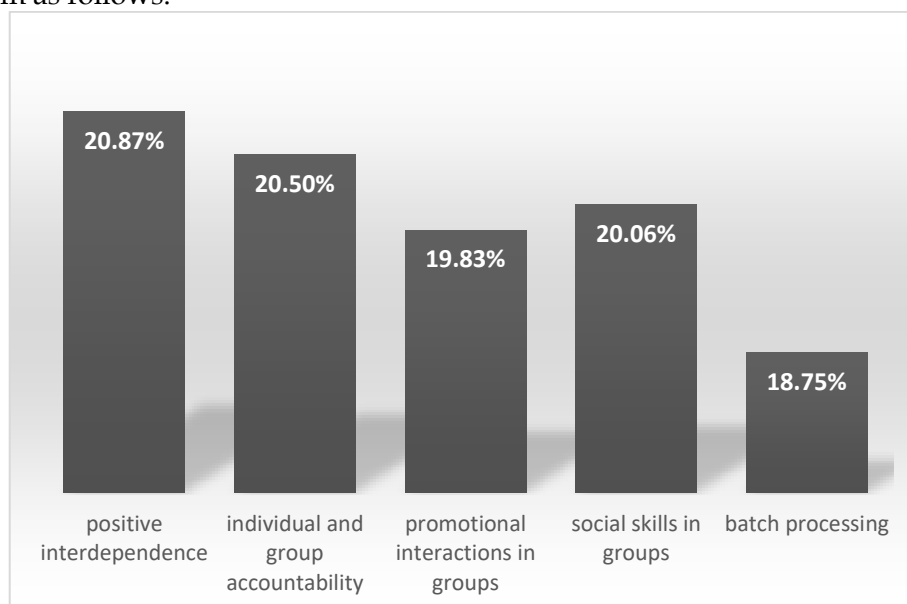


Figure 2. Analysis of Average Indicators of Student Collaboration Skills

Based on the analysis of student collaboration skill indicators, the positive interdependence indicator had the highest average score, at 21.96 (20.87%). Meanwhile, the indicator with the lowest average score was group processing, with an average score of 19.72 (18.75%). These findings provide important insights into the factors contributing to students' collaboration skills in educational contexts.

Learning Motivation Data Description

Data on students' learning motivation skills in this study were measured using a questionnaire containing 23 statements. Descriptive statistical results for the learning motivation variable are presented in Table 8 below.

Table 8. Descriptive Statistics of Student Learning Motivation

Variables	N	Min	Max	Mean	Std. deviation
Motivation	108	35	115	73.10	14.88

Based on the results of data analysis and statistical calculations, the maximum score was 115, the minimum score was 35, the mean was 73.10, and the standard deviation was 14.88. Then, after the maximum and minimum scores were known, they were used to determine the tendency of the student learning motivation variable. The range value of 17 was then divided into five categories, namely $80: 5 = 16$. Thus, the class interval used to determine the category of respondents' perceptions of student learning motivation was 16, so that each category reflects a certain score range that can be used to interpret the level of learning motivation in a more measurable and systematic way. Based on these calculations, the criteria for the tendency of answers to the student learning motivation variable can be obtained as follows.

Table 9. Distribution of Student Learning Motivation

No	Interval	Category	Frequency	Percentage
1	99 – 115	Very High	6	5,56%
2	83 – 98	High	22	20,37%
3	67 – 82	Moderate	38	35,19%
4	51 – 66	Low	39	36,11%
5	35 – 50	Very Low	3	2,78%

Student learning motivation data can also be presented in the form of a diagram as follows.

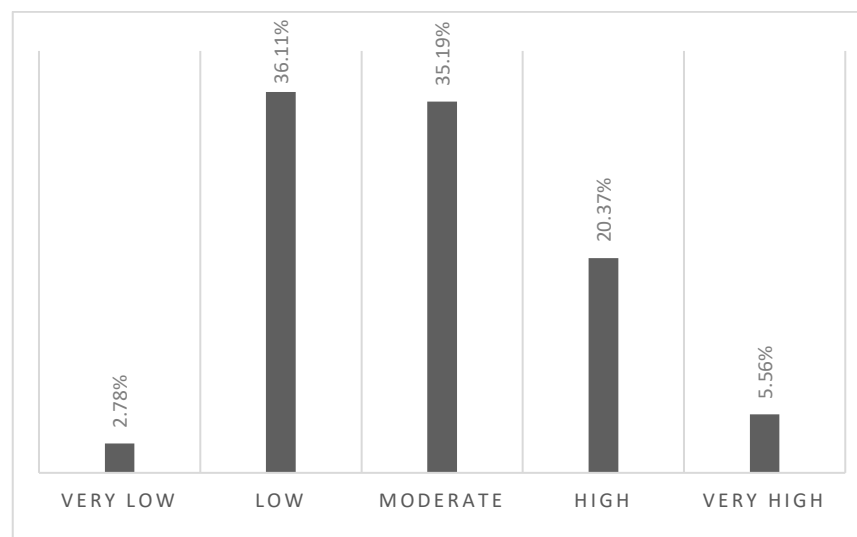


Figure 3. Respondents' Perceptions of Learning Motivation

Based on Figure 3, of the 108 respondents who have completed the questionnaire regarding learning motivation, 5.56% are included in the very high category; 20.37% in the high category; 35.19% in the medium category; 36.11% in the low category, and 2.78% in the very low category. Considering that the average learning motivation score of 73.1 is in the range of 67-82, which is included in the medium criteria, it can be concluded that the learning motivation of students in physics classes XII.A-XII.C at State Senior High School 1 Moga is classified as medium overall. An explanation of several indicators of student learning motivation can be seen in Table 10 and Figure 4 below.

Table 10. Analysis of Collaboration Skills Indicators

Indicator	Mean	Standard Deviation
Interest in selecting tasks or activities of interest	28,0	5,06
Efforts taken to achieve success	19,8	4,66
Perseverance or persistence in using time to complete tasks	11,7	3,60
Self-confidence when participating in activities	13,6	3,69

Data analysis of student learning motivation indicators can also be presented in the form of a diagram as follows.

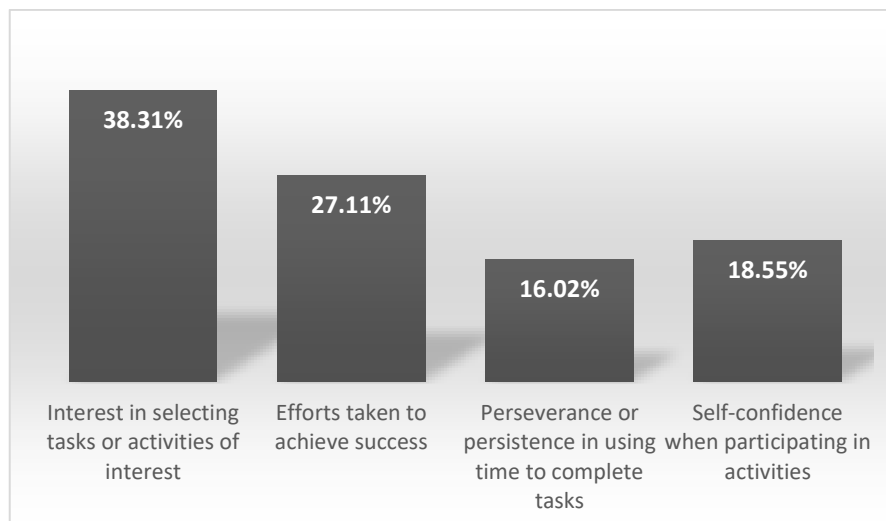


Figure 4. Analysis of Average Student Learning Motivation Indicators

Based on the analysis of student learning motivation indicators, the indicator with the highest average was choice or interest in tasks or activities, with an average value of 28.00 or 38.31%. Meanwhile, the indicator with the lowest average was persistence or tenacity, and time spent on a task, with an average of 11.70 or 16.02%. These findings provide important insights into the factors contributing to student learning motivation in educational contexts.

Discussion

Implementation of Project Based Learning Model to Support Students' Collaborative Skills

Based on the results of descriptive analysis on 108 students of grades XII.A–XII.C at SMA Negeri 1 Moga, overall collaboration skills are in the high category with an average score of 105.21 in the range of 103–114. The distribution of categories shows variations in ability: 33.33% very high, 24.07% high, 25.00% moderate, 16.67% low, and 0.93% very low. These findings indicate that although the majority of students achieve a good level of collaboration, there is a proportion that has not reached a good or very good level, thus requiring attention in learning practices. This finding aligns with the social interdependence framework, which emphasizes that positive interdependence fosters supportive participation and joint problem solving, thereby enhancing collaborative outcomes. Empirical research on project-based learning (PjBL) supports this view, with several studies reporting improvements in collaboration skills, particularly interdependence and promotive interaction, across different levels and contexts.

Project-based learning (PjBL) has been proven to be an approach capable of encouraging student engagement in the learning process, thus providing space for the development of collaborative skills and learning motivation. Research by Ermin & Hidayat (2024) shows that although PjBL provides opportunities for students to work collaboratively and produce project products, the achievement of collaboration skill indicators in their sample is still relatively low in several aspects, such as active contribution (75% in the low category) and working productively (87.5% in the low category), while the responsibility indicator is in the medium category (62.5%). These findings indicate that the implementation of PjBL alone does not automatically produce optimal collaboration without attention to task design, role allocation, and social skills development.

Research by Johnsen et al. (2024) shows that project-based learning (PjBL) improves collaboration skills, particularly interpersonal and conflict management skills, and that variations in collaboration outcomes are more determined by group dynamics (student group) than by individual characteristics such as gender or academic achievement. Ibrahim & Rashid

(2022) then compared PjBL with the traditional “doing a project” method and found that the PjBL-treated group showed significant improvements in all elements of collaboration skills, including positive interdependence, promotive interactions, and accountability. Pendit et al. (2024) quasi-experimental study of elementary school students showed a clear difference between the experimental (PjBL) and control classes, with the average achievement of collaboration indicators in the experimental class being approximately 90.78% versus 78.30% in the control class a finding very similar to the average of 90.65 in your sample. These results support the argument that PjBL can elevate collaboration scores to the fair to good range, provided the model is implemented comprehensively (clear role assignments, monitoring, rubrics, and structured discussion activities).

Other research findings enrich our understanding of the factors supporting and inhibiting the effectiveness of PjBL. Sinaga et al. (2025) found that the implementation of Project-Based Learning significantly contributed to increased student participation, strengthened collaboration, and developed problem-solving skills. However, the study also identified several practical obstacles, including limited infrastructure and suboptimal time allocation for project completion, as well as classroom management challenges that teachers must overcome for PjBL to run effectively. These findings emphasize that contextual aspects (facilities, time, and teacher capacity) play a crucial role in determining PjBL outcomes.

The qualitative approach in Putri & Jamaluddin (2025) study adds another dimension when PjBL is implemented with a constructivist foundation and facilitated by teachers acting as facilitators. Students are not only more active but also demonstrate the ability to analyze complex problems and collaborative cohesion in groups. This finding emphasizes the importance of the teacher's role as project task designer, reflection process guide, and social interaction manager to achieve learning objectives through projects.

Implementation of the Project Based Learning Model to Support Student Learning Motivation

Based on research data at SMA Negeri 1 Moga on 108 respondents, students' learning motivation showed a moderate category overall, with an average motivation score of 73.1. A total of 5.56% of students were in the very high category, 20.37% in the high category, 35.19% in the moderate category, 36.11% in the low category, and 2.78% in the very low category. These results show that the majority of students have good learning motivation, which can be associated with the application of PjBL in physics learning for grades XII.A–XII.C. In addition, the analysis of student learning motivation indicators shows that the aspect of choice or interest in tasks or activities has the highest average of 28 or 38.31%, while perseverance or tenacity, time spent on a task shows the lowest average of 11.7 or 16.02%. This indicates that PjBL supports students to have learning motivation towards physics learning through students' interest in tasks in completing the chosen project. However, students' perseverance in working on projects still needs to be improved.

From a learning motivation perspective, empirical evidence supports the positive effect of PjBL on increasing student motivation. Chaniago et al. (2024) found that the application of PjBL in Indonesian language learning resulted in significant improvements in motivation and learning outcomes (statistical significance value $p < 0.05$), with an increase in average performance in the experimental class compared to the control. These findings indicate that PjBL can stimulate curiosity, enthusiasm for completing tasks, and learning independence that support increased motivation. These findings are consistent with the results of research by Tesa Terara et al. (2024) which showed that PjBL based on creative media (such as video podcasts) can significantly increase student learning motivation and collaboration.

The implementation of the Project-Based Learning (PjBL) model has been shown to have a positive impact on increasing student learning motivation. Carrabba & Farmer (2018) stated that PjBL can increase student engagement and intrinsic motivation through relevant,

problem-based learning experiences. This finding aligns with the research findings of Bulkini & Nurachadijat (2023), which confirmed that the implementation of PjBL significantly influences the learning motivation of students with various learning styles.

However, the individual and group accountability indicators had the lowest influence (17.33 or 19.12%), indicating the need for additional strategies so that each student feels they have personal responsibility in completing the project. This is in line with the research of Putri & Jamaluddin (2025) who found that in the implementation of PjBL, the group collaboration factor is very dominant, but must be balanced with an emphasis on individual accountability so that learning motivation remains optimal.

Conclusion

Based on the research findings and discussion results, it can be concluded that the implementation of the project-based learning (PjBL) model at SMA Negeri 1 Moga has a positive contribution to the collaboration skills and learning motivation of grade XII students. The research data shows that students' collaboration skills is in the high category with an average score of 105.21, where the positive interdependence indicator is the most dominant, while group processing is still relatively low. Students' learning motivation is in the moderate category with an average score of 73.10, indicated by students' high interest in the task, but weaknesses are still seen in the aspects of perseverance and tenacity. Thus, PjBL has proven relevant in supporting learning that not only emphasizes academic achievement, but also the development of important soft skills for students.

The research suggests that teachers optimize the implementation of PjBL by designing projects that are more authentic, challenging, and contextual to students' real-life situations, fostering individual and group involvement and responsibility. Furthermore, learning strategies are needed to encourage students to be more diligent and persistent in completing projects, such as by providing ongoing evaluation stages, clear role allocation, and constructive feedback.

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