



## The Effects of Project-Based Learning on Social-Emotional Skills among Junior High School Students

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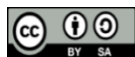
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### Keywords:

CASEL competencies;  
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### ABSTRACT

*This research investigated the impact of the project-based learning (PjBL) model on the social-emotional skills. A quantitative approach with a quasi-experimental pretest-posttest control group design was utilized. The study population included all grade eight students at SMP Negeri 4 Palu during the 2025/2026 academic year. Cluster random sampling was used to select the sample, resulting in two groups: Class VIII-A (experimental group, n=27), where the PjBL model was applied, and Class VIII-B (control group, n=30), which received traditional instruction. Social-emotional skills were measured using a questionnaire that assessed the five key CASEL competencies and demonstrated high reliability ( $\alpha = 0.87$ ). Data analysis involved the Shapiro-Wilk test for normality, Levene's test for homogeneity, and the Mann-Whitney U test for hypothesis testing, as the data did not meet normality and homogeneity assumptions. The findings revealed a Mann-Whitney p-value of 1.000 ( $p > 0.05$ ), leading to the acceptance of the null hypothesis. Therefore, it was concluded that the PjBl model did not significantly affect students' social-emotional skills.*



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## INTRODUCTION

Twenty-first-century education demands not only mastery of cognitive aspects ( Bahri et al., 2011; Agni et al., 2020; Jamhari et al., 2024; Zainal & Agni, 2024) but also social-emotional skills (SES). Empirical data indicate that low SES contributes to learning gaps. According to the Programme for International Student Assessment (PISA) (2022) report, Indonesian students remain in the lower ranks for collaborative problem-solving skills, which are closely related to social awareness and relationship skills (OECD, 2023). At the policy level, the Indonesian *Kurikulum Merdeka* (Independent

Curriculum) explicitly mandates the development of the *Profil Pelajar Pancasila* (Pancasila Student Profile), which includes the dimensions of mutual cooperation, independence, and critical reasoning – all of which are direct derivatives of SES competencies. Furthermore, 21st-century learning challenges require students to be adaptable, communicate across cultures, and make ethical decisions in complex situations (Partnership for 21st Century Learning, 2019).

In the context of science education, SES is crucial because the nature of science involves collaborative inquiry, communication of ideas, team-based problem solving, and evidence-based decision making (Ariyanto et al., 2024). The five core CASEL competencies (self-awareness, self-management, social awareness, relationship skills, and responsible decision making) (Durlak et al., 2011; Arsyah, 2025; Ritonga, 2024) are directly relevant to scientific activities such as designing experiments, engaging in group discussions, and reflecting on processes and learning outcomes. Without adequate SES, students tend to experience difficulties in scientific inquiry that requires self-regulation and empathy for peers' perspectives.

However, based on preliminary observations at SMP Negeri 4 Palu (August 2024), the science learning process is still dominated by conventional, teacher-centered approaches. Lecture methods accompanied by note-taking and practice exercises render students passive, minimize interaction, and provide insufficient training in collaboration and communication. Observational data show that only 20% of students actively ask questions or express opinions, while in group activities more than 60% of students tend to work individually without coordination. Concrete examples of low SES include students' difficulty in dividing tasks, lack of empathy toward peers who are struggling, and low individual responsibility in completing project components. This condition contradicts the demands of the *Kurikulum Merdeka* and the PISA results, both of which indicate the urgency of improving SES.

The Project-Based Learning (PjBL) model (Safarni et al., 2025; Ulfa, 2025; Al-barkah, 2026) has the potential to develop students' SES. However, the literature review reveals inconsistent findings. On one hand, several studies report positive effectiveness of PjBL. Hasim et al. (2021) proved that PjBL integrated with specific social-emotional techniques successfully improved junior high school students' collaborative skills, communication, teamwork, and argumentation skills. Utomo et al. (2024) also showed an improvement in eighth-grade students' relationship skills from 52% in cycle I to 85% in cycle II. On the other hand, Magallon (2025), in a project-based STEM program study, found no statistically significant change in students' SES competencies post-intervention, although positive trends were observed qualitatively.

These differing results can be explained by several factors. First, intervention duration: effective studies generally implemented PjBL over a longer period (at least 8–10 weeks) with intensive meeting frequencies, whereas Magallon (2025) used a relatively short duration, preventing optimal internalization of SES. Second, the level of SES integration into the PjBL syntax: Hasim et al. (2021) explicitly designed each project phase (essential question, planning, scheduling, monitoring, testing, evaluation) with measurable SES indicators, while Magallon (2025) focused more on technical STEM aspects without systematically embedding CASEL competencies. Third, students' initial characteristics: positive studies are often conducted in schools that already have a collaborative culture, whereas contexts with very low initial SES may require longer time to demonstrate statistically significant changes. Fourth, measurement instruments: the validity and sensitivity of SES instruments greatly affect the detection of change. Thus, the effectiveness of PjBL on SES is context-dependent and cannot be generalized without considering duration, quality of integration, subject characteristics, and measurement instruments.

Although the potential of PjBL has been extensively studied, these studies have not specifically examined the context of SMP Negeri 4 Palu, particularly in science subjects using a measurable CASEL framework. Therefore, there is a research gap regarding the lack of empirical evidence on the effectiveness of PjBL in improving the five SES competencies in junior high schools in regions with conventional instruction. The contributions of this study are: (1) extending PjBL studies on SES in science learning, (2) testing the application of the CASEL framework quantitatively in an Indonesian junior high school context, (3) providing local empirical evidence that can serve as a reference for teachers and policymakers, and (4) addressing 21st-century challenges and the mandate of the *Kurikulum Merdeka* through the integration of SES into PjBL.

Based on the above elaboration, the aim of this study is to determine the effect of the PjBL model on the social-emotional skills of eighth-grade students at SMP Negeri 4 Palu. The proposed hypotheses are: H<sub>0</sub>: The implementation of the Project-Based Learning (PjBL) model has no significant effect on social-emotional skills (including self-awareness, self-management, social awareness, relationship skills, and responsible decision making) of students. H<sub>1</sub>: The implementation of the Project-Based Learning (PjBL) model has a significant effect on social-emotional skills (including self-awareness, self-management, social awareness, relationship skills, and responsible decision making) of students.

## METHOD

This study employed a quantitative approach using a quasi-experimental design, specifically adopting a pretest-posttest control group format (Ina et al., 2026). The study population comprised all 320 eighth-grade students at SMP Negeri 4 Palu during the odd semester of the 2025/2026 academic year, distributed across ten intact classes. Samples were selected through cluster random sampling. The randomization procedure was conducted at the class level using a lottery method: all ten classes were listed and assigned unique codes, then two classes were randomly drawn. Class VIII-A was selected as the experimental group (n=27) and class VIII-B as the control group (n=30). To ensure initial equivalence between groups, a pretest measuring baseline social-emotional skills was administered. An independent samples t-test on pretest scores revealed no statistically significant difference between the two groups ( $p > 0.05$ ), indicating comparable initial levels of social-emotional skills.

The independent variable was the project-based learning (PjBL) model, implemented through the following syntax with corresponding student activities: (1) Essential question – students received a driving question about environmental pollution and conducted brainstorming in groups; (2) Planning – students designed a project plan, including material selection, task division, and timeline; (3) Schedule creation – students developed a detailed activity schedule and set deadlines; (4) Monitoring – students worked on the project under teacher guidance, maintained a project journal, and participated in checkpoint meetings; (5) Result testing – students presented their project outcomes and received peer and teacher feedback; (6) Reflection – students individually and collectively reflected on the learning process, challenges faced, and social-emotional experiences.

The intervention was conducted over three sessions (120 minutes each). This duration was selected based on two academic considerations: (1) the school's curriculum schedule allowed only three consecutive weeks for a single project theme without disrupting other subject allocations; (2) previous quasi-experimental studies on PjBL and social-emotional skills Islamiati & Irfan (2022) used a similar duration (2–4 sessions) and still detected significant changes, thus three sessions were considered sufficient to capture initial effects while maintaining operational feasibility.

The dependent variable was students' social-emotional skills, measured through the five CASEL competencies: self-awareness, self-management, social awareness, relationship skills, and responsible decision-making. Data were collected using a 5-point Likert-scale questionnaire. The questionnaire comprised 25 items (5 items per competency), with each item reflecting specific behavioral indicators adapted from the CASEL framework. Content validity was assessed by a panel of three experts: (1) a Biology education expert, (2) an expert in innovative learning models, and (3) a measurement and evaluation expert. The experts rated each item for relevance and clarity using a 4-point scale. The content validity index (CVI) ranged from 0.85 to 0.95, indicating good content validity. The questionnaire demonstrated high internal consistency reliability with a Cronbach's alpha coefficient of 0.87.

The consistency of PjBL implementation was maintained through syntax observation, project journal checks, checkpoint meetings, progress rubrics, visual documentation, and cross-observation by a collaborator. Data analysis included prerequisite tests (normality and homogeneity of variances) followed by hypothesis testing. The Shapiro-Wilk test indicated that the data were not normally distributed ( $p < 0.05$ ), and Levene's test showed that the variances were not homogeneous ( $p < 0.05$ ). Consequently, the parametric assumptions for an independent samples t-test were violated. Therefore,

the nonparametric Mann-Whitney U test was employed as a more appropriate alternative, using SPSS (Munifa et al., 2025). This test does not require normally distributed data and is robust against violations of homogeneity of variance when comparing two independent groups.

## RESULTS AND DISCUSSION

### Results

The improvement in students' social-emotional skills following the intervention was first examined using N-gain scores. A comparison of the descriptive statistics between the experimental and control classes is presented in Table 1.

Table 1. Comparison of Mean N-Gain Scores

Class	N	Mean	Mean (%)	Minimum	Maximum	Category
Control	30	23.6127	23.61%	-57.14	43.75	Ineffective
Experiment	27	74.7611	74.76%	45.45	100	Moderately Effective

Note: N-Gain categories based on Hake (1998): <40% (Ineffective); 50%–75% (Moderately Effective)

Based on Table 1, descriptively, the experimental class (PjBL) showed a moderately effective improvement in social-emotional skills (74.76%). The control class (conventional) showed an ineffective improvement (23.61%) and even had a negative minimum value (-57.14%), indicating that some students actually experienced a decrease in their scores. Numerically, the difference in the mean N-gain between the two classes was substantial (74.76% vs. 23.61%), indicating that PjBL was descriptively superior. A comparison of the average percentage scores for social-emotional skills between the experimental and control classes is presented in Table 2.

Table 2. Average Percentage Scores of Social-Emotional Skills per Competency

SES Competency	Experimental Class (%)	Control Class (%)
Self-awareness	74	73
Self-management	75	74
Social awareness	77	76
Relationship skills	78	77
Responsible decision-making	76	75
Overall Average	76	75

Table 2 shows no notable differences between the two groups across all five indicators. The largest difference was 1 percentage point, with the experimental class slightly higher but not statistically significant. These comparative results are further illustrated in Figure 1.

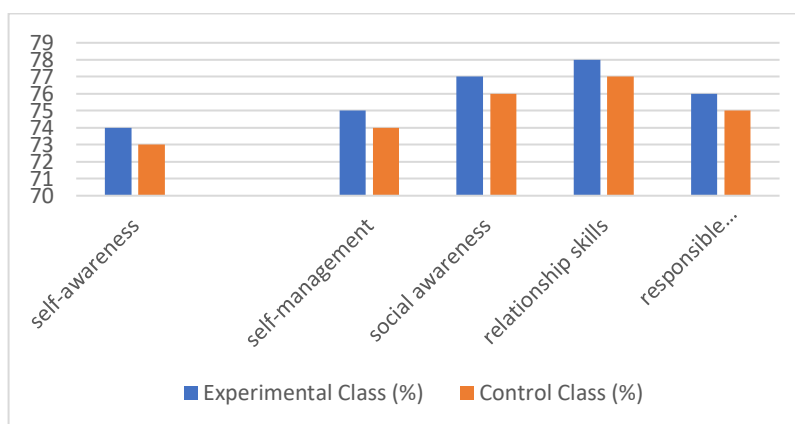


Fig.1. Average percentage scores of social-emotional skills per competency

Visually, Figure 1 shows that the score profiles of both classes are relatively parallel across the five CASEL competencies. The experimental class (PjBL) consistently obtained slightly higher average percentages than the control class for each competency, although the differences are very small, ranging from 0.3% (for self-awareness: 73.3% vs. 73.0%) to 1.0% (for relationship skills: 78.0% vs. 77.5%). This pattern indicates that no competency experienced a drastic surge; the improvement was evenly distributed but thin across all indicators. Furthermore, both classes demonstrated the highest scores in relationship skills and the lowest in self-awareness, reflecting that relationship-building skills are more easily stimulated in group learning compared to self-awareness, which requires deep internal reflection.

Although numerically the experimental class showed a slightly higher overall average (76.0% vs. 75.0%), this very small difference indicates that the implemented PjBL model has not yet been able to produce a substantial improvement in social-emotional skills compared to conventional learning. At least three explanatory factors can be identified. First, as affirmed by Valenzuela (2025), the success of PjBL in developing SES heavily depends on the systematic integration of all five CASEL competencies into each project phase, including the use of empathy mapping, the design of projects relevant to students' social context, and structured feedback cycles. In the present study, such integration was not carried out explicitly. Student activities within the PjBL syntax (brainstorming, planning, monitoring, reflection) were not equipped with specific scaffolding to train self-awareness or responsible decision-making. Consequently, the development of each competency occurred implicitly and without direction, resulting only in marginal improvements.

Second, according to Durlak et al. (2011), the five CASEL competencies ideally develop through sustained collaborative and reflective learning. An intervention duration of only three sessions (equivalent to three weeks) may be insufficient for the internalization of social-emotional behavioral changes. Meanwhile, conventional learning, which also contained elements of simple group discussion, was able to achieve nearly equivalent scores (only a 1 percentage point difference), indicating that the short duration prevented the theoretical advantages of PjBL from manifesting significantly. Third, Dussault & Thompson (2024) and Aisyah et al. (2024) state that although the regrouping of social-emotional competencies may differ among researchers, the five indicators remain interrelated. A domino effect (where lack of development in one area, e.g., self-awareness, suppresses other competencies) occurred in both classes. In this study, the minimal simultaneous improvement across all indicators was caused by the absence of a "leveraging competency" that was intensively developed. PjBL that is not specifically designed to train, for instance, responsible decision-making through projects imbued with ethical dilemmas, will lose its potential to create meaningful change.

Thus, descriptively, the superiority of PjBL over conventional methods in this study was almost imperceptible at the per-competency level (difference <1% across all indicators). This confirms that the effectiveness of the PjBL model on social-emotional skills is highly determined by the quality of SES integration into the syntax, adequate intervention duration, and the selection of focused competencies.

Prior to hypothesis testing, normality and homogeneity of variances tests were conducted. The normality test employed the Shapiro-Wilk test because the sample size of each group was < 50. The results showed that the data for both groups were not normally distributed (control group:  $p = 0.014$ ; experimental group:  $p = 0.001$ ), as presented in Table 3.

Table 3. Normality Test Results

Class	Shapiro-Wilk		
	Statistic	df	Sig
Control Class	0,909	30	0,014
Experimental Class	0,854	27	0,001

a. Lilliefors Significance Correction

Furthermore, the homogeneity of variances test using Levene's Test indicated that the variances between the two groups were not homogeneous ( $p = 0.034 < 0.05$ ), as shown in Table 4.

Table 4. Homogeneity of Variances Test Results

Variable	Levene Statistic	df1	df2	Sig.
Based on the mean	4,719	1	55	0,034
Based on the median	4,114	1	55	0,047
Based on the median and with adjusted df	4,114	1	53,731	0,047
Based on the trimmed mean	4,788	1	55	0,033

The presence of non-homogeneous variances indicates that the distribution of social-emotional skill scores differs considerably between the experimental and control groups. This condition may be caused by differences in the internal characteristics of each class, even though group assignment was conducted using cluster random sampling. Because the assumptions of normality and homogeneity were not satisfied, parametric hypothesis testing (Independent Samples t-test) was inappropriate. Therefore, the analysis was continued using the non-parametric Mann-Whitney U test. The results of the Mann-Whitney U test are presented in Table 5.

Table 5. Mann-Whitney Test Results

Statistic	Value
Mann-Whitney U	405.000
Wilcoxon W	870.000
Z	0.000
Asymp. Sig. (2-tailed)	1.000
Exact Sig. (2-tailed)	1.000
Effect size (r)	0.000

The obtained Mann-Whitney U value was 405.000, with a Z score approaching 0 (0.000). The two-tailed asymptotic significance was 1.000 ( $p > 0.05$ ), and the exact significance was also 1.000. This indicates that there is no statistically significant difference in social-emotional skill scores between the experimental class (PjBL) and the control class (conventional learning). The effect size (r) was calculated using the formula  $r = Z / \sqrt{N}$ , where  $N =$  total sample (57). Since  $Z = 0$ ,  $r = 0$ , indicating no practical effect of the intervention. Based on these results,  $H_0$  is accepted and  $H_1$  is rejected. Thus, the project-based learning (PjBL) model does not have a significant effect on the social-emotional skills of students at SMP Negeri 4 Palu.

Although descriptively the mean N-gain of the experimental class (74.76%) was substantially higher than that of the control class (23.61%), the inferential test did not reveal a significant difference. This can be attributed to high data variance, particularly the presence of an extreme negative value (-57.14%) in the control class, the relatively small sample sizes ( $n=27$  and  $n=30$ ), as well as violations of normality and homogeneity assumptions, resulting in low statistical power to detect the difference. This finding aligns with Magallon's (2025) study, which reported that a six-week integrated SEL and project-based STEM program did not produce statistically significant changes in students' social-emotional competencies, although there were qualitative positive trends. Similarly, Fazriah et al. (2025) found that applying PjBL to the topic of the Solar System only resulted in a low-criteria improvement in social-emotional skills.

## Discussion

The results indicate that the PjBL model did not significantly affect students' social-emotional skills compared to conventional learning. This conclusion is supported by two main findings: first, the difference in average percentage scores across the five CASEL competencies between the experimental and control classes was minimal, only one percentage point; second, the Mann-Whitney U test yielded a very high significance value ( $p = 1.000$ ) with a zero effect size, indicating no practical effect. Consequently, the null hypothesis ( $H_0$ ) is accepted. Interestingly, descriptively, the experimental class showed a mean N-gain in the moderately effective category, whereas the control class fell into the ineffective category, with a very large difference between them. However, this descriptive superiority was not statistically confirmed. This finding aligns with several previous studies (S. Fazriah & Winarno,

2025; Magallon, 2025) that also failed to detect significant improvements in SES despite qualitative positive trends.

The absence of a significant effect can be attributed to at least four interrelated factors. First, the intervention duration was relatively short, only three sessions. According to Durlak et al. (2011), the development of social-emotional competencies requires sustained and structured practice, and a short period may be insufficient for students to internalize new behavioral patterns such as self-regulation or empathy. This explanation is reinforced by the fact that conventional learning achieved nearly equivalent scores, suggesting that the theoretical advantages of PjBL could not manifest within a limited timeframe. In other words, although the N-gain of the experimental class was much higher, the high inter-individual variance—particularly the presence of an extreme negative value in the control class—caused this difference to be statistically meaningless. Second, there was a lack of systematic integration of SES into the PjBL syntax. Valenzuela (2025) emphasizes that successful PjBL for SES development depends on explicit integration of all five CASEL competencies into each project phase, including empathy mapping, socially relevant projects, and structured feedback cycles. In this study, such integration was not implemented; student activities were not equipped with specific scaffolding to train self-awareness or responsible decision-making. Consequently, SES development occurred implicitly and haphazardly, producing only marginal improvements. This finding supports Durlak et al. (2011) assertion that collaborative learning alone is insufficient without structured reflection and feedback.

Third, high internal variability and violations of statistical assumptions also contributed to the non-significant result. Normality and homogeneity tests showed significant violations, indicating that students' initial characteristics were highly diverse within both classes. This high variability reduced statistical power to detect a treatment effect, especially given the relatively small sample size. The presence of an extreme negative N-gain value in the control class further inflated variance, masking potential differences. Fourth, a domino effect among interrelated competencies also played a role. According to Dussault & Thompson (2024) and Aisyah et al. (2024), the five CASEL competencies are functionally clustered, with self-awareness as a foundational competency. Poor development of self-awareness cascades into weak self-management and relationship skills. In this study, the lack of explicit training in self-awareness (the experimental class was only slightly ahead of the control) likely triggered this domino effect, resulting in minimal simultaneous improvement across all indicators. Without a "leveraging competency" being intensively developed, PjBL failed to create meaningful change.

When compared with previous studies, the present findings are consistent with Magallon (2025) and Fazriah et al. (2025), who also found no statistically significant changes, but contradict studies that reported positive effects such as Islamiati & Irfan (2022) and Utomo et al. (2024). The key difference lies in the quality and duration of implementation: positive studies generally used longer interventions with explicit SES scaffolding, whereas the present study used a short duration and implicit integration. This contrast reinforces the conclusion that PjBL's effectiveness on SES is context-dependent.

In summary, this study aimed to examine the effect of the PjBL model on students' social-emotional skills. The statistical evidence showed no significant difference between the experimental and control groups. Therefore, the null hypothesis is accepted. The descriptive superiority of the PjBL class's mean N-gain (categorized as moderately effective) was not supported by inferential testing due to high data variance, assumption violations, and weak integration of SES into the PjBL syntax. In other words, a very large descriptive advantage was insufficient to achieve statistical significance. In conclusion, the PjBL model as implemented in this study—with short duration, lack of systematic SES integration, and high student variability—did not outperform conventional learning in developing social-emotional skills. Future research should extend the intervention period, integrate explicit scaffolding aligned with the CASEL framework, and employ larger, more homogeneous samples to increase statistical power.

## CONCLUSION AND SUGGESTION

This study found that the Project-Based Learning (PjBL) model did not have a significant effect on students' social-emotional skills. The statistical analysis confirmed no meaningful difference

between the experimental and control groups, and the average scores across all five CASEL competencies were nearly identical. The lack of effect is mainly due to the absence of systematic integration of social-emotional learning into the PjBL syntax, short intervention duration, and high variability in students' initial characteristics. The meaning of these findings is that PjBL, when implemented as a stand-alone method without explicit social-emotional scaffolding, does not automatically enhance students' self-awareness, self-management, social awareness, relationship skills, or responsible decision-making. Descriptive improvements in N-gain scores were not supported by inferential statistics, highlighting that practical significance does not guarantee statistical significance.

Practical implications are as follows. For science teachers, simply adopting PjBL is insufficient; they must embed structured SEL techniques—such as reflection journals, empathy mapping, and guided feedback cycles—into each project phase. For schools, professional development programs should train teachers to design projects that explicitly target CASEL competencies, and the curriculum should allow longer project durations (e.g., at least twelve weeks) to enable internalization of social-emotional behaviors. For the implementation of SEL-based PjBL, this study recommends that schools move beyond implicit development and adopt systematic, competency-aligned scaffolding, ensuring that each project phase includes intentional practice of specific social-emotional skills. In summary, PjBL is not a magic bullet for social-emotional learning; its effectiveness depends on deliberate, structured integration of SEL competencies, adequate time, and attention to student diversity

### **CONFLICTS OF INTEREST**

The authors declare that there are no financial, personal, professional, or institutional relationships that could have influenced the conduct, analysis, or reporting of this study. The research was conducted and reported independently and objectively, and no external party has any specific interest in the outcomes presented in this publication.

### **AUTHOR CONTRIBUTIONS STATEMENT**

Conceptualization, H.; methodology, H. and R.A.; formal analysis, H.; investigation, H.; data curation, H.; writing—original draft preparation, H.; writing—review and editing, M.J., R.A., G.S., B., and M.S.; supervision, M.J. and R.A.; validation, G.S., B., and M.S.; correspondence, R.A. All authors have read and agreed to the published version of the manuscript. Authorship was limited to individuals who made substantial contributions to the reported work. Abbreviations: H. (Hadina), M.J. (Mohammad Jamhari), R.A. (Raya Agni), G.S. (Gamar Shamdas), B. (Bustamin), and M.S. (Moh. Sabran).

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### **DECLARATION OF GENERATIVE AI SOURCES**

During the preparation of this manuscript, the authors used ChatGPT (OpenAI) and Grammarly to assist with language improvement, grammar checking, sentence refinement, and enhancement of the overall

clarity of the English text. All content generated or suggested by these tools was carefully reviewed, revised, and verified by the authors. The authors take full responsibility for the accuracy, integrity, and final content of the manuscript.

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