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Inclusive Education in Science: Factors Influencing the Development of Reflective Thinking and Problem-Solving

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ABSTRACT: The study was to explore the relationship of communication, teacher scaffolding, collaborative learning, and learning diversity to students' reflective thinking and problem-solving in science learning. Through the utilization of quantitative research design and Structural Equation Modelling (SEM), this study collected data from 317 students in six secondary schools by using a validated questionnaire. The findings of this study show that communication has a positive impact on reflective thinking and problem solving, highlighting the role of teachers and students dialogue in enhancing students' cognitive development. Teacher scaffolding positively influences reflective thinking, but has a negative effect on problem solving, hence indicating the need for a balance between teachers guidance and students autonomy. Collaborative learning enhances reflective thinking, although it shows a limited impact on problem solving. In addition, the significance of inclusive educational practices is suggested because the factors of learning diversity have a quasi-significant effect on reflective thinking. The integrative analysis used in this study produces new insights into combined impacts of communication, teacher scaffolding, collaborative learning, and learning diversity in science classrooms and suggests practical implications for improving the use of efficient instructional strategies that promote students' cognitive competencies in learning science.

Keywords: communication, teacher scaffolding, collaborative learning, learning diversity, reflective thinking and problem solving.

I. INTRODUCTION

Reflective thinking and problem solving are essential competences in contemporary learning systems, in particular for science education context. This is because reflective thinking is pivotal to enabling students to critically evaluate their prior knowledge and experiences [1-3]. Likewise, problem-solving skills are equally important, as they allow scientific reasoning to be used in science exploration [4, 5]. Over the past years, some variables have been considered as relevant to develop those skills: communication, teacher support, collaborative learning and learning diversity. These components help to establish an interactive and collective environment for learning, and are essential for the acquisition of critical thinking on complex scientific problems. In this sense, communicative competences contribute to the ideal exchange of ideas among students and from teacher support comes structured guide on the student's learning process [6]. Consistent with this, cooperative learning promotes interaction among the group and diversity should be taken into consideration in instructional design, in order to allow learners of different characteristics and backgrounds achieve enriched experiences for learning [7, 8].

These factors are well known in science education. Science education research has found that good student-teacher communication (and scaffold) influences the students' reflective thinking skills and their effectiveness in systematically solving problems [9, 10]. Collaborative learning has also been demonstrated to improve problem-solving skills that enable students to work together exchanging ideas while attempting to solve problems of scientific nature [11, 12]. Finally, acknowledging that not all students learn in the same way is important when striving to meet the needs of all students in order to help them be successful in the classroom [13, 14].

Prior studies have highlighted the role of supporting scaffolding and teacher communication in learning to promote the reflective capabilities of students. With the help of scaffolding, teachers guide students to gain entry into their zone of proximal development and help them complete tasks that cannot be accomplished alone, but can be achieved with guidance [15]. A study by Belland et al. [16] & Chen et al. [17] affirm teacher scaffolding in science education as a major factor, as teacher aid in structuring developing thought processes, helps students in monitoring their thinking and also develop problem solving skills. The good communication between teachers and students is another incentive to this process, since it facilitates continuous pedagogical exchange, promotes a deep understanding of concepts and deserves the student to think more critical about the studied content [18], [19]. Furthermore, collaborative learning has a positive effect on problem-solving skills of science students [20]. On one hand, collaborative learning environment benefits the performance of students, not only in academic performance but also in higher order thinking ability by interacting with different perspectives and reasoning patterns [21]. Research by Utami et al. [5], suggests that students who engaged in a collaborative science environment tend to be better problem-solvers due to extensive peer support and the exchange of knowledge. Additionally, the use of diversity in collaborative learning can assist varied ability students through peer action and teacher intervention [13, 22, 23].

Although the significance of communication, teacher scaffolding, collaborative learning, and learning diversity are acknowledged in science education, there is a dearth of research on the combination of these elements on reflective thinking and problem-solving. First, learning diversity, especially in multiculturally diverse and mixed-ability classrooms, is underestimated. Most contemporary literature is centered on an 'average' classroom environment, with little emphasis on diversity or inclusiveness. Research by Wang & Yan [24] found that the variance of learning can have a significant effect on graduate students' reflective thinking and problem-solving engagement. Moreover, these risk factors have usually been considered separately in previous studies, and their synergistic effects have seldom been studied. Little is known about how these elements might combine to support students' learning and enact deeper cognitive engagement in science education. Moreover, the variation of students' learning experiences, especially how these elements relate to differences between individuals have not yet been fully investigated.

This study aimed to bridge the existing gap by investigating how communication, teacher scaffolding, collaborative learning, and learning diversity collectively contribute to enhancing students' reflective thinking and problem-solving skills in science education. This gap in the literature indicates the necessity of an in-depth study which accounts for these factors, and examines their interaction effects on the students' reflective thinking and problem-solving levels. The novelty of this study is in focusing on these four factors to integrate analysis of the combined effects in a more comprehensive way. Although the current work is specific to science education, it has implications for pedagogy that seeks to improve students´ reflective thinking and problem-solving skills in inclusive and diverse classrooms. The research hypothesis is that there is an influence of;

1. *H1* communication towards reflective thinking,
2. *H2* communication towards problem solving,
3. *H3* teacher scaffolding towards reflective thinking,
4. *H4* teacher scaffolding towards problem solving,
5. *H5* collaborative learning towards reflective thinking,
6. *H6* collaborative learning towards problem solving,
7. *H7* learning diversity towards reflective thinking,
8. *H8* learning diversity towards problem solving, and
9. *H9* reflective thinking towards problem solving.

Relevant communication, teacher scaffolding, collaborative learning, and diversity of learning contribute to the development of the reflective and problem-solving abilities. The concept of inclusive education is closely related to the literature on learning diversity, as a factor that can shape students' reflective thinking and problem-solving skills in science. Inclusive education can accommodate students from diverse backgrounds and learning abilities. Several studies have shown that inclusive education strategies can accommodate differences in classroom settings, such as learning styles, creating an atmosphere and learning process that fosters student development without leaving anyone behind [25, 26]. Furthermore, inclusive education, through the application of effective communication, appropriate scaffolding, and active and meaningful collaborative learning, can significantly support the development of reflective thinking, which is currently the foundation for equitable problem-solving and academic success in diverse science classrooms [27].

II. MATERIAL AND METHOD

1. RESEARCH DESIGN

This study employed a quantitative design with an explanatory approach [28]. The purpose of this study was to investigate the effects of communication, learning diversity, teacher support, and collaborative learning on students' reflective thinking and problem-solving abilities in science learning. The structural equation modeling (SEM) approach allows for the verification of theoretical models and the analysis of relationships between latent variables measured by specific indicators. SEM is chosen for its capability to simultaneously analyze complex relationships between latent and manifest variables, in addition to testing both measurement and structural models concurrently. The SEM model diagram is presented in Figure 1.

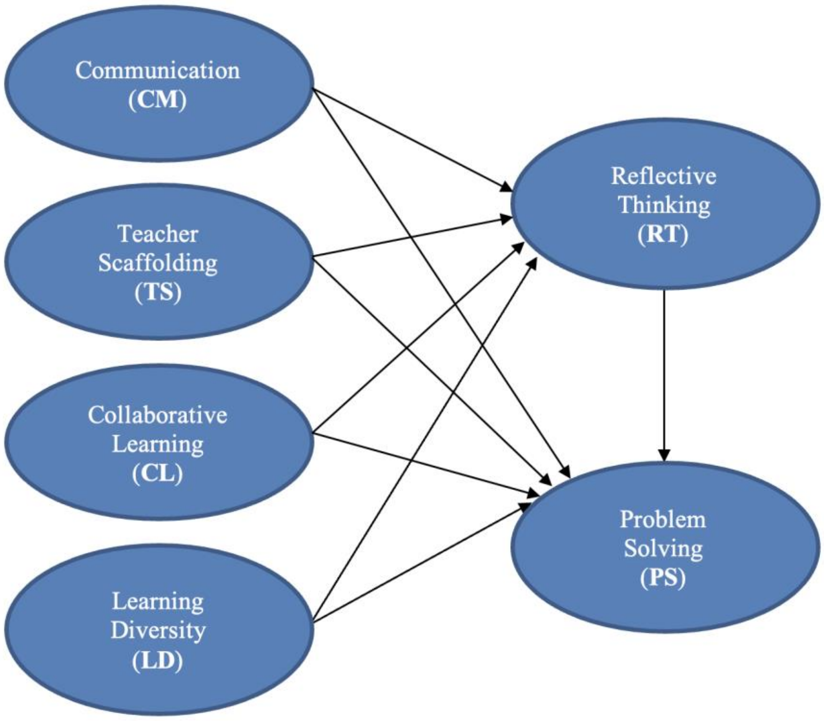

FIGURE 1. SEM model diagram

2. POPULATION AND SAMPLE

The study population consists of all eleventh-grade science students from State Senior High Schools (SMAN) 1, 2, 3, 4, 5, and 6 in Barru, involving communication skills, teacher scaffolding, collaborative learning, learning diversity, as well as reflective thinking and problem-solving skills during science learning (Table 1). The sample was selected using purposive sampling, where subjects were chosen based on specific characteristics that align with the research objectives. The characteristics of students are that students must come from exact science classes. The sample size was determined based on the number of indicators in the SEM model, adhering to a minimum ratio of ten samples for each indicator utilized. Out of 457 students, only 317 met the qualifications and consented to participate in the data collection process.

Table 1. Distribution of research samples.

Item	Grade	N	Percentage (%)
Male Students	X	34	28.81
	XI	41	34.75
	XII	43	36.44

Total		118	100.00
Female Students	X	61	30.65
	XI	73	36.68
	XII	65	32.66
Total		199	100.00

3. INSTRUMENTS

Data were collected using a questionnaire that had been validated through tests of validity and reliability. Each item of the research instrument was measured using a Likert scale (4 = strongly agree, 3 = agree, 2 = disagree, and 1 = strongly disagree). The validation results show that it is in the valid category (3.44), with a range (strongly valid=4.00-3.51, valid=3.50-3.01, not valid=3.00-2.50, and strongly not valid=below 2.50). The questionnaire contained statements representing each indicator, as detailed in Table 2.

Table 2. Questionnaire statements in the research instrument.

Variable Items	Survey Item Statement
CM1	I feel comfortable communicating with my peers during science lessons.
CM2	I believe the teacher provides clear explanations in each class meeting.
CM3	I am able to express my opinions well in class during science lessons.
CM4	Communication between the teacher and students in class is effective.
CM5	I feel heard when speaking with the teacher.
CM6	I am capable of collaborating with my peers through effective communication.
TS1	The teacher always gives clear instructions when encountering challenging assignments in science learning.
TS2	I feel that the teacher supports me when I struggle to understand science concepts.
TS3	The teacher helps me comprehend difficult concepts in a more accessible way.
TS4	The teacher provides relevant examples to enhance my understanding of science material.
TS5	I receive additional guidance from the teacher when needed.
CL1	I often collaborate with classmates to complete assignments.
CL2	I believe that learning together in groups helps me better understand science material.
CL3	I actively contribute to group discussions during science lessons.
CL4	We frequently exchange ideas and solutions while working in groups.
CL5	Collaborative learning makes me more receptive to the perspectives of my peers.
LD1	I am often exposed to diverse learning styles in the classroom.
LD2	I perceive that various teaching methods are employed by the teacher in science learning.
LD3	The teacher values the different learning approaches of students in class.
LD4	I am often encouraged to learn from different viewpoints.
LD5	Our classroom supports various types of learning activities tailored to the needs of each student.
RT1	I frequently reflect on my learning experiences to find better approaches to learn science.
RT2	I am able to identify my strengths and weaknesses in my learning process.
RT3	I tend to consider various perspectives before reaching conclusions.
RT4	I often self-evaluate to improve my understanding of science material.
RT5	I can connect my learning experiences with other relevant situations.
RT6	I reflect on what I have learned and strive to apply it in daily life.
PS1	I am capable of identifying problems effectively before seeking solutions.
PS2	I usually analyze various alternative solutions before making decisions.
PS3	I employ a logical approach when solving problems.
PS4	I feel capable of solving complex problems with the aid of appropriate strategies.
PS5	I can think creatively when faced with situations requiring quick solutions.

4. DATA COLLECTION AND ANALYSIS TECHNIQUES

Data were collected through online and offline questionnaires and then analyzed using the SEM method, with SmartPLS 3.2 software. SEM analysis uses a measurement model and a structural model. Validity is assessed by outer loading (>0.70), consistency of reliability with Composite Reliability (>0.70), Rho A (>0.70), and Cronbach's Alpha (>0.70). Convergent validity through Average Variance Extracted (AVE) (>0.50), while discriminant validity through the Fornell-Larcker, HTMT, and cross-loading criteria. The discriminant validity criteria per Fornell-Larcker require that the square root of the AVE (on the diagonal) for each variable is greater than the other variables, and uses the Heterotrait-Monotrait Ratio (HTMT) method [29]. HTMT values below 0.90 indicate that the constructs are empirically different from each other. Bootstrapping statistical tests T and F were performed to determine the significance of the path coefficients using the structural model ($p<0.05$ and $T>1.96$) at 95% confidence intervals with a subsample of 5000 [29-33].

III. DATA ANALYSIS

Overall, the outer loadings displayed in Table 3 indicate the strength of the relationship between each item and the latent variable, with most values exceeding 0.70, indicating good measurement validity. However, there is an exception for item CM6 in the communication variable, which has an outer loading value of 0.586, falling below the threshold of 0.7; thus, this item may need to be reevaluated or removed from the model. In the Cronbach's Alpha column, all variables demonstrated values exceeding 0.7, indicating good internal consistency, with the exception of the communication variable, which recorded a value of 0.909. The Rho_A and Composite Reliability values for each variable were also sufficiently high, indicating that all variables possess strong reliability. The Average Variance Extracted (AVE) values greater than 0.5 for most variables suggest that each variable explains more than 50% of its variance, thus indicating adequate convergent validity. Overall, the reflective measurement analysis indicates that the measurement instruments employed are sufficiently valid and reliable, although a few items, such as CM6 in the communication variable, require further attention.

Table 3. Measurement model analysis.

Variable	Variable Items	Outer Loadings	Cronbach's Alpha	Rho_A	Composite Reliability	AVE
Communication	CM1	0.884	0.909	0.911	0.932	0.698
	CM2	0.881				
	CM3	0.904				
	CM4	0.900				
	CM5	0.881				
	CM6	0.586 (Out)				
Teacher Scaffolding	TS1	0.949	0.955	0.956	0.966	0.849
	TS2	0.937				
	TS3	0.906				
	TS4	0.896				
	TS5	0.918				
Collaborative Learning	CL1	0.849	0.933	0.935	0.949	0.790
	CL2	0.883				
	CL3	0.890				
	CL4	0.916				
	CL5	0.906				
Learning Diversity	LD1	0.918	0.912	0.927	0.935	0.742
	LD2	0.737				
	LD3	0.835				
	LD4	0.880				
	LD5	0.925				
Reflective Thinking	RT1	0.875	0.917	0.923	0.936	0.708
	RT2	0.839				
	RT3	0.858				

	RT4	0.801				
	RT5	0.892				
	RT6	0.780				
Problem Solving	PS1	0.746	0.863	0.873	0.900	0.645
	PS2	0.789				
	PS3	0.778				
	PS4	0.848				
	PS5	0.835				

Discriminant validity is considered achieved when the square root of AVE for a variable exceeds its correlations with other variables (Table 4). For instance, for the Communication (CM) variable, the square root of the AVE is 0.946, which is greater than its correlations with other variables such as Teacher Scaffolding (0.931) and Collaborative Learning (0.892). This signifies that the CM variable possesses good discriminant validity. Moreover, discriminant validity is also evident in the other variables. For example, for the Problem Solving (PS) variable, the square root of the AVE is 0.921, which surpasses the correlations of PS with other variables such as Reflective Thinking (0.813) and Collaborative Learning (0.662). This indicates that these variables are indeed conceptually distinct from one another within the model. With adequate discriminant validity, this suggests that the instruments used to measure each variable are capable of differentiating the measured concepts and do not significantly overlap with other variables. This validity is crucial to ensure that the research model can reliably measure the relationships among the examined variables.

Table 4. Descriptive Fornell-Larcker criterion.

Variable Items	CM	TS	CL	LD	RT	PS
CM	0.946					
TS	0.931	0.931				
CL	0.892	0.892	0.889			
LD	0.836	0.836	0.882	0.803		
RT	0.805	0.818	0.794	0.763	0.842	
PS	0.757	0.757	0.649	0.662	0.813	0.921

The results of the Fornell-Larcker Criterion analysis are in line with the results of the HTMT value analysis in Table 5. The HTMT results show that the research model has good discriminant validity, indicating that each variable measures a significantly different concept, and there are no overlapping issues that can affect the integrity of the model.

Table 5. HTMT analysis.

Variable Items	CM	TS	CL	LD	RT	PS
CM						
TS	0.853					
CL	0.811	0.865				
LD	0.693	0.721	0.801			
RT	0.735	0.709	0.793	0.814		
PS	0.683	0.691	0.732	0.709	0.803	

Each value represents the relationship between certain items in that category and other variables (Table 6). Item CM1 exhibits the highest loading within the Communication (CM) variable at 0.880, which is greater than its loadings in other variables such as Teacher Scaffolding (TS) at 0.818 and Collaborative Learning (CL) at 0.779. This indicates that item CM1 validly reflects the Communication variable and does not conflate with other variables. In factor analysis or structural modeling, high cross-loadings on some variables indicate that the item may contribute to more than one factor, which is important to consider in interpreting the model. For example, items CL1 and CL2 have relatively balanced cross-loading values between the CL and LD categories, 0.766 and 0.787, respectively, indicating that the item has a significant contribution in both categories.

However, there are also higher outer loadings values other than the main factors, such as in item CM3 which loads higher on Teacher Scaffolding (TS) (0.918) than on Communication (CM) (0.889). This can happen because the item reflects a concept that is closely related to more than one latent variable, in communication between students and teachers there are often elements of support or scaffolding that also affect the learning process. In addition, interactions between interrelated latent variables can be the cause, such as teacher support in the context of communication that can improve problem solving.

Table 6. Results of Cross-loading analysis on discriminant validity.

Variable Items	CM	TS	CL	LD	RT	PS
CM1	0.880	0.818	0.779	0.770	0.720	0.636
CM2	0.870	0.799	0.742	0.751	0.696	0.594
CM3	0.889	0.918	0.791	0.822	0.735	0.598
CM4	0.876	0.842	0.774	0.810	0.707	0.575
CM5	0.870	0.823	0.906	0.831	0.731	0.611
TS1	0.894	0.949	0.857	0.874	0.780	0.645
TS2	0.875	0.937	0.843	0.925	0.770	0.615
TS3	0.823	0.906	0.792	0.778	0.737	0.581
TS4	0.806	0.896	0.777	0.773	0.722	0.608
TS5	0.889	0.918	0.791	0.822	0.735	0.598
CL1	0.735	0.766	0.849	0.715	0.673	0.542
CL2	0.770	0.787	0.883	0.774	0.713	0.573
CL3	0.745	0.723	0.890	0.682	0.675	0.536
CL4	0.837	0.815	0.916	0.790	0.733	0.617
CL5	0.870	0.823	0.906	0.831	0.731	0.611
LD1	0.856	0.919	0.823	0.918	0.756	0.604
LD2	0.585	0.576	0.571	0.737	0.533	0.432
LD3	0.660	0.657	0.644	0.835	0.609	0.504
LD4	0.764	0.752	0.762	0.880	0.675	0.566
LD5	0.875	0.937	0.843	0.925	0.770	0.615
RT1	0.645	0.625	0.630	0.616	0.875	0.636
RT2	0.588	0.592	0.611	0.581	0.839	0.582
RT3	0.646	0.614	0.634	0.613	0.858	0.628
RT4	0.587	0.573	0.555	0.549	0.802	0.563
RT5	0.694	0.667	0.659	0.654	0.891	0.763
RT6	0.894	0.949	0.857	0.874	0.780	0.645
PS1	0.586	0.419	0.433	0.376	0.474	0.771
PS2	0.694	0.667	0.659	0.654	0.891	0.763
PS3	0.516	0.445	0.407	0.410	0.481	0.788
PS4	0.573	0.494	0.492	0.486	0.529	0.852
PS5	0.617	0.562	0.543	0.562	0.561	0.835

In the Table 7, the impact of communication (CM) on problem solving (PS) has a coefficient of 0.922, indicating a very strong positive effect of CM on PS. The t-statistics value of 6.717 and the p-value of 0.000 signify that this relationship is statistically significant with a significance level below 0.05. Similarly, the CM variable also exhibits a positive influence on reflective thinking (RT), with a coefficient of 0.305, which is also statistically significant (p-value 0.001). Conversely, the influence of teacher scaffolding (TS) on problem solving (PS) reveals a negative relationship with a coefficient of -0.434 and t-statistics of 3.869, which remains statistically significant with a p-value of 0.000. This suggests that while teacher scaffolding may influence students' learning processes, it potentially has a negative effect on problem-solving abilities. Nevertheless, TS exhibits a positive influence on reflective thinking (RT) with a coefficient of 0.215, which is significant with a p-value of 0.025. In the variable of learning diversity (LD), there is no significant effect on problem solving (PS) with a p-value of 0.525, while the effect of LD on reflective thinking (RT) approaches significance with a p-value of 0.076. Finally, reflective thinking (RT) has a significant positive effect on problem solving (PS) with a coefficient of 0.547 and a p-value of 0.000, confirming the importance of reflective ability in improving students' problem solving skills in science learning.

Table 7. Results of path test analysis (Hypothesis).

Path	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
CM -> RT	0.305	0.310	0.095	3.205	0.001
CM -> PS	0.922	0.928	0.137	6.717	0.000
TS ->PS	-0.434	-0.438	0.112	3.869	0.000
TS -> RT	0.215	0.205	0.096	2.246	0.025
CL -> PS	-0.175	-0.174	0.083	2.095	0.036
CL -> RT	0.215	0.213	0.068	3.186	0.001
LD -> PS	-0.059	-0.065	0.093	0.636	0.525
LD -> RT	0.138	0.139	0.077	1.777	0.076
RT -> PS	0.547	0.545	0.057	9.668	0.000

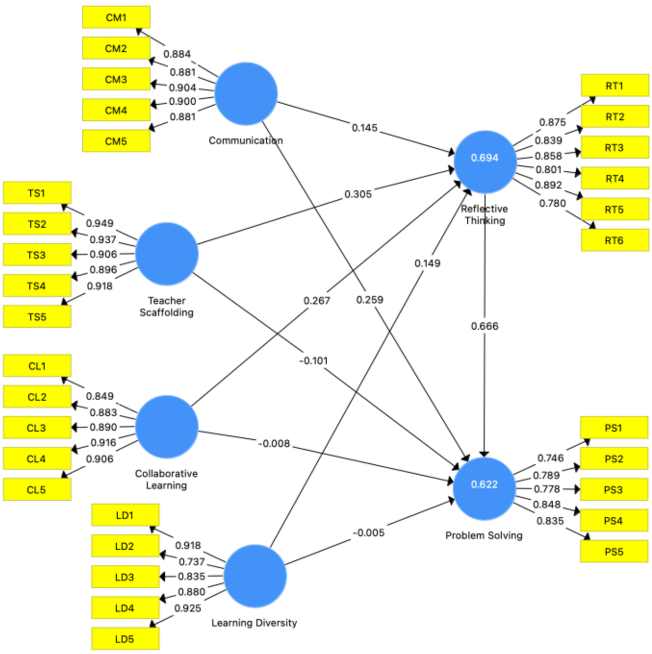

FIGURE 2. SEM analysis results.

Figure 2 presents the complex relationships between several variables. The results show that there are positive and negative paths, which indicates that each learning process must be adapted to the context and needs of students.

IV. DISCUSSION

The results of the study showed a relationship between several variables, such as communication (CM) has a positive impact on reflective thinking (RT) and problem solving (PS). Communication is able to provide a good effect on reflective thinking (coefficient = 0.305, $p < 0.05$), which indicates that the communication process is one of the bases in the formation of reflective thinking. This result is also in line with student problem solving, it is seen that CM has a strong correlation with PS (coefficient = 0.922, < 0.05), which indicates that effective communication can empower and shape problem solving for students, especially in science learning. Collaborative learning (CL) contributes positively to RT but has a slightly negative effect on PS. Specifically, RT contributes directly to PS (coefficient = 0.547, $p < 0.05$), emphasizing the critical role of reflective thinking in improving problem-solving skills. Overall, several variables have positive and significant impacts.

This study is in line with previous research that confirms that effective communication between teachers and students is an important factor in improving problem-solving skills [9, 10]. Furthermore, the positive impact of communication on reflective thinking is consistent with Feezel [34], Kamid et al. [35], Maragha [36], and Sabbah et al. [37], which emphasizes interaction as a driver of cognitive development. However, the negative effect of TS on PS challenges conventional findings that emphasize the importance of scaffolding in problem solving [16], [17]. These findings suggest that excessive scaffolding can hinder cognitive independence and lead to dependency. Similarly, the role of CL supports the cooperative learning model by Jamaluddin et al. [38, 39], but the small negative effect on PS suggests challenges in balancing collaboration with individual problem-solving skills [21]. According to Wang et al. [40, 41], in some cases, students involved in group discussions or teamwork sometimes rely more on the contributions of other group members than on developing their own problem-solving strategies. In addition, it is possible that interactions in groups can lead to learning that is not focused on individual problem solving, but rather on achieving mutually agreed solutions [42].

The effect of LD approaching significance reflects the findings of Wang & Yan [24], who stated that learning diversity has a complex contextual effect on learning outcomes. According to Munniksma [43], although diversity in learning is expected to support various students in learning, in reality, this diversity can cause confusion or even difficulty in focusing students' attention on solving problems systematically. In addition, when various learning methods are applied to accommodate different learning styles, fragmentation may occur in the learning process [44]. Students who are accustomed to certain methods feel uncomfortable or have difficulty adapting to different approaches, which in turn can hinder their ability to identify and solve problems effectively [45]. This diversity, although intended to increase flexibility and inclusiveness, can also lead to students' confusion in choosing the right strategy or approach to solving problems.

This study presents several scientific and practical implications. From a scientific perspective, the results indicate the necessity for adjustments in the application of scaffolding techniques to enhance problem-solving skills without compromising student independence. Furthermore, the positive correlation between communication and reflective thinking suggests that appropriate communication strategies can systematically improve cognitive reflection and problem-solving abilities [46, 47]. Practically, the findings recommend that educational practitioners carefully design collaborative learning environments to balance collaborative work with individual problem-solving initiatives. These results highlight the need for further research to explore optimal scaffolding practices and the conditions in which collaborative strategies and diverse learning experiences yield the best cognitive outcomes, particularly in the context of science education.

V. CONCLUSION

The roles of communication, teacher scaffolding, collaborative learning, and learning diversity demonstrated different contributions to the development of reflective thinking and problem-solving in science learning. Communication between teachers and students appeared positive in fostering reflective thinking and problem-solving. These results demonstrate that intense communication can foster cognitive development in students. However, teacher scaffolding demonstrated a negative effect on problem-solving, indicating that the science learning process requires a balance between teacher scaffolding and independent learning to prevent students from becoming dependent on their learning. Furthermore, collaborative learning demonstrated positive results on reflective thinking, although this was limited in fostering student problem-solving in learning.

This study also demonstrated the distinct role of learning diversity in the variables identified. The results were not significant for empowering problem-solving, and only approached significance for fostering reflective thinking. It is crucial to implement inclusive education processes that consider other factors, such as student learning styles, during science learning. Therefore, further research is needed to explore effective strategies related to teacher scaffolding, the alignment between collaboration and student problem-solving, and the development of inclusive teaching processes that meet students' science learning needs. This research is indirectly able to provide an impact on teachers' understanding in perfecting effective teaching processes, developing reflective thinking strategies, and developing interesting learning in building students' problem-solving processes.

There are several limitations in this study, such as; 1) the study only focuses on the context of science learning in high school, so generalization of findings to other levels of education or different contexts must be done further research. 2) although the variables studied include important factors in the development of reflective thinking and problem solving, the influence of other external factors such as social environment, culture, or family support that can affect the results are not taken into account in this study, and 3) the instrument used, although it has gone through validity and reliability tests, still has several items that may require further attention, such as items in the communication variable that have lower loading values.

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Author Contributions

Conceptualization, A. M and A.B.J; methodology, A.M; validation, A.C.P and A.B.J; formal analysis, A.M and A.B.J.; investigation, A. M., A.B.J and A.C.P.; data curation, A.M.; writing—original draft preparation, A.M and A.B.J.; writing—review and editing, A.B.J.; visualization, A.M and A.C.P.; supervision, A.M. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data are available from the authors upon request.

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