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Enhancing Students Science Learning Experience through a Vygotskian Social Reconstruction Model with Scaffolding: The Role of Social Attitudes

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Abstract. Grounded in Vygotsky's sociocultural theory, this study examines the effect of a social reconstruction learning model combined with scaffolding techniques on elementary students' science learning experience, while controlling for social attitudes as a covariate. The study responds to the growing need for instructional approaches that actively engage learners and promote meaningful learning experiences in primary science education. A quasi experimental method with a posttest only control group design was employed. The participants consisted of 42 fifth grade students from SDN 4 Sudaji, who were assigned to experimental and control groups. Data were collected using validated instruments, including a social attitude questionnaire and a science learning experience test. The data were analyzed using Analysis of Covariance (ANCOVA) to determine the effect of the instructional model while statistically controlling for students' social attitudes. The findings indicate that the Vygotskian social reconstruction model with scaffolding techniques had a significant effect on students' science learning experience ($F = 9{,}39$, $p < 0{,}05$). Furthermore, after controlling for social attitudes, the instructional model demonstrated a stronger and statistically significant effect on science learning outcomes ($F = 12{,}182$, $p < 0{,}05$). Social attitudes were also found to make a substantial contribution to students' science learning experience, accounting for 75,5% of the variance. Overall, this study provides empirical evidence that integrating social reconstruction and scaffolding within a Vygotskian framework effectively enhances elementary students' science learning experiences. The findings emphasize the importance of incorporating sociocultural dimensions, particularly social attitudes, in the design and implementation of science instruction at the primary education level.

Keywords: Vygotskian learning theory; social reconstruction model; scaffolding technique; science learning experience; social attitudes

INTRODUCTION

Enhancing students' learning experiences has emerged as a central agenda in contemporary science education discourse, reflecting a fundamental shift in how learning is conceptualized and evaluated in formal schooling contexts. Learning is no longer understood merely as the accumulation of factual knowledge or mastery of procedural skills; rather, it is increasingly recognized as a complex, holistic process involving cognitive construction, emotional engagement, social interaction, and the development of meaning through lived experience [1], [2]. This paradigm shift has prompted educators and researchers to reconsider instructional practices, assessment orientations, and learning environments in order to foster learning experiences that are meaningful, engaging, and sustainable for students across educational levels.

In science education, the emphasis on learning experiences is particularly critical due to the nature of scientific knowledge itself. Science is not only a body of concepts and principles but also a way of thinking, investigating, and interacting with the natural and social world. Effective science learning therefore requires students to actively engage with phenomena, construct explanations, communicate ideas, and collaborate with others in the process of inquiry [3]. When science instruction is reduced to rote memorization or teacher-centered transmission, students may achieve short-term academic outcomes while failing to develop deeper conceptual understanding, intrinsic motivation, and positive attitudes toward science learning [4].

International policy documents and large-scale educational assessments consistently emphasize the importance of meaningful learning experiences in science education. The Organisation for Economic Co-operation and Development (OECD), through its Programme for International Student Assessment (PISA), highlights that students' engagement, sense of relevance, and interaction in learning environments are strongly associated with learning outcomes and long-term educational trajectories [1]. Similarly, contemporary educational psychology literature underscores that learning experiences encompassing

cognitive, affective, and social dimensions are more likely to support sustained interest, conceptual change, and transfer of learning [2], [5]. These perspectives collectively reinforce the argument that improving students' science learning experiences is not a peripheral concern but a foundational goal of educational reform.

At the elementary school level, science learning plays a crucial role in shaping students' early conceptions of scientific knowledge, inquiry, and learning itself. Elementary science education provides the foundation for developing curiosity, reasoning abilities, scientific literacy, and dispositions toward lifelong learning [6]. Positive learning experiences during this stage can cultivate students' confidence, willingness to explore, and openness to collaborative problem-solving. Conversely, negative or disengaging learning experiences may lead to anxiety, disinterest, and persistent misconceptions that hinder students' future engagement with science [7].

Despite the recognized importance of meaningful learning experiences, elementary science instruction in many contexts continues to face persistent challenges. Instructional practices often prioritize curriculum coverage and assessment performance over student engagement and interaction. Learning activities frequently rely on teacher explanations, textbook-based exercises, and individual tasks, offering limited opportunities for dialogue, collaboration, and inquiry-based exploration [8]. Such approaches may constrain students' agency and reduce learning to a passive process, resulting in experiences that are perceived as abstract, disconnected, and irrelevant to students' everyday lives [9].

These challenges are not unique to global contexts but are also evident within Indonesian elementary education. Although national curriculum frameworks emphasize student-centered learning, scientific inquiry, and character education, practical implementation often encounters constraints related to instructional time, class size, teacher preparedness, and assessment demands. In many elementary schools, science learning remains dominated by conventional pedagogical approaches that position students as recipients rather than active constructors of knowledge. As a result, students' learning experiences may not adequately support the development of scientific understanding, collaborative skills, and positive learning attitudes that are central to holistic education.

Within the Indonesian educational context, science learning is expected to contribute not only to cognitive achievement but also to the formation of students' social and moral character. The national education system emphasizes values such as cooperation, responsibility, respect, and mutual support as integral components of learning. These values align closely with the social nature of scientific inquiry, which requires communication, collaboration, and shared problem-solving. However, when instructional practices limit opportunities for interaction and collective meaning-making, students may struggle to develop both meaningful learning experiences and positive social attitudes within science learning environments.

Science learning experience can be conceptualized as a multidimensional construct encompassing cognitive, affective, and social dimensions of learning [10]. It reflects how students perceive and interpret learning activities, how they engage emotionally and intellectually with tasks, and how they interact with peers and teachers throughout the learning process. Positive science learning experiences are characterized by curiosity, active participation, meaningful interaction, and perceived relevance between scientific concepts and real-world contexts. Empirical studies indicate that such experiences are associated with increased motivation, deeper conceptual understanding, and sustained interest in science learning [1], [11].

Conversely, learning environments that restrict student agency, minimize interaction, or emphasize performance over understanding may hinder the development of positive learning experiences. Students in such environments may exhibit low engagement, surface-level understanding, and limited willingness to participate in collaborative activities. Over time, these experiences can negatively affect students' attitudes toward science and reduce the effectiveness of instruction [4], [10]. Therefore, understanding how instructional models shape students' science learning experiences is essential for improving educational quality at the elementary level.

A theoretical framework that offers strong explanatory power for understanding learning as a socially mediated process is Vygotsky's sociocultural theory. Vygotsky conceptualized learning as a fundamentally social phenomenon that occurs through interaction with others and engagement with cultural tools, particularly language [12]. From this perspective, knowledge is not transmitted unilaterally from teacher to student but is constructed through dialogue, collaboration, and shared activity within a cultural context. Learning is thus inherently situated, shaped by interactions among learners, teachers, and the learning environment.

One of the central constructs within Vygotsky's theory is the Zone of Proximal Development (ZPD), defined as the distance between what learners can accomplish independently and what they can achieve with appropriate guidance and support [12]. The ZPD highlights the critical role of instructional mediation

in facilitating learning, particularly when students encounter tasks that exceed their current level of competence. This concept is especially relevant in elementary science learning, where students are often introduced to abstract concepts that require guided exploration, explanation, and reflection.

Derived from the concept of the ZPD, scaffolding refers to the provision of temporary, adaptive support that enables students to engage successfully in learning tasks that would otherwise be beyond their reach. Scaffolding can take various forms, including guiding questions, prompts, modeling, feedback, and structured learning activities [13]. As students develop competence and confidence, instructional support is gradually withdrawn, allowing learners to assume increasing responsibility for their own learning. Research suggests that effective scaffolding can enhance engagement, reduce cognitive load, and promote deeper understanding when aligned with students' learning needs [14].

In elementary school settings, such as public schools in Indonesia, scaffolding is particularly important due to the diversity of students' abilities, prior knowledge, and readiness levels. Instructional support that is responsive to students' needs can help ensure that all learners are able to participate meaningfully in science learning activities. By guiding students through complex tasks while gradually fostering independence, scaffolding contributes to more positive and inclusive learning experiences.

Beyond individual instructional support, learning experiences are also shaped by the broader pedagogical model in which instruction is embedded. The social reconstruction model offers an instructional framework that emphasizes learning as a collaborative, socially situated, and contextually meaningful process. This model encourages students to engage in dialogue, group discussion, and problem-solving activities grounded in real-life issues and shared experiences [15]. Learning is viewed as a process of reconstructing understanding through interaction, reflection, and collective inquiry rather than the passive reception of information.

In science education, the social reconstruction model enables students to collaboratively explore scientific phenomena, articulate ideas, challenge assumptions, and negotiate meaning through interaction with peers and teachers. Such environments support the development of higher-order thinking, communication skills, and social responsibility, aligning closely with the goals of contemporary science education [16]. When combined with scaffolding strategies, social reconstruction-based instruction can provide structured yet flexible learning environments that support both cognitive development and social interaction.

Empirical studies indicate that collaborative learning environments can enhance student engagement and learning quality when effectively designed and supported [17], [18]. However, the success of such environments is not determined solely by instructional design; it is also influenced by students' social attitudes. Social attitudes refer to students' dispositions toward interaction, cooperation, responsibility, and participation in social learning activities. These attitudes shape how students engage with peers, respond to instructional support, and participate in collaborative tasks [19].

Positive social attitudes can facilitate productive interaction, strengthen peer support, and enhance the effectiveness of scaffolding and collaborative learning. In contrast, negative social attitudes—such as reluctance to participate, low responsibility, or limited cooperation—may hinder group processes and reduce the quality of learning experiences. In elementary school contexts, where students are still developing social competencies, social attitudes play a critical role in determining whether collaborative instructional models function effectively.

This emphasis on participation in collaborative activity is also consistent with situated learning, in which learning develops through engagement in socially organized practice [20].

Although sociocultural approaches and collaborative learning models have been widely discussed in science education research, empirical studies that explicitly examine students' science learning experiences through a Vygotskian social reconstruction model with scaffolding remain limited. Moreover, research that considers social attitudes as a key factor influencing learning experiences is still scarce, particularly in Indonesian elementary school contexts and specific school settings such as SDN 4 Sudaji. Existing studies have predominantly focused on cognitive outcomes, with less attention given to students' subjective learning experiences and social dispositions [10], [1].

METHODS

Research Design

This study employed a quasi experimental research design using a posttest only control group design, with social attitudes treated as a covariate. This design was selected to rigorously examine the causal effect of a Vygotskian social reconstruction learning model integrated with scaffolding strategies on students' science learning experiences, while statistically controlling for pre-existing differences in students' social

attitudes. The use of a quasi-experimental approach is widely recognized as appropriate in educational research contexts where random assignment of participants to experimental and control groups is not feasible due to administrative constraints, ethical considerations, or intact classroom settings [21], [22]. In school based research, particularly at the elementary level, researchers are often required to work with naturally formed classes. Random reassignment of students to different instructional conditions may disrupt learning continuity and conflict with school policies. Under such conditions, quasi-experimental designs provide a robust alternative for investigating instructional effectiveness while maintaining ecological validity [23]. The posttest-only control group design was deemed suitable for this study because it minimizes potential testing effects that may arise from repeated measurements and reduces the influence of students' prior exposure to similar assessment instruments [21].

The independent variable in this study was the Vygotskian social reconstruction learning model with scaffolding, which emphasizes collaborative learning, social interaction, guided inquiry, and gradual release of instructional support based on students' developmental readiness. This instructional model was implemented in the experimental group through structured collaborative activities, teacher guided discussions, and scaffolded learning tasks aligned with the principles of the Zone of Proximal Development (ZPD). In contrast, the control group received conventional science instruction that predominantly relied on teacher explanations, textbook-based activities, and individual assignments, reflecting typical instructional practices commonly found in elementary school science classrooms.

The dependent variable was students' science learning experience, conceptualized as a multidimensional construct encompassing cognitive engagement, emotional involvement, and social interaction during science learning activities. This construct reflects students' perceptions of the learning process, their level of participation and interest, and the quality of their interactions with peers and teachers. Learning experience has been increasingly recognized as a critical indicator of instructional effectiveness, as it captures students' subjective engagement beyond traditional achievement measures [24], [25].

In addition to the independent and dependent variables, social attitudes were incorporated as a covariate in the research design. Social attitudes refer to students' dispositions toward cooperation, responsibility, participation, and interaction within learning environments. These attitudes are particularly relevant in collaborative and socially oriented instructional models, as they may significantly influence how students engage with peers, respond to scaffolding, and participate in shared learning activities [26]. Prior research suggests that students with more positive social attitudes tend to demonstrate higher levels of engagement, effective communication, and constructive collaboration, which in turn may enhance their learning experiences [27].

The inclusion of social attitudes as a covariate was intended to statistically control for individual differences that could confound the relationship between the instructional model and students' learning experiences. By adjusting for variations in social attitudes, the analysis was able to provide a more accurate estimation of the instructional model's effect on science learning experiences, independent of students' predispositions toward social interaction [28]. The use of covariates in quasi-experimental educational research is a well-established strategy for improving internal validity and reducing bias when random assignment is not possible [22], [29].

Analytically, controlling for social attitudes allows the study to disentangle whether observed differences in learning experiences are attributable primarily to the instructional intervention or to students' existing social characteristics. This approach is particularly important in studies involving collaborative learning environments, where social dynamics play a central role in shaping learning processes and outcomes. Without such controls, the effectiveness of socially oriented instructional models may be overestimated or underestimated due to unaccounted individual differences among learners [27].

Overall, the selected research design aligns with the theoretical framework underpinning this study, which conceptualizes learning as a socially mediated process influenced by both instructional structures and learners' social dispositions. By integrating a quasi-experimental posttest-only control group design with the use of a social attitude covariate, this study sought to balance methodological rigor with practical feasibility, thereby producing findings that are both empirically sound and contextually relevant for elementary science education settings such as SDN 4 Sudaji.

Research Setting

The research was conducted at SDN 4 Sudaji**,** an Indonesian public elementary school located in Buleleng Regency, Bali. The school implements the national curriculum and serves students with diverse academic abilities and social backgrounds. Science learning at SDN 4 Sudaji is integrated into thematic instruction and emphasizes both cognitive development and character education, including collaboration, responsibility, and social interaction. This context made SDN 4 Sudaji a relevant setting for examining the effectiveness of a socially oriented instructional model grounded in Vygotskian theory. The population of

this study consisted of all fifth grade students at SDN 4 Sudaji during the academic year in which the research was conducted. The sample was selected using intact group sampling**,** as the existing class structure could not be reorganized. Two fifth-grade classes were involved, with one class assigned as the experimental group and the other as the control group. The experimental group received science instruction using the Vygotskian social reconstruction model with scaffolding, while the control group was taught using conventional instructional practices commonly applied at the school, including teacher explanation and individual exercises. The total number of participants was 42 students**,** with comparable distributions of age and gender across groups. Prior to data collection, all participants were informed about the purpose of the study, and ethical considerations related to confidentiality and voluntary participation were observed.The participants of this study were fifth-grade students enrolled at SDN 4 Sudaji**,** an Indonesian public elementary school located in Buleleng Regency. The selection of participants was based on intact classroom sampling, a common practice in quasi experimental educational research where random assignment at the individual level is not feasible due to administrative and ethical constraints [30]. A total of 42 students participated in the study, comprising 21 students in the experimental group and 21 students in the control group.

The experimental group was taught using the Vygotskian social reconstruction learning model integrated with scaffolding**,** while the control group received conventional science instruction. Both groups followed the same curriculum content, learning objectives, and instructional time allocation, ensuring that differences in learning experiences could be attributed primarily to the instructional model rather than content exposure. Prior to the intervention, both groups were identified as having comparable academic backgrounds based on school records and teacher assessments, which supports group equivalence in quasi-experimental designs [21], [31]. The participants were at a developmental stage characterized by emerging cognitive, social, and emotional competencies. At this age level, students are increasingly capable of engaging in collaborative learning, guided inquiry, and reflective discussion when provided with appropriate instructional support [32]. This developmental readiness made the participants particularly suitable for examining the effectiveness of a socially oriented instructional model grounded in Vygotskian theory. Ethical considerations were carefully addressed throughout the research process. Permission to conduct the study was obtained from the school principal and classroom teachers. Informed consent was secured from students' parents or guardians, and participants were assured that their involvement was voluntary and that all data would be treated confidentially. These procedures align with ethical standards for educational research involving human participants [33].

Instruments

Students' science learning experiences were measured using a science learning experience questionnaire designed to capture students' cognitive engagement, emotional involvement, and social interaction during science learning activities. The instrument was adapted from established learning environment and student perception frameworks that emphasize the multidimensional nature of learning experiences [10], [24]. The questionnaire consisted of Likert-scale items ranging from strongly disagree to strongly agree, enabling students to express their perceptions of the learning process. The cognitive dimension assessed students' perceived understanding, curiosity, and engagement with scientific concepts. The affective dimension measured students' interest, enjoyment, and motivation during science learning, while the social dimension focused on interaction, collaboration, and communication with peers and teachers. Such multidimensional measurement is recommended in learning experience research, as it provides a more comprehensive representation of students' engagement than achievement scores alone [25], [34]. Content validity of the instrument was established through expert judgment**,** involving university lecturers in science education and experienced elementary school teachers. Construct validity was examined through item–total correlation analysis, and reliability was assessed using Cronbach's alpha coefficient**,** with values exceeding the minimum acceptable threshold of 0.70, indicating satisfactory internal consistency [35].

Students' social attitudes were measured using a social attitude questionnaire focusing on cooperation, responsibility, participation, and respect in learning activities. This instrument was developed based on social learning and cooperative learning theories, which emphasize the role of social dispositions in shaping learning processes and outcomes [19], [26]. The questionnaire employed a Likert scale format suitable for elementary school students and was administered prior to the instructional intervention. The social attitude instrument was treated as a covariate measure**,** as these attitudes were assumed to influence students' engagement in collaborative learning environments. Previous studies have demonstrated that social attitudes are significant predictors of participation, communication quality, and responsiveness to instructional support in group-based learning contexts [27], [36]. Reliability testing yielded acceptable Cronbach's alpha values, indicating consistency in measuring students' social dispositions.

Data Analysis

Data analysis in this study was conducted using Analysis of Covariance (ANCOVA) to examine the effect of the instructional model on students' science learning experiences while statistically controlling for social attitudes. ANCOVA is particularly appropriate in quasi-experimental designs where random assignment is not possible and where one or more covariates are expected to influence the dependent variable [37], [38]. In this study, the instructional model (Vygotskian social reconstruction with scaffolding vs. conventional instruction) served as the independent variable, science learning experience as the dependent variable, and social attitude as the covariate. By adjusting posttest scores based on students' social attitudes, ANCOVA enabled a more accurate estimation of the instructional effect, reducing error variance and increasing statistical power [39].

Prior to conducting ANCOVA, several statistical assumptions were tested, including normality of residuals, homogeneity of variances, linearity between the covariate and dependent variable, and homogeneity of regression slopes**.** Meeting these assumptions is essential to ensure the validity of ANCOVA results [37]. The results indicated that all assumptions were adequately satisfied, allowing the analysis to proceed. The ANCOVA results were interpreted based on adjusted mean scores**,** F-values**,** and significance levels (p-values)**.** In addition to statistical significance, effect size measures were calculated to assess the practical significance of the instructional intervention. Reporting effect sizes is recommended in educational research to provide a clearer understanding of the magnitude of treatment effects beyond p-values alone [40]. The use of ANCOVA aligns with the theoretical framework of this study, which recognizes that learning outcomes and experiences are shaped by both instructional conditions and learner characteristics. By controlling for social attitudes, the analysis more accurately reflects the contribution of the Vygotskian social reconstruction model with scaffolding to students' science learning experiences. This analytical approach strengthens the internal validity of the study and enhances the interpretability of the findings for instructional practice and future research.

RESULTS AND DISCUSSION

Result-1 (The influence of Vygotsky's Social Reconstruction Model with Scaffolding Techniques on the Social Studies Learning Experience)

The results of the hypothesis testing on students' science learning experience indicate a statistically significant effect of the Vygotskian Social Reconstruction Model integrated with scaffolding techniques. The analysis was conducted using inferential statistical procedures in accordance with the research design described in the Methods section. Based on the analysis of variance (ANOVA), the obtained F value was 9,399, which exceeded the critical F value of 4.00 at the 0.05 significance level. In addition, the probability value (Sig. = 0.000) was lower than the predetermined alpha level ($\alpha = 0.05$). These findings demonstrate sufficient statistical evidence to reject the null hypothesis (H_0) and accept the alternative hypothesis (H_1), which posits that the implementation of the Vygotskian Social Reconstruction Model with scaffolding techniques significantly influences the science learning experience of fifth-grade students at SDN 4 Sudaji. A summary of the results of the analysis using ANACOVA is presented in Table 1.

Table 1. ANCOVA Test Result

Source	Type III Sum of Squares	df	Mean Square	F	Sig
Corrected Model	2477,229	2	1238,615	9,399	<0,000
Intercep	10730,393	41	135,828		<0,000
Corrected Total	13207,622	43			<0,000

This result suggests that learning activities designed around social interaction, collaborative problem-solving, and structured instructional support contribute positively to students' engagement, understanding, and overall learning experience in science. The scaffolding strategies embedded within the social reconstruction framework enabled students to gradually construct scientific concepts through guided participation, peer interaction, and meaningful contextualization of learning tasks. Furthermore, considering that students' social attitudes may function as a confounding variable influencing learning experience, a more advanced statistical analysis was conducted to control for this covariate. An Analysis of Covariance was employed to examine the effect of the instructional model on students' science learning experience after statistically controlling for social attitudes. This approach aligns with the quasi experimental design adopted in the study and allows for a more accurate estimation of the treatment effect by reducing error variance associated with individual differences in social attitudes.

The ANCOVA was performed using SPSS version 17.0 for Windows, with science learning experience as the dependent variable, instructional model as the independent variable, and social attitudes as the covariate. The decision criterion applied in this analysis stipulated that a significance value (p-value) less than 0.05 would indicate a statistically significant effect, thereby leading to the rejection of the null hypothesis. The results of the ANCOVA analysis, as summarized in Table 1, reveal that the Vygotskian

Social Reconstruction Model with scaffolding techniques remained statistically significant in influencing students' science learning experience even after controlling for social attitudes.

These findings indicate that the observed differences in students' science learning experience are not solely attributable to variations in social attitudes, but rather reflect the substantive contribution of the instructional model itself. In other words, the positive impact of the Vygotskian approach with scaffolding persists independently of students' initial social attitude levels. This reinforces the robustness of the instructional model in enhancing students' science learning experience through socially mediated learning processes.

Overall, the results provide empirical support for the effectiveness of the Vygotskian Social Reconstruction Model with scaffolding in improving students' science learning experience at the elementary school level. The integration of social interaction, collaborative learning, and systematic scaffolding appears to create a supportive learning environment that fosters active participation, conceptual understanding, and positive learning experiences in science education. These findings are consistent with the theoretical underpinnings of Vygotsky's sociocultural theory, which emphasizes the central role of social interaction and guided assistance in cognitive development.

Result-2 (The influence of Vygotsky's social reconstruction model with scaffolding techniques on the social studies learning experience)

To further determine the effect of the Vygotskian social reconstruction model with scaffolding techniques on fifth-grade students' science learning experience at SDN 4 Sudaji after controlling for social attitudes as a covariate, an ANCOVA was performed using SPSS version 17.0 for Windows. The hypothesis testing criterion applied in this analysis stated that the null hypothesis (H_0) would be rejected and the alternative hypothesis (H_1) accepted if the obtained significance value was less than 0.05. A summary of the ANCOVA results is presented in Table 2.

Table 2. ANCOVA Test Result

Source	Type III Sum of Squares	df	Mean Square	F	Sig
Corrected Model	6198,958	2	2066,319	22,996	<0,000
Group	2189,232	1	1094,616	12,182	<0,000
Corrected Total	13207,622	43			<0,000

The results shown in Table 2 indicate a statistically significant effect of the Vygotskian social reconstruction model with scaffolding techniques on students' science learning experience after controlling for social attitudes. The ANCOVA analysis demonstrates that the obtained F value (F = 12,182) with a significance level well below the threshold of 0,05.This finding confirms the rejection of the null hypothesis (H_0) and supports the alternative hypothesis (H_1), suggesting that the instructional model contributes meaningfully to enhancing students' science learning experience independent of their initial social attitude levels.

More importantly, the persistence of the model's effect after statistically controlling for social attitudes indicates that the improvement in students' learning experience cannot be explained solely by individual differences in social disposition. Rather, it reflects the instructional strength of the Vygotskian social reconstruction model, particularly its emphasis on guided social interaction and systematic scaffolding. This result implies that structured instructional support embedded within collaborative learning environments plays a decisive role in shaping how students engage with and experience science learning.

These findings provide a critical foundation for further discussion on how sociocultural learning principles, as proposed by Vygotsky, operate in elementary science classrooms. Specifically, they invite deeper examination of the mechanisms through which social interaction, scaffolding, and learners' social attitudes interact to influence students' science learning experience. In the following section, these results are discussed in relation to Vygotsky's sociocultural theory and relevant empirical studies to elucidate the pedagogical implications of the instructional model.

Result-3 Contribution of Social Attitude Covariates to Social Studies Learning Experiences

The results of the Product Moment correlation analysis indicate that social attitudes contribute significantly to students' science learning experience, as evidenced by the squared correlation coefficient (r^2), which represents the proportion of variance in learning experience explained by social attitudes. This significant relationship confirms that social attitudes function as a relevant covariate influencing students' learning experience in science. Accordingly, the null hypothesis (H_0) was rejected at the 5% significance level, indicating that social attitudes cannot be ignored as a background variable in the analysis of instructional effects.

Given the significant contribution of social attitudes to students' science learning experience, it was methodologically appropriate to control for this variable in order to obtain a more accurate estimation of the effect of the instructional model. Therefore, an ANCOVA was subsequently employed, with social attitudes treated as a covariate. The inclusion of this covariate allowed the analysis to statistically adjust for individual differences in students' social attitudes, thereby reducing potential bias and isolating the true effect of the Vygotskian social reconstruction model with scaffolding techniques on students' science learning experience.

By integrating correlational analysis and ANCOVA in a sequential manner, this study ensures methodological rigor in examining both the independent contribution of social attitudes and the instructional effect of the learning model. This analytical approach strengthens the internal validity of the findings and provides a clearer interpretation of how socially mediated instructional strategies influence students' science learning experience beyond the influence of individual social dispositions

Table 3 Results of Analysis of the Contribution of Social Attitudes to Students' Learning Experiences

Model	R	R Squared	R Squared Alignment
1	0,755	0,5700	0,385

The results of the analysis indicate that social attitudes play a meaningful role in shaping students' science learning experience. The significant contribution identified through the correlation analysis suggests that students who exhibit positive social attitudes such as cooperation, mutual respect, responsibility, and active participation tend to experience science learning as more engaging and meaningful. These attitudes support effective interaction during collaborative learning activities, which are central to socially mediated instructional approaches. Furthermore, the findings demonstrate that social attitudes are not merely peripheral factors but constitute an important explanatory variable influencing how students engage with science learning processes. Students with well-developed social attitudes are more likely to participate actively in group discussions, respond constructively to peer feedback, and benefit from guided instructional support. As a result, their overall learning experience is enhanced in both cognitive and affective dimensions.

The decision to include social attitudes as a covariate in the subsequent ANCOVA analysis is therefore empirically justified. By statistically controlling for social attitudes, the study ensures that differences in students' science learning experience can be more accurately attributed to the instructional model rather than to individual variations in social disposition. This analytical approach strengthens the validity of the findings by isolating the effect of the Vygotskian social reconstruction model with scaffolding techniques. Overall, the results suggest that while social attitudes contribute significantly to students' science learning experience, the instructional design grounded in sociocultural principles remains a dominant factor in enhancing learning quality. The interaction between structured scaffolding and students' social attitudes creates a learning environment that supports meaningful engagement and facilitates the construction of scientific understanding.

Discussion

This study makes a substantive theoretical contribution to Vygotskian sociocultural theory by extending its application beyond cognitive achievement toward a more holistic understanding of students' science learning experience as a socioculturally mediated outcome. Classical interpretations of Vygotsky's theory emphasize that cognitive development emerges through social interaction and mediation within culturally organized activities, particularly through guidance provided in the Zone of Proximal Development (ZPD) [12]. However, much empirical research grounded in this framework has focused predominantly on learning outcomes such as conceptual understanding or academic performance. The present study advances Vygotskian theory by empirically demonstrating that sociocultural mediation, when operationalized through a social reconstruction model with systematic scaffolding, also reshapes how learners experience the learning process itself, cognitively, emotionally, and socially.

By foregrounding learning experience as a central theoretical construct, this study reconceptualizes sociocultural learning as a lived and experiential process rather than merely an outcome of instructional effectiveness. The findings suggest that social interaction and mediation do not only support the internalization of scientific concepts, but also influence students' sense of engagement, agency, and participation in science learning activities. This perspective aligns with contemporary sociocultural interpretations that view learning as meaning-making situated in social practice, where learners' experiences are shaped by interaction, discourse, and shared activity [41], [42]. In this sense, the study extends Vygotsky's theoretical legacy by positioning learning experience as an integral dimension of sociocultural development.

A significant theoretical contribution of this study lies in its expanded interpretation of the Zone of Proximal Development. Traditionally, the ZPD is understood as the distance between what learners can

achieve independently and what they can achieve with assistance [12]. The present findings suggest that the ZPD should also be conceptualized as an experiential space in which learners develop not only cognitive competence but also confidence, motivation, and positive orientations toward learning. Through structured scaffolding embedded in collaborative inquiry, instructional support in this study transformed the ZPD into a space where students actively negotiated meaning, participated in shared problem-solving, and developed a more positive engagement with science learning. This reconceptualization strengthens the explanatory power of Vygotskian theory by integrating affective and social dimensions into the core notion of developmental assistance.

Furthermore, this study contributes to sociocultural theory by clarifying the theoretical role of scaffolding as an active mediational mechanism rather than a purely technical instructional strategy. In the context of the social reconstruction model, scaffolding functioned as intentional mediation that structured interaction, regulated cognitive demand, and guided participation in scientific inquiry. The persistence of the instructional model's effect after controlling for social attitudes indicates that scaffolding actively constructs developmental opportunities rather than merely responding to learners' existing dispositions. This finding refines Vygotskian theory by emphasizing that the ZPD is not solely an inherent attribute of the learner, but a pedagogically designed space shaped by instructional decisions, cultural tools, and patterns of social interaction [43], [44].

The integration of social attitudes as a covariate further enriches the theoretical contribution of this study. While sociocultural theory acknowledges the fundamentally social nature of learning, learners' dispositions toward cooperation, responsibility, and interaction are often implicitly assumed rather than empirically examined. The results of this study demonstrate that social attitudes contribute to students' science learning experience, yet do not fully determine it. The continued significance of the instructional model after controlling for these attitudes supports a dialectical interpretation of sociocultural theory, in which individual dispositions and social structures interact dynamically. Well-designed scaffolding and structured collaboration can compensate for differences in social readiness, reinforcing the sociocultural claim that learning is co-constructed rather than predetermined by individual traits alone [45], [46].

Finally, this study strengthens the theoretical relevance of Vygotskian sociocultural theory in the context of elementary science education. Science learning at the elementary level often involves abstract concepts and diverse learner readiness, making it a critical context for examining sociocultural mediation. The findings demonstrate that when Vygotskian principles are systematically operationalized through social reconstruction and scaffolding, they produce meaningful improvements in students' learning experiences. By emphasizing experience alongside cognition, this study positions Vygotskian theory not only as a framework for understanding how learning occurs, but also as a powerful guide for designing inclusive, engaging, and developmentally responsive science learning environments. In doing so, the study contributes to the ongoing theoretical evolution of sociocultural theory by aligning it with contemporary educational priorities that emphasize holistic development, learner engagement, and meaningful participation in learning.

This study advances Vygotskian sociocultural theory by offering a novel theoretical positioning of *science learning experience* as a primary outcome of sociocultural mediation, rather than as a secondary or peripheral consequence of cognitive achievement. While Vygotsky's theory has been extensively employed to explain conceptual development, problem solving, and academic performance through social interaction and mediation [12], empirical studies have rarely foregrounded learning experience itself as a theoretically meaningful construct within the sociocultural framework. The present study addresses this theoretical gap by demonstrating that socially mediated instruction, when systematically operationalized through a social reconstruction model with scaffolding, fundamentally reshapes how learners experience science learning cognitively, emotionally, and socially. This repositioning constitutes a clear theoretical novelty by expanding the scope of Vygotskian theory from *what learners achieve* to *how learning is lived and experienced*.

A second major theoretical contribution lies in the reconceptualization of the Zone of Proximal Development (ZPD). Classical interpretations of the ZPD emphasize the role of guidance in enabling learners to perform tasks beyond their independent capability [12]. This study extends the ZPD construct by empirically showing that instructional support within the ZPD also transforms learners' engagement, agency, and emotional orientation toward learning. In this sense, the ZPD is theorized not merely as a cognitive distance but as an experiential and relational space co-constructed through interaction, dialogue, and scaffolded participation. This expanded interpretation responds to recent calls in sociocultural research to move beyond static or task-oriented views of the ZPD and to conceptualize development as a dynamic process involving changes in participation and learner identity [47], [48]. The study thus contributes a theoretically refined understanding of the ZPD that integrates cognitive, affective, and social dimensions of development.

The study further contributes novelty by theoretically elevating scaffolding from a predominantly methodological or instructional technique to a central mediational mechanism within Vygotskian theory. While prior research has acknowledged scaffolding as a practical application of the ZPD, it has often been treated as a set of instructional moves rather than as a theoretically generative construct. The present findings demonstrate that scaffolding functions as an intentional design of mediation that actively constructs developmental opportunities by regulating interaction, structuring participation, and aligning cognitive demand with learners' evolving capacities. Importantly, the persistence of the instructional model's effect after controlling for social attitudes provides empirical evidence that scaffolding does not merely amplify existing learner dispositions but actively reorganizes the social conditions of learning. This advances Vygotskian theory by emphasizing the pedagogical construction of the ZPD as a product of instructional design rather than a fixed learner attribute [43], [44].

Another distinctive theoretical contribution of this study is the explicit integration of *social attitudes* into the sociocultural explanatory framework. Although sociocultural theory assumes the social nature of learning, learners' social dispositions are rarely operationalized as analytical variables in empirical research. By treating social attitudes as a covariate, this study clarifies their theoretical role as contextual conditions that shape—but do not determine—sociocultural learning processes. The finding that the instructional model remains significant after statistically controlling for social attitudes offers a theoretically important insight: sociocultural mediation through structured scaffolding can compensate for variability in learners' social readiness. This supports a dialectical interpretation of Vygotskian theory, in which development emerges from the dynamic interaction between individual dispositions and socially designed learning environments [45], [46]. Such an interpretation strengthens the theory's explanatory robustness and inclusivity.

From a broader theoretical perspective, this study contributes to the modernization of Vygotskian sociocultural theory in the context of contemporary science education. Elementary science learning increasingly emphasizes inquiry, collaboration, and learner agency, yet theoretical models often lag behind these pedagogical shifts. By empirically demonstrating how a Vygotskian social reconstruction model enhances science learning experience through mediated interaction and adaptive support, this study positions sociocultural theory as a design-oriented framework capable of guiding the creation of meaningful and inclusive learning environments. The novelty lies not only in applying Vygotskian theory to science education, but in refining the theory itself to account for experiential, relational, and affective dimensions of learning that are central to 21st-century educational goals.

In sum, the theoretical novelty of this study resides in its integrative and generative use of Vygotskian sociocultural theory. By (1) elevating learning experience as a core theoretical outcome, (2) expanding the conceptualization of the ZPD as an experiential space, (3) repositioning scaffolding as a central mediational construct, and (4) empirically clarifying the role of social attitudes within sociocultural learning processes, the study extends Vygotskian theory beyond traditional outcome focused interpretations. These contributions not only reinforce the enduring relevance of Vygotsky's ideas but also advance their theoretical utility for understanding and designing science learning in contemporary educational contexts.

Taken together, the findings of this study provide strong theoretical reinforcement for Vygotskian sociocultural theory as a coherent and empirically robust framework for elementary science education. The significant influence of the Vygotskian social reconstruction model with scaffolding on students' science learning experience affirms Vygotsky's central proposition that learning is fundamentally a socially mediated process shaped by interaction, language, and cultural tools [12]. This reinforcement is particularly salient in elementary education contexts, where learners' cognitive, emotional, and social development are deeply intertwined and highly responsive to the quality of guided participation provided within instructional environments [47].

The convergence between theoretical expectations and empirical outcomes further strengthens the discussion. Core constructs of sociocultural theory such as mediation, guided participation, and the Zone of Proximal Development (ZPD) were not only conceptually referenced but also systematically operationalized through structured scaffolding and collaborative inquiry. This alignment supports arguments that sociocultural theory possesses strong explanatory and generative power when translated into intentional pedagogical designs [41], [43]. By demonstrating that scaffolded social interaction enhances students' learning experiences, the study reinforces the view that the ZPD is a pedagogically constructed space shaped by instructional decisions rather than a static learner attribute [44]. The findings of this study provide compelling evidence that students' social attitudes play a critical role in shaping their science learning experiences at SDN 4 Sudaji. Social attitudes manifested through cooperation, respect for peers, willingness to communicate, and responsibility during group activitiesfunctioned as an important covariate influencing how students engaged with the Vygotskian social reconstruction learning model. This

reinforces the sociocultural assumption that learning experiences are not solely cognitive phenomena, but are deeply embedded within social dispositions and interpersonal dynamics [12], [41].

The significant contribution of social attitudes aligns with Vygotsky's proposition that cognitive development emerges through socially mediated activity, where learners' readiness to participate meaningfully in interaction determines the quality of internalization processes [12]. Students with positive social attitudes demonstrated higher levels of engagement, openness to peer feedback, and sustained participation in scaffolded inquiry activities. These behaviors enriched their learning experiences by enabling more frequent and meaningful exchanges within the Zone of Proximal Development (ZPD), thereby enhancing both conceptual understanding and affective involvement in science learning [44], [47].

In the context of elementary science education, social attitudes are particularly influential due to the developmental characteristics of young learners. At this stage, students are still forming social identities and learning norms for collaboration. Positive social attitudes facilitate shared problem-solving, peer explanation, and collective meaning-making—processes that are essential for experiential science learning [49]. Prior research confirms that students who exhibit cooperative and prosocial attitudes tend to experience learning as more meaningful, enjoyable, and relevant, especially in inquiry-based and collaborative instructional settings [50], [51]. The present findings empirically reinforce these assertions within a real classroom context at SDN 4 Sudaji.

Moreover, the use of social attitudes as a covariate in this study strengthens the theoretical interpretation of the results. By statistically controlling for variations in social attitudes, the analysis demonstrates that while instructional design is a primary driver of learning experience, students' social dispositions significantly shape how instructional affordances are perceived and utilized. This supports contemporary sociocultural perspectives which argue that pedagogical effectiveness is co constructed by instructional structures and learner characteristics, particularly social and affective traits [43], [45]. Thus, social attitudes do not merely act as background variables but actively mediate students' engagement with scaffolding and collaborative tasks.

Importantly, the findings from SDN 4 Sudaji highlight the contextual relevance of social attitudes in culturally grounded learning environments. In collectivist educational contexts, such as Indonesian elementary schools, social harmony, mutual support, and group responsibility are culturally valued and directly influence classroom interaction patterns [52]. The positive contribution of social attitudes observed in this study suggests that culturally responsive sociocultural pedagogy can amplify students' learning experiences by aligning instructional strategies with prevailing social norms and values [53].

Overall, this reinforced discussion underscores that students' science learning experiences are the product of an interaction between instructional mediation and social attitudes. While the Vygotskian social reconstruction model with scaffolding provides the structural conditions for learning, social attitudes determine the depth and quality of students' participation within those conditions. By empirically demonstrating the contribution of social attitudes to learning experience at SDN 4 Sudaji, this study extends sociocultural theory by highlighting the affective–social dimension as a critical mechanism through which mediated learning operates in elementary science classrooms [48], [54].

The discussion is also strengthened by empirical evidence regarding learner diversity. The persistence of the instructional model's effect after controlling for social attitudes indicates that sociocultural mediation can mitigate variability in learners' social readiness. This finding reinforces Vygotsky's assertion that developmental potential is socially constructed and expandable through interaction with more capable others and structured environments [12]. It aligns with contemporary sociocultural research suggesting that scaffolding functions as an equalizing mechanism that supports inclusive participation in learning activities, particularly in heterogeneous classrooms [45]. In elementary science education, where differences in social attitudes and engagement are common, this reinforces the theoretical resilience and inclusivity of Vygotskian theory [46].

Importantly, the strengthened discussion situates the findings within broader contemporary science education discourse. Current educational paradigms emphasize inquiry, collaboration, and learner agency as essential components of meaningful science learning. The present study reinforces Vygotskian sociocultural theory as theoretically congruent with these priorities by demonstrating that mediated social interaction and adaptive support enhance students' engagement, motivation, and experiential involvement in science learning [49], [54]. Rather than being an outdated framework, Vygotskian theory emerges as a modern, design-oriented theory capable of addressing the experiential and participatory dimensions of 21st-century science education [55].

Finally, this reinforcing discussion contributes to theoretical consolidation within science education research. Instead of introducing competing explanatory models, the study strengthens an established theoretical tradition by extending its explanatory scope and empirically validating its mechanisms in a

specific educational context. Such consolidation is valuable for cumulative knowledge building, as it reinforces sociocultural theory as a stable yet adaptable foundation for understanding learning across contexts [48], [42]. Overall, the strengthened argument confirms that meaningful science learning experiences are not incidental outcomes, but the result of intentional pedagogical mediation rooted in sociocultural principles. By empirically reinforcing the coherence, inclusivity, and contemporary relevance of Vygotskian theory, this study positions sociocultural pedagogy as both theoretically sound and pedagogically transformative for elementary science education.

CONCLUSION

This study concludes that the Vygotskian social reconstruction model integrated with scaffolding enhances fifth-grade students' science learning experiences in the study context. The instructional effect remained statistically significant after students' social attitudes were controlled, while social attitudes also made a substantial contribution to variation in learning experiences. These findings indicate that elementary science instruction can benefit from combining structured sociocultural interaction, adaptive instructional support, and attention to students' social dispositions. Within the limits of the posttest-only quasi-experimental design and the school context examined, the model offers a pedagogically relevant approach for strengthening the cognitive, affective, and social dimensions of science learning.

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