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Original Research Article

The role of classroom social environment in shaping high school students' physics motivation

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Abstract: Students' drive to engage with physics shapes how strongly students engage with the subject, persist through setbacks, and ultimately perform academically, yet little empirical work has examined how features of the classroom's social climate contribute to this motivation. This study examines how three social-climate factors feeling recognized, feeling accepted, and interacting with classmates relate to two outcomes central to physics learning, namely how interested and how confident senior high school students are in the subject. A cross-sectional survey gathered responses from 423 students drawn from 13 senior high schools in West Sulawesi, Indonesia, and the collected data were processed through partial least squares structural equation modeling (PLS-SEM). The analysis shows that both feeling accepted in class and interacting with peers positively and significantly shape students' interest and confidence in physics, whereas perceived recognition only strengthens self-efficacy without meaningfully affecting interest. The proposed model explained 48.2% of the varience in physics interest and 51.6% of the varience in physics self-efficacy, indicating a moderate degree of explanatory power. Overall, the findings highlight that a socially supportive classroom especially one where students experience a solid sense of belonging and substantive peer engagement plays a key role in fostering students' motivation to learn physics.

Keywords: Interest; Peer Interaction; Perceived Recognition; Self-Efficacy; Sense of Belonging

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INTRODUCTION

The extent to which students interact productively with course material is largely driven by their learning motivation, and this holds especially true in physics education. A substantial body of research points to physics as one of the subjects high school students find most demanding, a pattern documented in both international and Indonesian settings (Diana et al., 2021; Wei et al., 2025). When students view physics as abstract and hard to grasp, their motivation to learn often declines, which in turn dampens their engagement with the material (Cwik & Singh, 2021; Kwarikunda et al., 2020). Motivation, in this sense, shapes not just whether students interact with the material but also in how they cope with difficultie and whether they persist through difficulties. What sets physics apart from many other subjects is precisely this combination of abstraction and mathematical demand, which can provoke anxiety and a sense that the subject is inherently difficult (Li, 2021, 2022). Physics is also tied to a distinct "physics person" identity, so how teachers and classmates perceive a student can

meaningfully shape that student's confidence and interest in the subject (Li & Singh, 2023; Li et al., 2020).

Motivation researchers commonly treat self-efficacy and interest as the two central pillars influences how students engage, the choices they make, and the outcomes they achieve (Schweder & Raufelder, 2022; Tang et al., 2026). Self-efficacy denotes a person's confidence in their own ability to design and carry out the actions required to attain an objective (Waddington, 2023); within physics classrooms specifically, this shows up as students' confidence in grasping concepts, working through problems, and completing coursework (Wang et al., 2022). Interest, by contrast, reflects a state of sustained attention and positive engagement with a particular subject (Guo & Fryer, 2025), and it helps sustain students' effort when academic tasks become challenging.

Much of the motivation literature is grounded in expectancy-value theory (EVT), a framework asserting that students' choices, engagement, and persistence follow from how likely they expect to succeed and how much value they place on a task (Eccles & Wigfield, 2020; Wigfield & Eccles, 2000). Situated expectancy-value theory (SEVT) builds on this framework by proposing that motivation is not solely an individual trait but is continually shaped through interaction with the social and contextual conditions of the learning environment (Eccles & Wigfield, 2023). Under this framework, self-efficacy captures students' beliefs about their own competence in physics, while interest reflects the subjective value they assign to physics-related learning activities.

Despite a growing body of work on motivation across STEM subjects broadly, comparatively little research has connected the social climate of the classroom specifically to physics motivation among high school students. Much of the existing literature centers on individual-level psychological variables self-efficacy, attitudes toward science without fully accounting for how classroom social experiences shape the emergence of physics motivation (İnce, 2023; Lestari et al., 2023; Sökmen, 2021). What research does exist on classroom social environments and science motivation skews heavily toward developed-country settings (Aldridge & Rowntree, 2022; Cayubit, 2022; Tang et al., 2026), leaving developing-country contexts comparatively understudied. A handful of studies point to inclusive classrooms boosting students' motivation and confidence in science, though these tend to be descriptive or drawn from small experimental samples (Kurniawan & Kuswanto, 2025; Li, 2022). Other work links self-efficacy to learning outcomes (Fatonah & Wicaksana, 2023; Jansen et al., 2015), without fully unpacking how social variables peer interaction, recognition from others shape motivation to learn physics specifically.

Classroom social dynamics carry real weight in shaping how students experience learning. Sense of belonging refers to how accepted, recognized, and included students feel within their classroom community (Pei et al., 2024; Runa et al., 2025), and existing evidence links this construct to stronger academic engagement, motivation, and persistence (Gillen-O'Neel, 2021; Nurlina, 2026; Pedler et al., 2022; Yi et al., 2024). In turn, interacting with peers allows students to co-construct conceptual understanding via discussion and joint work (Michelsen & Groß, 2025). Perceived recognition captures something different: students' sense that meaningful others teachers, peers acknowledge their abilities (Li & Singh, 2023; Whitcomb et al., 2023), which can bolster confidence and deepen engagement with learning.

Even so, findings on how learning environments shape motivation remain mixed. One study found that classrooms emphasizing self-directed learning boosted both self-efficacy and interest among German secondary students (Schweder & Raufelder, 2022).

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While other work suggests that differing social experiences and instructional approaches can produce quite different motivational outcomes across student groups (Tang et al., 2026). This inconsistency suggests the link between classroom social environment and student motivation deserves closer, more systematic study.

Closing this gap matters because student motivation carries consequences for long-term academic achievement and shapes interest in pursuing STEM careers later on (Blotnicky et al., 2018; Julià & Antolí, 2019; Watt et al., 2019). A clearer picture of how social elements of the classroom feed into physics motivation would support more effective teaching strategies, stronger engagement, and less disengagement from science subjects generally.

In response to this gap, the current study constructs a model that treats three dimensions of classroom social climate recognition, belonging, and peer interaction as antecedents of students' self-efficacy and interest in physics. Rather than studying these social and motivational constructs separately, as much prior work has done, this study brings them together within a single SEVT-grounded framework, extending SEVT by empirically testing how several classroom social dimensions operate together to shape physics-specific motivation a question that remains underexamined, particularly within physics education research set in developing countries such as Indonesia. From a theoretical standpoint, this research contributes by showing that classroom social factors do not operate independently but combine to influence students' confidence and interest in physics. Practically, its findings carry implications for teachers and schools seeking to build more inclusive, collaborative physics classrooms that support the kinds of social interaction that strengthen learning motivation.

Having laid out this conceptual foundation, the following sections outline how each dimension of the classroom social environment peer interaction, sense of belonging, and perceived recognition is theoretically linked to physics interest and self-efficacy. Peer interaction stands out as a core feature of students' classroom experience (Tenenbaum et al., 2020). Through discussion, collaboration, and the exchange of ideas, students gain chances to deepen their conceptual grasp and jointly work out problem-solving approaches. Prior work has linked peer interaction to stronger learning engagement and greater confidence in completing academic work (Jin et al., 2022; Shao et al., 2024). Because physics is so often experienced as difficult, peer interaction may be particularly valuable here helping students untangle confusing concepts and build confidence in working through physics problems. Positive social interaction more broadly can also lift students' interest in classroom activities. Peer interaction is therefore expected to meaningfully shape both physics interest and self-efficacy.

Beyond peer interaction, students' classroom experience is also colored by how much they feel they belong to the learning community. Sense of belonging captures students' perception of being accepted, valued, and included within their classroom (Ahn & Davis, 2020; Bettencourt, 2021), and prior research links a firmer sense of belonging with higher academic engagement and motivation (Gillen-O'Neel, 2021; Pedler et al., 2022; Yi et al., 2024). Within science classrooms specifically, feeling part of the learning community can bolster students' confidence in joining discussions and tackling difficult scientific problems (Pei et al., 2024). Sense of belonging is therefore expected to strengthen students' enthusiasm for physics along with their self-efficacy.

A further social influence on academic motivation is perceived recognition students' sense that their abilities and effort are acknowledged by people who matter to them, such as teachers and peers. Being recognized in this way can strengthen a student's

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sense of competence and reinforce their confidence when facing academic challenges (Li et al., 2020; Li & Singh, 2023). Physics education research similarly finds that students who perceive their competence as recognized by others tend to show higher self-efficacy and deeper interest in science (Whitcomb et al., 2023). Perceived recognition may thus function as a form of social validation that both builds self-confidence and sparks greater interest in physics.

Building on SEVT's assumption that confidence and interest develop under social and contextual influence, the proposed model posits direct paths from recognition, belonging, and peer interaction toward students' interest and self-efficacy. Building on this theoretical foundation, the present research tests the direct influence of these three classroom social-environment dimensions on the two motivational outcomes in high school students, seeking to pinpoint which social factors most strongly drive physics learning motivation and to provide evidence for building more inclusive and collaborative physics classrooms. Accordingly, the following hypotheses were tested:

H1: Perceived recognition positively affects students' interest in learning physics.
H2: Perceived recognition positively affects students' self-efficacy in learning physics.
H3: Sense of belonging positively affects students' interest in learning physics.
H4: Sense of belonging positively affects students' self-efficacy in learning physics.
H5: Peer interaction positively affects students' interest in learning physics.
H6: Peer interaction positively affects students' self-efficacy in learning physics.

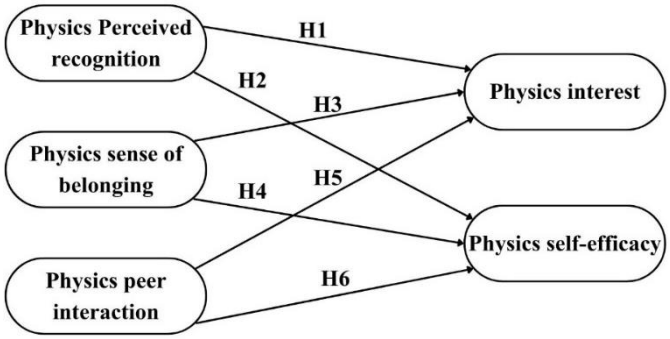


Figure 1. Conceptual framework and hypothesis

METHODS

Research Design

This research applied a quantitative survey with a cross-sectional design to examine the proposed relationships among the study's constructs. PLS-SEM was adopted as the main analytical technique because it is well suited to handling intricate models involving several latent variables simultaneously and remains robust even when data deviate from normal distribution or sample sizes are moderate (Hair Jr et al., 2021). The combination of a cross-sectional design and PLS-SEM allowed the researcher to examine, in one data-collection round, whether the three classroom social variables recognition, belonging, and peer interaction were associated with students' interest in and self-efficacy toward physics. Figure 2 outlines the overall research process: defining the population and sample, selecting a sampling technique, collecting data, running the PLS-SEM analysis, and testing the hypotheses.

Participants

Data collection took place during the second semester of the 2025/2026 academic year, involving several public and private senior high schools in West Sulawesi Province,

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Indonesia, and targeted Grade X, XI, and XII students enrolled in physics classes. The study used convenience sampling (Fraenkel et al., 2019), applying two criteria: students needed to be currently taking physics and to have studied it for at least one semester, and participating schools were selected based on researcher access and administrative approval. Thirteen senior high schools participated in the study, comprising 12 public schools and 1 private school, and yielding a total of 423 student respondents. This sample size satisfies the commonly cited minimum for PLS-SEM models involving multiple predictor constructs and two endogenous constructs.

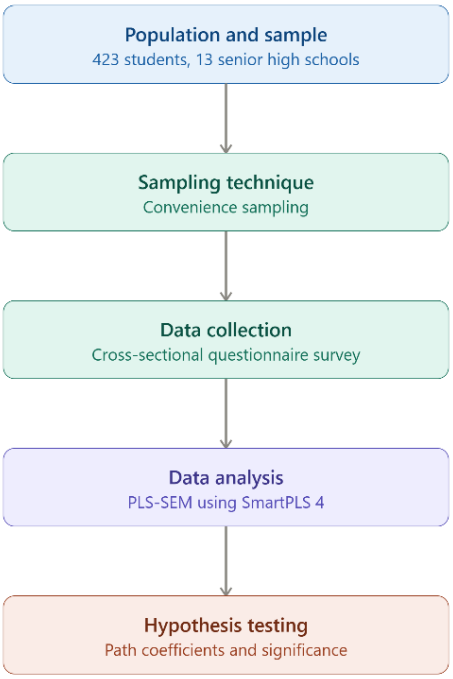


Figure 2. Research design flow

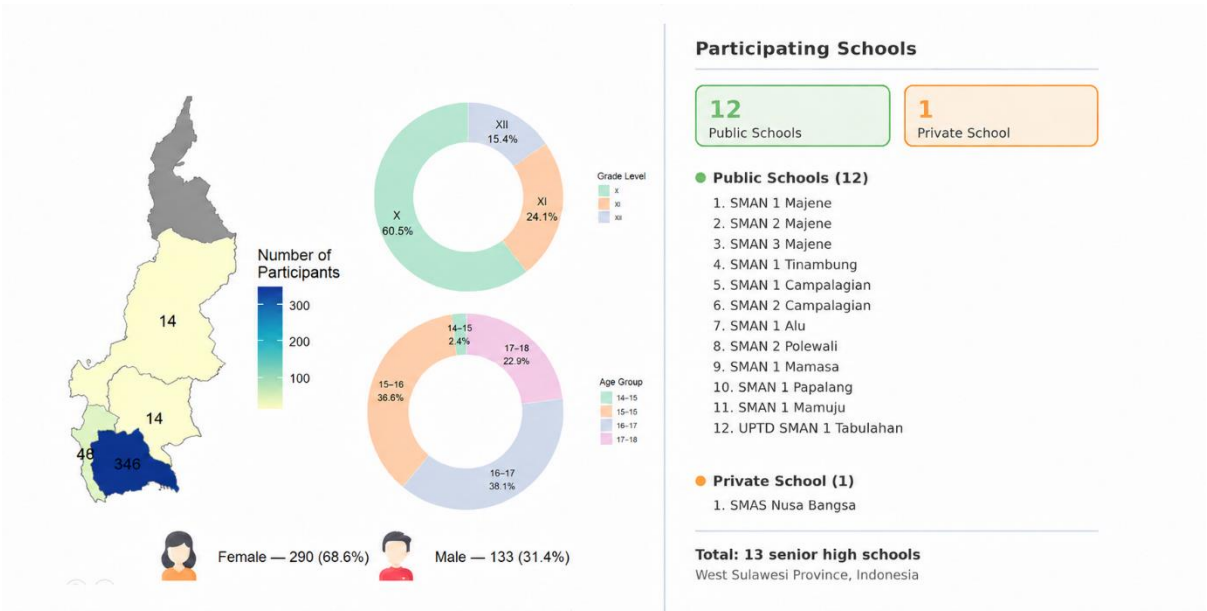


Figure 3. Demographic profile of the study participants

Figure 3 summarizes participants' demographic makeup. Female students made up the majority (290 students, 68.6%), with male students comprising 133 (31.4%). By grade level, Grade X students were most represented (60.5%), followed by Grade XI (24.1%)

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and Grade XII (15.4%), meaning most of the data reflect the experiences of students early in their senior high school years. By age, most participants were 16–17 years old (38.1%), followed by those aged 15–16 years (36.6%), 17–18 years (22.9%), and a smaller proportion aged 14–15 years (2.4%).

Research Instrument

Data were gathered through one questionnaire designed to capture both students' perceptions of the classroom social climate and their motivation for learning physics. The instrument consisted of two sections: demographic items (gender, grade, school, and ethnicity) and measurement scales for the study's latent variables three constructs representing the social environment (perceived recognition, sense of belonging, and peer interaction in physics) and two motivational constructs (physics self-efficacy and physics interest), each modeled reflectively.

Table 1. Instrument items for learning environment and physics motivation constructs

Construct	Item	Item Code
Physics perceived recognition	My family perceives me as a physics enthusiast.	REC1
	My peers perceive me as a physics enthusiast.	REC2
	My physics teacher recognized me as someone who is good at physics.	REC3
Physics sense of belonging	I perceive a sense of belonging in this class.	SB1
	I am at ease in this class.	SB2
	I believe I can express my true self in this class.	SB3
Physics peer interaction	Interactions and experiences with classmates in this course help me feel more at ease when learning physics.	INTER1
	My interactions with peers in this class have strengthened my confidence in doing physics tasks.	INTER2
	Engaging with other students in this class increases my beliefs that I can succeed in physics.	INTER3
	Experiences with classmates in this course improve my confidence in solving challenging physics problems.	INTER4
Physics self-efficacy	I may assist my peers with physics during laboratory sessions or recitation events.	SE1
	I have a good understanding of the physics concepts I have learned.	SE2
	With sufficient study, I am confident that I can perform well on physics tests.	SE3
	When I face difficulties in a physics exam, I am able to recover and overcome them.	SE4
Physics interest	I often think about how physics phenomena work.	INT1
	In general, I like physics.	INT2
	I am motivated to learn as much as possible about physics.	INT3
	I am interested in recent developments and discoveries in physics.	INT4

Items for each construct were adopted from previously validated instruments used in international physics-education studies, so as to keep conceptual definitions and results comparable with prior research (Li, 2021; Tang et al., 2026). The adaptation process used forward translation to maintain equivalence of meaning between the original English items and the Indonesian versions. Content validity was then examined by two physics-education experts and one evaluation expert, who assessed whether the item phrasing matched senior high school students' comprehension level and cultural context; revisions were made accordingly to improve clarity, relevance, and

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readability. Responses were measured on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), and the complete list of items per construct is shown in Table 1.

Data Analysis

The primary analytical technique for examining relationships among the study's constructs was PLS-SEM. This multivariate method is commonly used to assess complex relationships between latent variables and their indicators, and it was chosen for its robust predictive power and adaptability in models containing multiple latent constructs. As a widely applied multivariate method for assessing complex relationships between latent variables and their indicators (Hair et al., 2021), it was selected here for its strong predictive capability and flexibility in handling models with multiple latent constructs. Analysis was conducted using SmartPLS version 4.0.9.9 to determine how the three social-climate dimensions recognition, belonging, and peer interaction related to students' interest and self-efficacy in physics.

As illustrated in Figure 4, PLS-SEM was carried out in two sequential stages: first, evaluating the measurement model, and second, evaluating the structural model. The initial stage checked whether each indicator sufficiently reflected its corresponding latent construct in terms of validity and reliability. Evidence of convergent validity was obtained by evaluating outer loadings, composite reliability (CR), Cronbach's alpha, and average variance extracted (AVE); a loading value of 0.70 or higher is generally recommended, although 0.60 is often deemed acceptable, and an AVE at or above 0.50 indicates that the construct accounts for the majority of variance among its indicators. Discriminant validity was examined through the Fornell-Larcker criterion together with the heterotrait-monotrait ratio (HTMT), verifying that each construct is empirically separate from the rest (Afthanorhan et al., 2021; Hair et al., 2021).

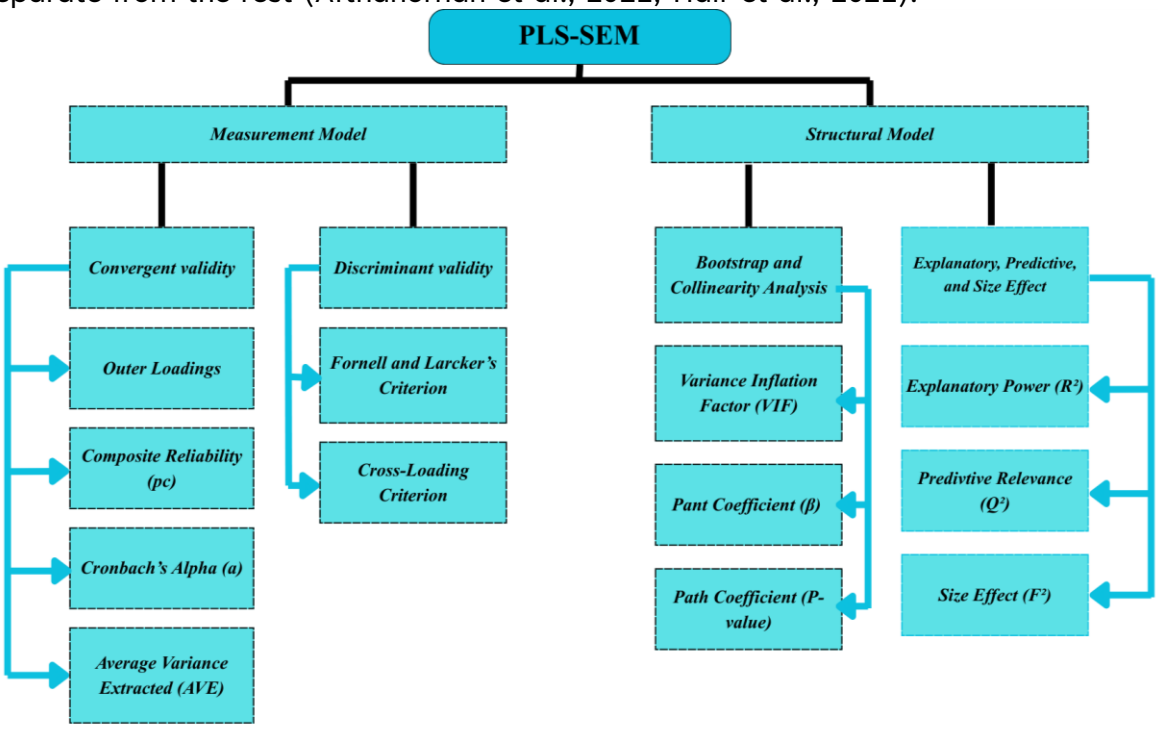


Figure 4. PLS-SEM analytical framework

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Once the validity and reliability of the measurement model were established, evaluation moved to the structural model to test the study's hypotheses. The first step involved checking multicollinearity among predictor variables through variance inflation factor (VIF) values, where scores below 5, and ideally below 3, are considered free of major concern (Hair et al., 2021). Standardized structural path estimates, t-statistics, and significance values for each hypothesis were then obtained through a bootstrapping procedure with 5,000 resamples. Additional model assessment used the coefficient of determination (R^2) to measure explanatory power, the blindfolding-based Q^2 value to gauge predictive relevance, and effect size (f^2) to evaluate how much each construct contributed to its respective dependent variable (Hair Jr et al., 2021).

Ethical Statement

This study involved human participants and was conducted in accordance with ethical principles for educational research. Prior to data collection, permission to conduct the study was obtained from the participating schools. Students were informed about the research objectives, questionnaire procedures, and the intended use of their responses for academic research purposes. Participation was voluntary, and students were informed of their right to decline participation or discontinue their participation without any negative consequences. The collected data were handled confidentially and used exclusively for research purposes, with participants' identities kept confidential in the reporting of the findings.

RESULT AND DISCUSSION

Descriptive Statistics and Measurement Model Evaluation

Prior to structural model testing, the measurement model's reliability and validity were evaluated first. Descriptive statistics along with reliability and convergent validity results for each indicator are shown in Table 2. Mean scores across indicators varied from 2.560 to 4.116, indicating diverse student responses across the constructs, while standard deviations ranging from 0.779 to 0.954 suggest a moderate variation in responses. Loading values ranged from 0.698 to 0.885, demonstrating that each indicator was reasonably strongly associated with its latent construct; several loadings fell slightly below 0.70 but were kept in the model since their constructs' CR and AVE values still met the required cutoff.

Table 2. Summary of item descriptive, reliability, and validity assessment

Observed Variable	Item	Mean	SD	OL	Cronbach's Alpha	CR	AVE
Physics perceived recognition	REC1	2.560	0.923	0.846	0.824	0.839	0.738
	REC2	2.719	0.919	0.885			
	REC3	2.686	0.863	0.846			
Physics sense of belonging	SB1	3.463	0.944	0.733	0.703	0.713	0.628
	SB2	3.697	0.898	0.840			
	SB3	3.411	0.876	0.799			
Physics peer interaction	INTER1	3.600	0.896	0.826	0.860	0.862	0.705
	INTER2	3.664	0.862	0.869			
	INTER3	3.426	0.866	0.842			
	INTER4	3.693	0.899	0.821			
Physics self-efficacy	SE1	2.879	0.949	0.698	0.765	0.773	0.589
	SE2	3.288	0.779	0.725			
	SE3	4.116	0.954	0.793			
	SE4	3.922	0.870	0.844			

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Observed Variable	Item	Mean	SD	OL	Cronbach's Alpha	CR	AVE
Physics interest	INT1	3.768	0.929	0.796	0.853	0.858	0.694
	INT2	3.615	0.915	0.819			
	INT3	3.787	0.876	0.884			
	INT4	3.617	0.872	0.831			

Cronbach's alpha values for all constructs, obtained through the reliability analysis, ranged from 0.703 to 0.860, comfortably exceeding the 0.70 cutoff. Similarly, CR values between 0.713 and 0.862 confirmed sufficient internal consistency, and AVE scores from 0.589 to 0.738 surpassed the 0.50 benchmark required for convergent validity. Overall, these findings suggest the instrument's indicators adequately capture their intended constructs, warranting continuation to the next stage of analysis.

Table 3 displays the Fornell–Larcker discriminant validity results. Each construct's diagonal value the square root of its AVE was higher than its correlations with all other constructs (0.833 for interest, 0.840 for peer interaction, 0.859 for perceived recognition, 0.767 for self-efficacy, and 0.792 for sense of belonging), thereby satisfying the discriminant validity requirement.

Table 3. Fornell-Larcker criterion

Construct	Physics Interest	Physics P eer Interaction	Physics Perceived Recognition	Physics Self-Efficacy	Physics Sense of Belonging
Physics interest	0.833				
Physics peer interaction	0.583	0.840			
Physics perceived recognition	0.304	0.311	0.859		
Physics self-efficacy	0.655	0.640	0.395	0.767	
Physics sense of belonging	0.662	0.630	0.385	0.653	0.792

To further verify discriminant validity the heterotrait-monotrait ratio (HTMT) was also calculated, with results as provided in Table 4. The HTMT estimates ranged between 0.355 and 0.888, all of which were below the recommended threshold of 0.90, indicating that the construct demonstrated acceptable discriminant validity.

Table 4. Heterotrait-Monotrait ratio (HTMT)

Construct	Physics Interest	Physics Peer Interaction	Physics Perceived Recognition	Physics Self-Efficacy	Physics Sense of Belonging
Physics interest					
Physics peer interaction	0.679				
Physics perceived recognition	0.355	0.369			
Physics self-efficacy	0.808	0.820	0.527		
Physics sense of belonging	0.845	0.766	0.494	0.888	

Structural Model Evaluation

Before testing the structural model, VIF was used to check multicollinearity among predictor factors to ensure the model was free from such issues. Findings showed predictor VIF estimates ranging between 1.193 and 1.823, well under the maximum recommended limit of 5.00, confirming the absence of multicollinearity problems. Therefore, all predictor constructs meet the required criteria and are suitable for further analysis in the structural model evaluation.

Table 5 reports the R^2 values, reflecting how much variance in the endogenous variables the model explains. Physics interest recorded an R^2 of 0.482, meaning close to half of its variation (48.2%) is jointly explained by perceived recognition, sense of belonging, and peer interaction. Physics self-efficacy's R^2 of 0.516 similarly indicates that slightly over half (51.6%) of its variance stems from the same three predictors. Values around 0.50 suggest the model has moderate explanatory strength for both outcomes.

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Table 5. Explained variance of the endogenous latent constructs

Construct	R-square	R-Square Adjusted
Physics interest	0.482	0.478
Physics self-efficacy	0.516	0.513

Table 6 shows the f^2 effect-size values, indicating the contribution of each predictor toward its endogenous variable. Findings reveal that sense of belonging produces a comparatively large effect on physics interest ($f^2 = 0.243$), followed by peer interaction ($f^2 = 0.080$) and perceived recognition ($f^2 = 0.002$). For physics self-efficacy, sense of belonging again contributes the most ($f^2 = 0.164$), trailed by peer interaction ($f^2 = 0.146$) and perceived recognition ($f^2 = 0.028$). These figures suggest that sense of belonging offers a more substantial contribution than the other constructs in accounting for the model's endogenous variables.

Table 6. Predictive effect sizes of the exogenous constructs

Construct	Physics Interest	Physics Self-Efficacy
Physics peer interaction	0.080	0.146
Physics perceived recognition	0.002	0.028
Physics sense of belonging	0.243	0.164

Table 7 summarizes the Q^2 predictive-relevance results, which describe how effectively the model predicts each endogenous construct. Physics interest yielded a Q^2 of 0.328, while physics self-efficacy showed a Q^2 of 0.295; since both exceed zero, the model can be considered to have predictive capability for these two endogenous constructs. Following widely used interpretive guidelines, these Q^2 figures suggest the model holds a moderate degree of predictive relevance.

Table 7. Predictive relevance based on Q^2 values

Endogenous Construct	SSO	SSE	Q^2	Interpretation
Physics interest	1780	1196.314	0.328	Moderate predictive relevance
Physics self-efficacy	1780	1254.378	0.295	Moderate predictive relevance

The bootstrapping-based hypothesis testing results in Table 8 reveal that five of the six proposed hypotheses were confirmed. Perceived recognition showed no significant effect on physics interest ($\beta = 0.032$; $t = 0.735$; $p = 0.462$), so H1 was rejected. On the other hand, perceived recognition significantly and positively influenced self-efficacy ($\beta = 0.127$; $t = 2.741$; $p = 0.006$), thereby supporting H2

Table 8. Structural model results (hypothesis testing)

Hypothesis	Structural Path	β	Mean	SD	t-value	p-value	Result
H1	REC→INT	0.032	0.031	0.043	0.735	0.462	Not Supported
H2	REC→SE	0.127	0.127	0.046	2.741	0.006	Supported
H3	SB→INT	0.479	0.482	0.053	9.111	< 0.001	Supported
H4	SB→SE	0.381	0.382	0.054	7.072	< 0.001	Supported
H5	INTER→INT	0.267	0.266	0.056	4.768	< 0.001	Supported
H6	INTER→SE	0.347	0.345	0.053	6.572	< 0.001	Supported

In addition, sense of belonging exhibited a statistically significant positive relationship with both physics interest ($\beta = 0.479$, $t = 9.111$; $p < 0.001$) and self-efficacy ($\beta = 0.381$; $t = 7.072$; $p < 0.001$), confirming H3 and H4. Peer interaction was also shown to positively and significantly predict interest ($\beta = 0.267$; $t = 4.768$; $p < 0.001$) as well as self-efficacy ($\beta = 0.347$; $t = 6.572$; $p < 0.001$), supporting H5 and H6.

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Figure 5 presents the structural model's bootstrapping outcomes, displaying path coefficients and significance levels for each relationship. As the figure shows, most inter-construct relationships are positive and significant, with the exception of the recognition-to-interest path. Sense of belonging and peer interaction emerge as having the greatest influence on students' interest and confidence in physics relative to the other constructs. Overall, these findings show that the majority of the hypothesized structural relationships significantly affect students' motivation to learn physics.

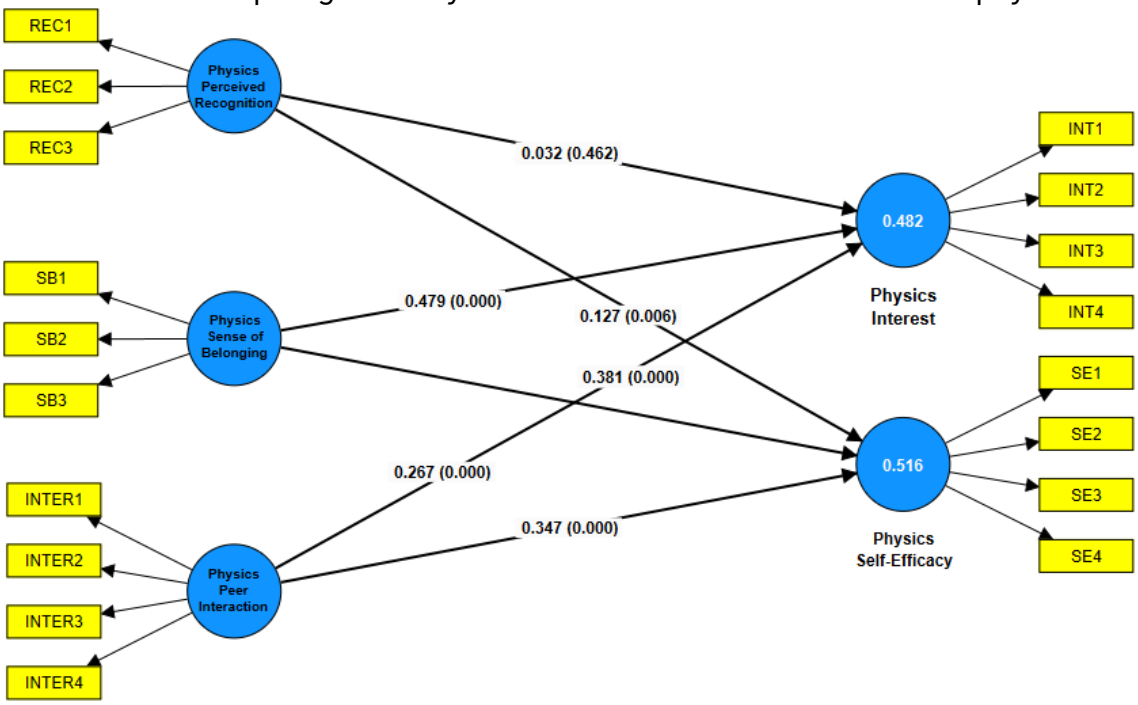


Figure 5. Results of the bootstrapping analysis for the structural model

Discussion

These findings indicate that factors within the social environment considerably shape high school students' motivation to learn physics. Belonging and peer interaction consistently predicted both motivational outcomes, whereas recognition only influenced self-efficacy and not interest. This pattern reveals that different aspects of students' social experience in the physics classroom affect each motivational dimension in distinct ways overall, the classroom's social context evidently influences both students' sense of competence and their level of interest in physics. Such a finding aligns with prior research indicating that classroom social factors belonging, peer interaction, and recognition are strongly linked to students' confidence and interest (Whitcomb et al., 2023), as well as studies suggesting that the physics learning environment shapes students' motivation and identity, though the magnitude varies depending on social experience and instructional context (Tang et al., 2026).

More specifically, sense of belonging had a significant positive effect on both interest and self-efficacy. Practically speaking, students who perceive themselves as accepted, valued, and included within their physics classroom tend to show greater interest in the subject as well as increased confidence in mastering its concepts. Physics classrooms fostering this type of social connectedness seem to promote more meaningful student engagement and greater participation. This corresponds with earlier work linking a sense of belonging within the learning setting to enhanced academic motivation, engagement, and persistence in the face of academic challenges (Mtshweni, 2024),

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and supports the notion that an inclusive, supportive classroom allows students the freedom to express opinions, raise questions, and explore new physics ideas without fear of judgment (Liang et al., 2025).

In a comparable way, peer interaction significantly and positively influenced both physics interest and self-efficacy. Classroom activities such as group discussion, collaborative problem-solving, and idea exchange appear to help students develop deeper conceptual mastery, while also offering social support beyond cognitive benefits that boosts students' confidence in physics. This is in line with social cognitive theory's argument that learning occurs not solely through direct experience but also via observation and social interaction (Bandura, 2001; Schunk & DiBenedetto, 2020), as well as previous evidence indicating that peer collaboration enhances conceptual understanding in science, fosters self-regulated learning, and generally increases academic motivation (Pan et al., 2024).

A different pattern emerged for perceived recognition, however it did not significantly affect physics interest, yet was a significant predictor of self-efficacy. This implies that being recognized by teachers, peers, or family influences students' beliefs about their own competence more than it stimulates genuine interest in the subject being acknowledged for physics ability seems to strengthen confidence and perceived competence without necessarily deepening curiosity toward physics itself. This aligns with earlier studies linking perceived recognition to the formation of academic identity and perceived competence in science (Whitcomb et al., 2023), as well as findings suggesting that while recognition is beneficial, it does not automatically lead to greater interest in a particular domain (Li & Singh, 2023).

Theoretically, these findings support SEVT's assumption that academic motivation arises from the interplay between personal beliefs and the social context of learning (Eccles & Wigfield, 2023, 2024). Within physics classrooms specifically, favorable social experiences such as feeling accepted in the learning community and engaging constructively with peers appear to reinforce students' sense of competence and elevate the subjective value they place on learning activities. In other words, the classroom's social climate functions not simply as a setting for learning but as an active driver of students' academic motivation.

Given that the model accounts for 48.2% of variance in physics interest and 51.6% in physics self-efficacy, its explanatory power sits in the moderate category signaling that social-environmental factors, while clearly meaningful, do not fully explain students' motivation. Other plausible contributing factors include the quality of teaching, instructional approach, and individual psychological characteristics (Pečiuliauskienė, 2023). Including these variables in future analytical models could yield a more complete picture of the drivers of physics learning motivation

Although this study adds to the understanding of how classroom social environment relates to physics learning motivation, several limitations should be acknowledged. First, since the design is questionnaire-based, findings rely on respondents' self-reported perceptions, which carry the risk of response bias. Second, because the sample consists solely of high school students from West Sulawesi, the broader applicability of these results to other learning contexts is limited. Third, the cross-sectional nature of the design means data were collected at only one point in time, preventing observation of how students' motivation might shift over a longer period.

Subsequent studies would benefit from broadening the geographic coverage and including more diverse student populations to improve generalizability. Longitudinal

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designs could help trace how physics learning motivation develops over time, and future studies might also incorporate additional variables teacher support, collaborative learning strategies, teaching quality, students' prior learning experiences as further influences on physics motivation. Employing mixed-methods approaches could likewise offer a more nuanced understanding of how the social learning environment shapes this motivation.

CONCLUSION

Employing a PLS-SEM approach, this research aimed to explore how the classroom social environment influences high school students' motivation to learn physics. Findings reveal that sense of belonging and peer interaction significantly predict both physics interest and self-efficacy, whereas perceived recognition predicts self-efficacy only, not interest. Taken together, these patterns demonstrate that students' social experiences within physics classrooms substantially shape both their perceptions of competence and their interest in the subject.

In brief, motivation for learning physics reflects a combination of personal factors and the quality of classroom social interaction. Feeling included in the learning community, coupled with authentic opportunities for meaningful peer interaction, seems to enhance both students' interest and their confidence. Accordingly, effective physics instruction should not focus solely on delivering conceptual material but also on cultivating a classroom atmosphere that promotes social connectedness and collaborative learning.

Practically, these results suggest that teachers and schools ought to design instructional strategies that intentionally foster positive social interaction within physics classrooms. Practices such as collaborative learning activities, group discussions, and community-building efforts in the classroom can all serve as effective means for reinforcing students' learning motivation. Nonetheless, given the study's limitations reliance on perception-based survey data and a geographically narrow sample caution is warranted before generalizing the findings too widely. Future research that expands the study context, uses longitudinal designs, and considers additional variables such as teacher support, instructional quality, and prior learning experience would contribute to a fuller understanding of how students' motivation to learn physics develops.

AUTHOR DECLARATION

Author Contribution. **VV**, as the lead researcher, conducted the research, collected and analyzed the data, and drafted the manuscript; **NN**, as the principal supervisor, guided the research design and methodology, supervised the research process, and contributed to reviewing and refining the manuscript; **SS** contributed to the interpretation of the research findings and provided input on the manuscript. All authors reviewed and approved the final manuscript.

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Declaration of AI and AI-assisted technologies in the writing process. The authors declare the use of technological tools throughout the research process. SmartPLS was used for data analysis using Partial Least Squares Structural Equation Modeling (PLS-

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SEM), while Mendeley was utilized for reference management. Additionally, artificial intelligence (AI) tools, specifically ChatGPT, were used solely to refine academic language and assist in translating the manuscript from Indonesian into English. The authors reviewed and edited all content and take full responsibility for the final manuscript.

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