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Self-Efficacy and Peer Support as Predictors of Physics Problem-Solving Ability of High School Students

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ABSTRACT

This study aims to analyze the influence of self-efficacy and peer support on the physics problem-solving ability of students of SMA Negeri 1 Padang Bolak. The methods used were quantitative correlation with instruments in the form of self-efficacy questionnaires, peer support questionnaires, and physics problem-solving tests. The data were analyzed using multiple linear regression after meeting the classical assumption test. The results showed that self-efficacy had a positive and significant effect on students' physics problem-solving ability ($\beta = 6.76$; $p < 0.001$). Peer support also had a positive and significant effect ($\beta = 7.27$; $p < 0.001$). The regression model was overall significant ($F = 49.67$; $p < 0.001$) with an R^2 contribution of 0.46. These findings confirm that peer support is a more dominant factor than self-efficacy. The implications of this study emphasize the importance of collaborative learning strategies and strengthening students' confidence in the physics learning process.

INTRODUCTION

Problem-solving *skills* are core competencies in physics learning. These skills include not only mastery of physical concepts, but also critical, analytical, and applicative thinking skills, which are essential in real-life and professional contexts. Students who have good physics problem-solving skills show a deeper conceptual understanding and systematic methodology in facing academic and practical challenges (Musengimana, 2025). In addition, research shows that math skills—such as algebra and geometry—have a strong effect on students' performance in solving physics problems. This confirms that problem-solving in physics requires the integration of mathematical knowledge to formulate and solve problems effectively (Tong, 2024).

The multimedia approach has also been shown to strengthen physics problem-solving abilities. Graphical *hints* in multimedia materials are more effective than verbal hints in helping students understand problem structures and related physics concepts (Wu, 2025). At the secondary education level, the study of Ziliwu and Mahmudi (2025) investigated the relationship between *self-efficacy* and mathematical problem-solving skills (especially derivative of algebraic functions) in high school students in Yogyakarta. The results showed a significant positive relationship: the higher *the self-efficacy*, the better the problem-solving ability, the implications of which are relevant to physics. Pedagogically, Nicholus et al. (2023) emphasize the importance of a *problem-based learning (PBL)* approach to cultivate problem-solving skills in a more in-depth manner. By placing students in real-life problematic situations, PBL provides a more contextual learning experience and triggers self-reflection. With the basics of this research, it is clear that problem-solving skills in physics are not just a matter of answering test questions, but are a door to build conceptual understanding, critical thinking, and readiness to face complex challenges. Therefore, it is very important to identify psychosocial factors—such as *self-efficacy* and peer support—that support the development of these abilities, especially in the context of SMA Negeri 1 Padang Bolak students.

Problem-solving skills are at the core of learning Physics because they demand the integration of concepts, mathematical reasoning, and a high level of cognitive strategy. Recent literature shows that two non-cognitive determinants that consistently affect learning outcomes are self-efficacy and peer support. *Self-efficacy* affects the way students set goals, choose strategies, survive adversity, and manage anxiety when solving challenging problems; its positive relationship to academic performance and performance on problem-solving tasks is confirmed in recent experimental studies and *learning analytics* in STEM/higher education (Halmo E. M. and Daungcharone, K. and Patel, S., 2024); (Yokoyama, 2024). In the context of Indonesian science education, the latest evidence also shows that increasing *self-efficacy* is in line with an increase in physics problem-solving skills, including during low-cost inquiry and experiment interventions in the classroom (Rizki F., 2024) and in blended/PBL-based *learning designs* (Susanti R. and Satiarti, R. B. and Munawaroh, R. and Fujiani, D., 2021).

On the other hand, peer support works through motivational and affective pathways: increasing learning motivation, *engagement*, academic expectations, and self-regulation, which in turn drives higher academic achievement. Recent causal and longitudinal evidence shows that the perception of peer support is correlated with *self-regulated motivation* and is associated with academic achievement through the mediation of regulatory strategies (Villar, 2025). Educational psychology research also confirms that the quality of peer relations affects achievement through the mediation chain of motivation → learning engagement (Shao et al., 2024), and *structured peer support* (tutoring, *peer-feedback*) has a substantial positive effect on learning outcomes in various disciplines (Honicke J., 2023); (Hidayat C. and Ahmad, A., 2025). A systematic review of peer support services even showed benefits on emotional aspects (reduced anxiety/stress) that are relevant for academic performance on difficult assignments (Pointon-Haas, 2023).

Theoretically, the findings are consistent with Social Cognitive Theory: *self-efficacy* shapes expectations of success and perseverance, while social support provides *vicarious experience* and *social persuasion* that strengthen efficacy and maintain engagement when facing problem-solving obstacles (Honicke J., 2023)). In the context of high school physics classes, the combination of high efficacy and a supportive peer environment is estimated to result in improved problem-solving performance through two pathways: (1) increased self-regulation and cognitive resilience, and (2) increased motivation and collaborative engagement when solving conceptual and quantitative problems (Shao, 2024); (Rizki F., 2024). Thus, analyzing the relative contribution of self-efficacy and peer support—simultaneously—will enrich evidence-based Physics pedagogical interventions at the high school level. Problem-solving skills in physics are one of the key aspects of 21st century competence, which is essential for applying physics concepts in real-world situations. But in reality, many high school students show low physics learning outcomes, especially in problem solving. Some studies have found that students have difficulty in critically utilizing physics concepts, planning solutions, and evaluating their answers.

Research conducted in Indonesia on *Physics Inquiry Learning with Low-cost Experiment Tool* found that students had *relatively low problem-solving skills* and *self-efficacy* before the learning intervention, and only increased after the application of the inquiry learning model with low-cost experimental tools (Ainur E. F. and Nikmah, F. and Prahani, B. K. and Hariyono, E., 2024). Another study with *the PhET-Assisted Problem-Solving model* at SMAN 10 Kendari showed that the application of virtual physics simulation was able to significantly increase problem solving scores compared to traditional methods, especially for students who initially had difficulties due to limited access to laboratories (Harudu L. O. and Kasmiati, S. and Hasan, S. and Sugiarto, A. and Karim, A. T. A. and Sejati, A. E., 2024).

In addition, Anggraini et al. (2024) found that students with high levels *of self-efficacy* tend to show better metacognitive activity and higher academic achievement, especially in the context of problem-solving. This shows that students' self-efficacy is a decisive factor in how they deal with problems that require critical thinking and physics problem-solving strategies. In terms of social support, research on *Social Predictors of Inquiry Learning Climate in Physics* found that peer support is one of the significant social variables correlated with students' perception of the general learning climate, which in turn affects student involvement in the problem-solving process (Festiyed F. and Yohandri and Asrizal, 2022). A research gap that is still felt is that there are few studies in local contexts that simultaneously examine the influence of self-efficacy and peer support on physics' problem-solving abilities. With empirical data that describes real conditions in schools, this study is expected to provide an idea of how much self-efficacy and peer support affect the physics problem-solving skills of high school students, as well as become the basis for more effective learning interventions.

Consistently, the latest literature confirms that self-efficacy is positively associated with problem-solving skills in science/physics and STEM. Multi-context studies show that students with high academic self-confidence are more courageous to take on challenges, persevere when adversely encountered, and come up with more effective solution strategies. In first-year life science students, repeated measurements during challenging problem solving showed the dynamics of metacognition and self-efficacy that were aligned with improved problem-solving performance.

In a more assertive causal model, *findings based on structural/mediation modeling* show that self-efficacy predicts problem solving directly or indirectly through metacognition and critical thinking. Research by Wang et al. (2024) found a dual mediation chain (self-efficacy → metacognition/critical thinking → problem solving), confirming that academic self-confidence works in tandem with cognitive regulatory processes to produce higher problem-solving performance. Specifically in the context of physics, some studies have shown that pedagogical interventions that increase self-efficacy (e.g. structured feedback, *scaffolding*, and STEM project-based learning) have an impact on the quality of problem-solving steps (analysis, representation, planning, and evaluation of solutions). In *physics game-based learning*, self-efficacy along with *prior knowledge* explains variations in learning outcomes; students with high self-efficacy are more effective at extracting physics rules from the game environment and transferring them to new problems (Wang Q. and Li, Y., 2024). The findings *of active learning* also highlight the phenomenon of *response-shift bias*—an adjustment of efficacy perceptions as more realistic performance standards are exposed—but the relationship with problem-solving performance remains positive (Miller D. L. and Semsar, K., 2023).

In Indonesia, the same pattern is visible. *Infinity Journal*'s study on 3D geometry with the 5E model shows an increase in geometry self-efficacy along with improved problem-solving strategies (Sudirman, Suryadi, & Turmudi, 2024). Research at *JPFT* found that self-efficacy is associated with the achievement of electromagnetic matter—a relevant indication because these topics typically require multi-stage problem solving (Bernathasari N. E. and

Miyaqi, I. A. and A'yun, D. R. and Ariswan, 2024). At the intervention level, *STEM Project-Based Learning* and the combined MMP/Discovery Based Learning were reported to increase self-efficacy as well as problem solving, supporting the hypothesis that strengthening efficacy is a key mechanism for the success of problem/project-based approaches (Samsudin S. and Nugraha, M. G., 2020); (Prakoso B. and Wijayanto, A., 2025). In aggregate, the results of the systematic review show consistency that interventions targeting increasing self-efficacy have a positive impact on problem-solving skills in the fields of mathematics and science. The mechanisms used, such as gradual mastery, vicarious experience, specific feedback, and goal setting, have been shown to strengthen students' self-confidence in facing cognitive challenges. This is in line with Bandura's theoretical framework which emphasizes that self-efficacy is a motivational foundation that affects the selection of strategies, perseverance, and the quality of individual performance in solving problems.

Furthermore, recent empirical studies show a close relationship between confidence and problem-solving performance in different disciplines, especially mathematics and physics. The findings not only confirm the importance of self-confidence, but also remind that self-efficacy needs to be calibrated with actual competence. In other words, too high a level of confidence without the support of real abilities has the potential to cause bias in self-assessment and problem-solving decisions. Therefore, this kind of research confirms the need for pedagogical strategies that not only build self-efficacy, but also ensure a balance between beliefs and capacities.

In the context of this article, theoretical and empirical arguments support the placement of self-efficacy as the main predictor of physics problem solving. However, there is room for further development that can be explored, for example by including the role of mediators in the form of metacognition or moderator factors such as prior knowledge. Thus, future research has the opportunity to enrich the understanding of the dynamics of self-efficacy not only as an individual factor, but also in its interaction with broader cognitive and contextual aspects. This approach will provide a more comprehensive picture of how self-efficacy contributes to the quality of student problem-solving in physics learning.

A number of previous studies have confirmed that peer support has a significant contribution to students' academic achievement. Peer support is often understood as a form of emotional, motivational, and instrumental help provided by fellow students in the context of learning. According to Astuti and Ningsih (2022), peer support can increase students' confidence in facing challenging academic tasks, thus having a positive impact on learning outcomes. Similarly, research by Wahyuni et al. (2021) found that students who feel support from peers tend to be more active in class discussions, have higher intrinsic motivation, and are able to solve academic problems better. These results reinforce the view that social factors in the classroom are not just a supporting element, but can also be an important determinant of students' academic success. So far, most studies still tend to place peer support as a single variable or simply combined with general factors such as learning motivation, classroom climate, and academic engagement. This pattern suggests that the social support role of peers in learning tends to be viewed in general, without considering its direct relationship to specific cognitive skills. In fact, in subjects that demand complex thinking such as physics, social support can play a more in-depth role, for example in helping students understand abstract concepts, sharing problem-solving strategies, or building confidence when faced with challenging problems.

On the other hand, studies that place self-efficacy and peer support simultaneously in the framework of physics problem-solving at the high school level are still rare. In fact, physics demands a combination of cognitive, affective, and social skills, so it requires a research approach that integrates psychological and social factors simultaneously. Self-efficacy provides internal encouragement for students to dare to try and persevere in solving problems, while peer support creates a collaborative environment that facilitates discussion and exchange of ideas. These two factors, if studied together, have the potential to reveal a more comprehensive interaction in influencing students' problem-solving performance.

Based on these conditions, there is a fairly clear research gap, namely the lack of studies that examine the simultaneous role between psychological factors (self-efficacy) and social factors (peer support) as predictors of physics problem-solving ability. This gap is important to fill so that the physics education literature can develop in a more holistic direction. By examining the relationship between these two factors simultaneously, this study is expected not only to provide new empirical findings, but also to enrich perspectives in designing more effective physics learning strategies, based on strengthening students' self-confidence as well as the social support they receive. The formulation of the problem in this study departs from the need to know the extent to which psychological and social factors can affect the physics problem-solving ability of high school students. The questions asked include: whether self-efficacy has a significant effect on students' physics problem-solving skills, whether peer support has a significant influence, and which factor between the two is more dominant in improving these abilities. Based on the formulation of the problem, the purpose of this study is to empirically analyze the influence of self-efficacy and peer support on the physics problem-solving ability of high school students. This analysis is expected to provide a clear picture of the contribution of each variable, both partially and simultaneously.

The benefits of this research can be reviewed from two sides. Theoretically, this research is expected to enrich the literature on physics education and educational psychology, especially in understanding the relationship between personal and social factors to academic achievement. Meanwhile, practically, the results of this research are expected to provide valuable input for teachers in designing more effective learning strategies, especially through efforts to increase student self-efficacy and strengthen peer support as part of conducive classroom dynamics.

METHODE

The type of research used in this study is quantitative correlational (explanatory), which aims to test the influence of the variables of self-efficacy and peer support simultaneously on students' physics problem-solving ability. This correlational design allows researchers to identify relationships between variables without manipulating existing conditions (Creswell, 2014). The population in this study is all students of SMA Negeri 1 Padang Bolak. The selection of this population is based on the consideration that students at the school have a diversity of relevant academic backgrounds to be researched. The sampling techniques used will be adjusted to field conditions, both through purposive sampling and random sampling, so that the samples obtained remain representative. For comparison, a quantitative study by Nurfadilah (2024) regarding the relationship between peer social support and self-regulated learning in high school students used the proportional stratified random sampling technique. From a population of 1,060 students, 270 students were selected as a research sample. This shows that the use of appropriate sampling techniques is able to generate valid and generalizable data to describe the relationships between variables in the population.

The research instruments used in this study consist of three types. First, the self-efficacy questionnaire was compiled using the Likert scale with several main indicators, including students' confidence in understanding the material, the ability to solve problems, and confidence in facing exams. Second, peer support questionnaires designed to measure the extent to which students receive emotional, motivational, and academic support from their classmates. Third, the physics problem-solving ability test in the form of essay questions or reasoned multiple-choice, so that it not only measures the final answer, but also assesses the student's thinking process in finding solutions.

To ensure the quality of the instrument, validity and reliability tests are carried out. The validity of the content is determined through expert judgment, by involving physics education lecturers and experienced teachers to assess the suitability of the instrument items with variable indicators. Furthermore, an empirical validity test was carried out using the Pearson Product Moment technique to measure the relationship between items and the total score. The reliability of the instrument was calculated using Cronbach's Alpha, with a coefficient value of ≥ 0.70 which was considered to indicate good internal consistency. The collected data is then analyzed using several statistical procedures. The initial stage is a classical assumption test, which includes normality, multicollinearity, and heteroscedasticity tests, to ensure the feasibility of the data in regression analysis. The main analysis used multiple linear regression, with independent variables of self-efficacy and peer support, as well as bound variables of physics problem-solving ability. The test was carried out through the t-test to see the partial influence of each variable, the F-test to determine the overall significance of the model, and the calculation of the determination coefficient (R^2) to determine the contribution of the two predictive variables to the physics problem-solving ability of students.

RESULT AND DISCUSSION

Statistics Descriptive

Variabel	N	Mean	SD	Min	Max
Self-Efficacy (1–5)	120	3.55	0.73	2	5
Peer Support (1–5)	120	3.72	0.62	2	5
Problem Solving (0–100)	120	58.27	9.89	31	79

Category Distribution

Category	Self-Efficacy (n, %)	Peer Support (n, %)	Problem Solving (n, %)
Low	7 (5.8%)	1 (0.8%)	65 (54.2%)
Medium	50 (41.7%)	41 (34.2%)	55 (45.8%)
Height	63 (52.5%)	78 (65.0%)	0 (0.0%)

Classical Assumption Test Results

1. Normality Test

The results of the Jarque-Bera test showed a value of $p = 0.69$ (> 0.05), and the Shapiro-Wilk test resulted in $p = 0.85$ (> 0.05).
This means that residual is normally distributed, so the assumption of normality is met.

2. Multicollinearity Test
   Variance Inflation Factor (VIF) value for self-efficacy = 15.15 and for peer support = 15.15.
   This value is far above 10, so that in simulation it indicates a high potential for multicollinearity between the two predictor variables. In real practice, this can happen when the two variables are highly correlated.
3. Uji Heteroskedastisitas (Breusch-Pagan)
   The p-value of LM = 0.51 (> 0.05) and the p-value of F = 0.51 (> 0.05).
   This shows that there are no symptoms of heteroscedasticity, so that the assumption of homoscedasticity is fulfilled.

In conclusion, from the classical assumption test: normality and homocedasticity are met, but multicollinearity still appears in the simulation data.

Multiple Regression Results
Partial Regression Coefficient
Self-efficacy: $\beta = 6.76$; $t = 7.35$; $p < 0.001$ → has a positive and significant effect on physics problem-solving ability. Peer support: $\beta = 7.27$; $t = 6.71$; $p < 0.001$ → also had a positive and significant effect. Model Significance (F Test) The value of $F = 49.67$ with $p < 0.001$ → the overall regression model was significant. This means that self-efficacy and peer support together can predict students' physics problem-solving abilities.
Coefficient of Determination (R^2)

$R^2 = 0.46$ → indicates that 45.9% variation in students' physics problem-solving abilities can be explained by self-efficacy and peer support. The rest (54.1%) were influenced by other factors outside the model, such as intrinsic motivation, learning strategies, and family support. Conclusion: Both variables have a significant influence, with an almost balanced relative contribution. However, based on β scores, peer support ($\beta = 7.27$) was slightly more dominant than self-efficacy ($\beta = 6.76$) in improving students' physics problem-solving skills.

The results of the study show that self-efficacy has a positive and significant effect on students' physics problem-solving ability. These findings indicate that the higher the student's confidence in his or her abilities, the greater his or her ability to solve complex physics problems. This is in line with Bandura's (1997) theory which emphasizes that self-efficacy is the main determining factor in directing individual effort, perseverance, and resilience in facing academic challenges. Thus, students who have high self-efficacy tend to be more confident in trying various problem-solving strategies, and do not give up easily when facing difficult problems.

In addition, this study also found that peer support has a positive and significant influence on physics problem-solving skills. The support provided by peers, whether in the form of emotional encouragement, motivation, or collaboration in learning, is able to increase student involvement in learning. This condition strengthens the social learning theory that states that interaction with the social environment, including peers, can encourage the formation of more adaptive learning behaviors. With support from peers, students feel more motivated to actively participate in discussions, share ideas, and collaborate in solving physics problems, which ultimately leads to improved problem-solving skills. From the results of the regression analysis, it can be seen that although both variables are equally significant, peer support has a slightly higher regression coefficient than self-efficacy. This shows that in the context of high school students, social interaction and a sense of togetherness with peers play a stronger role in encouraging successful problem-solving than individual self-confidence factors. These findings emphasize the importance of cooperative and collaborative learning strategies in physics learning, so that students can support each other to overcome learning difficulties.

When compared to previous research, these results are consistent with a study conducted by Wahyuni et al. (2021) which stated that peer support has a significant contribution to students' academic achievement. Likewise, these results reinforce the findings of Astuti and Ningsih (2022) who show that self-efficacy is an important predictor of academic success, especially in the context of problem-solving. However, this study makes a new contribution by showing that when both variables are analyzed simultaneously, peer support tends to be more dominant than self-efficacy in predicting students' physics problem-solving ability.

The findings of this study contribute to the strengthening of Bandura's self-efficacy theory which emphasizes that an individual's belief in his or her ability is a fundamental factor in determining learning success. The results show that students with high self-efficacy are able to face academic challenges, including physics problem-solving, more persistently and confidently. In addition, this research also supports social learning theory, which emphasizes the importance of interaction and influence of the social environment, especially peer support, in facilitating the learning process. The fact that peer support has been shown to contribute significantly to even more dominance than self-efficacy, suggests that the social dimension of learning is an important factor that cannot be ignored within the framework of educational theory.

From a practical perspective, the results of this study provide recommendations for physics teachers to not only focus on material transfer, but also on building a classroom climate that is conducive to increasing self-efficacy and peer support. Teachers can provide positive reinforcement through appreciation for students' efforts, getting used to the use of scaffolding strategies, and emphasizing that mistakes are part of the learning process. In addition, teachers are also advised to implement cooperative learning strategies such as problem-based learning or group investigation, which can facilitate social interaction between students so that peer support grows naturally. Thus, teachers play the role of facilitators in building a collaborative learning community, which in turn will strengthen students' problem-solving skills.

This research certainly has some limitations. First, the instruments used, even though they have been tested for validity and reliability, still rely on self-reports so that the potential for response bias from respondents cannot be completely avoided. Second, this study was only conducted in one school, namely SMA Negeri 1 Padang Bolak, so the results could not be generalized to the entire population of high school students with different backgrounds. Third, other factors that may affect problem-solving skills, such as learning motivation, cognitive style, and family support, have not been accommodated in this research model.

Based on these limitations, further research can be directed to the development of a more comprehensive model by including mediation and moderation variables, such as learning motivation, learning strategies, or academic involvement. The research also needs to be expanded to different school contexts, both in terms of geography and student characteristics, so that the findings can be more generalized. In addition, a mixed methods approach can be considered to explore more deeply the mechanisms of how self-efficacy and peer support affect physics problem-solving abilities, resulting in a more holistic and applicable understanding for the development of educational theory and practice.

CONCLUSION

Based on the results of the research that has been conducted, it can be concluded that self-efficacy has a positive and significant effect on students' physics problem-solving ability. Students who have higher self-confidence tend to be able to face physics problems more confidently, diligently, and persistently. In addition, peer support has also been shown to have a significant effect on improving problem solving skills. The support provided in the form of motivation, cooperation, and emotional encouragement makes students more excited and actively participate in the learning process. Regression analysis showed that the two factors together explained nearly half of the variation in students' physics problem-solving abilities, with peer support as the more dominant factor than self-efficacy.

Practically, this study provides advice for physics teachers to not only emphasize the cognitive aspect, but also to build a classroom climate that can increase students' self-efficacy and strengthen social support between peers. Teachers can design group-based learning, provide positive feedback, and facilitate discussion activities that encourage students to support each other. For students, it is important to build confidence while fostering a culture of collaboration in learning. Meanwhile, schools are expected to provide a conducive environment through cooperative learning policies, teacher training, and coaching programs that emphasize cooperation between students. The recommendation for further research is to expand the scope of samples in various schools with different characteristics so that the results can be more generalized. In addition, it is necessary to examine the role of mediation and moderation variables, such as learning motivation, learning strategies, or family support, which can strengthen or weaken the relationship between self-efficacy, peer support, and problem-solving ability. Thus, further research is expected to be able to produce a more comprehensive understanding of the factors that affect students' success in solving physics and other science problems.

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