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Integrating Social Emotional Intelligence into Project-Based Learning: Enhancing Web Programming Competencies in Vocational Education

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Abstract

The rapid evolution of the digital industry demands that vocational education graduates possess not only technical proficiency but also robust social-emotional competencies. However, a critical disparity exists in current vocational pedagogy, where technical instruction often overlooks the collaborative and emotional skills vital for the modern workforce. This study investigates the efficacy of integrating Social Emotional Intelligence (SEI) into Project-Based Learning (PjBL) to enhance web programming competencies at SMK Negeri 4 Bandung. Employing a quasi-experimental design with 70 students, data were collected via cognitive pretest-posttest assessments, SEI scales, and motivation questionnaires. The results revealed a statistically significant difference in learning outcomes (Sig. 0.010 < 0.05), with the experimental group achieving a moderate N-Gain of 0.62, substantially outperforming the control group's low N-Gain of 0.30. Furthermore, path analysis confirmed that SEI significantly influences learning motivation, which functions as a partial mediator for academic achievement. These findings contribute a novel pedagogical framework for vocational education, demonstrating that integrating emotional intelligence into technical training is essential for fostering holistic student development and professional readiness

Keyword: Learning Motivation, Project-Based Learning, Social Emotional Intelligence, Vocational Education, Web Programming Competencies.

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INTRODUCTION

In the contemporary digital landscape, proficiency in web programming has transcended basic technical literacy, evolving into a complex skill set required to navigate the dynamic demands of the technology sector. Nevertheless, there remains a substantial gap between vocational pedagogical practices and the actual demands of the industry. Although the "Kurikulum Merdeka" Phase F requires students to master complex skills—such as server-side programming, documentation, and framework utilization—instructional delivery often remains rigid and overly teacher-centric. This conventional approach frequently neglects the development of Social Emotional Intelligence (SEI), resulting in a workforce that possesses technical knowledge but lacks the requisite collaborative and high-order thinking skills (HOTS) demanded by the business and industrial world (DUDIKA). Consequently, students are often ill-prepared for professional environments that prize not only code efficiency but also the reliability and user-centricity of software products—qualities deeply rooted in empathy and effective teamwork.

To address this pedagogical deficit, the integration of Project-Based Learning (PjBL) with the framework of Social Emotional Intelligence (SEI) offers a promising solution. PjBL provides the necessary authentic context for learning, shifting the focus from rote memorization to the practical application of skills in real-world scenarios. Recent research reinforces the urgency of adaptive learning modules in vocational settings. As highlighted by Sutiah, Eraku, and Nurfaika (2025) in this journal, the development of structured project-based modules is critical for bridging the gap between theoretical knowledge and practical application. Their study confirms that well-designed project interventions significantly enhance students' higher-order thinking skills, a finding that supports our approach to integrating Social Emotional Intelligence into web programming projects to foster not just technical skill but holistic competence. However, the rigor of collaborative projects inevitably introduces psychological stressors and interpersonal conflicts. Here, the CASEL framework's five core competencies—self-awareness, self-management, social awareness, relationship skills, and responsible decision-making—serve as a critical scaffolding mechanism. By embedding SEI into the PjBL structure, students are better equipped to manage the frustrations inherent in complex coding tasks and develop the empathy required for superior User Experience (UX) design. This synergistic approach aligns with the educational philosophy of fostering mutual cooperation, ensuring that technical development is bolstered by emotional resilience and social competence.

Despite the theoretical benefits of this integrated model, empirical observations at SMKN 4 Bandung reveal that web programming instruction remains dominated by conventional

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methods, leading to fragmented understanding and suboptimal learning outcomes across cognitive, affective, and psychomotor domains. Students struggle to synthesize front-end and back-end concepts and lack the emotional regulation necessary for effective team-based development. Therefore, this research aims to rigorously analyze the impact of integrating SEI with PjBL on web programming learning outcomes. Beyond examining direct causal links, this study specifically investigates the mediating role of learning motivation in this dynamic, seeking to demonstrate that a holistic educational approach is essential for producing graduates who are technically proficient, socially adaptive, and professionally competitive in the modern digital industry

LITERATURE REVIEW

Project-Based Learning (PjBL) functions as a pedagogical strategy that places the student at the center, prioritizing deep learning through direct involvement in authentic, real-world challenges. As outlined by Anggraini and Wulandari (2021), this instructional model proceeds through specific phases, initiating with essential questions and project formulation, followed by collaborative planning, scheduling, and execution under teacher supervision. This method allows students to develop critical thinking, teamwork, and practical application of knowledge, aligning perfectly with the "Kurikulum Merdeka" for Software Engineering. This curriculum explicitly recommends PjBL to prepare students for developing complex software solutions, such as mastering server-side programming and frameworks for web development. By focusing on complex, open-ended problems, PjBL shifts the educational paradigm from passive reception to active inquiry, granting students autonomy and responsibility for their learning process.

Parallel to technical skills, Social Emotional Intelligence (SEI) plays a pivotal role in education. Research by Ulutaş, Engin, and Polat (2021) emphasizes that emotional competence—comprising self-awareness, self-management, social awareness, relationship skills, and responsible decision-making—is foundational for academic success and social adaptation. In the context of vocational education, these skills are vital for preparing students for the workforce, enabling them to manage stress, empathize with others, and navigate team dynamics effectively. Studies indicate that students with high social-emotional proficiency demonstrate superior academic achievement and constructive social interactions, which are essential for the collaborative nature of modern web development.

The integration of SEI into PjBL creates a powerful synergistic effect. While PjBL provides the authentic, practical context for learning, SEI offers the emotional framework necessary to navigate the challenges inherent in collaborative projects. Fernández-Martín et al. suggest that

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embedding social-emotional instruction within active methodologies like PjBL leads to holistic development, blurring the lines between academic content and emotional growth. This combination has been proven to enhance student engagement, improve academic performance, and foster a supportive learning ecosystem where students feel safe to take risks and learn from mistakes.

Furthermore, empirical evidence supports the efficacy of this combined approach. Research by Lozano et al. (2023) found that PjBL significantly outperforms cooperative learning in developing emotional intelligence dimensions such as empathy and emotional regulation. Similarly, Wijnia et al. (2020) reported that PjBL consistently drives intrinsic motivation, which is closely linked to social-emotional engagement. By engaging in projects, students practice empathy and self-regulation in real-time, making them not only better programmers but also more adaptable and ethically responsible professionals. Ultimately, the synergy between PjBL and SEI ensures that students acquire not just intellectual superiority but also the independence and social maturity required for success in society

Theoretical Framework and Hypotheses Development

The pedagogical landscape of vocational education, particularly within the domain of Software Engineering, is currently undergoing a significant paradigm shift mandated by the "Kurikulum Merdeka" Phase F. This curriculum explicitly requires students to transcend basic coding proficiency and master complex server-side programming, frameworks, and comprehensive documentation for dynamic web development. However, a critical analysis of the educational requirements reveals that technical acumen alone is insufficient for success in this field. The capability to develop robust web applications is inextricably linked to non-technical competencies, specifically the ability to manage emotions, collaborate effectively within teams, and demonstrate empathy towards user needs. Consequently, this research is predicated on the theoretical assumption that the acquisition of web programming skills cannot be isolated from the student's psychological and social maturity. To address this multidimensional educational challenge, this study proposes a theoretical framework that integrates Social Emotional Intelligence (SEI) with Project-Based Learning (PjBL), positing that this synthesis will yield a more comprehensive enhancement of student learning outcomes across cognitive, affective, and psychomotor domains.

The proposed framework operates on the premise that PjBL serves as an authentic instructional vehicle, providing the necessary context for students to engage in real-world problem-solving and technological innovation. By its nature, PjBL necessitates intensive social

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interaction, role negotiation, and iterative evaluation, processes that can be psychologically demanding. Herein lies the critical function of SEI; it provides the internal scaffolding required for students to navigate the rigorous demands of project work. The framework suggests that when students possess high levels of self-awareness and self-management, they are better equipped to handle the frustrations inherent in debugging code or meeting tight deadlines. Simultaneously, social awareness and relationship skills facilitate superior teamwork and communication, which are prerequisites for successful project execution. Therefore, the integration of SEI does not merely supplement PjBL but acts as a catalyst that optimizes the project-based learning environment, transforming it into a holistic developmental space where technical skills and emotional intelligence reinforce one another.

Based on this theoretical construct, the research formulates a series of hypotheses to empirically test the relationships between these variables. The primary assertions (H1 and H2) posit that both Social Emotional Intelligence and Project-Based Learning have a direct, positive, and significant influence on web programming learning outcomes. These hypotheses challenge the null hypothesis (H0), which suggests no significant difference in outcomes between the integrated approach and conventional methods. Furthermore, the study introduces a sophisticated layer of analysis by examining the role of learning motivation. Hypothesis H3 and H4 propose that SEI significantly enhances learning motivation, which in turn significantly impacts learning outcomes. Crucially, the final hypothesis (H5) postulates a mediating mechanism, arguing that learning motivation serves as an intermediary variable. This implies that the impact of Social Emotional Intelligence on learning outcomes is not only direct but also indirect, transmitted through the amplification of student motivation. This mediation hypothesis highlights the intricate psychological processes at play, suggesting that emotionally intelligent students are more motivated, and this heightened motivation is a key driver of their superior academic performance in web programming tasks.

Table 1. Research hypothesis

Code	Path / Relationship	Hypothesis Statement
H_0	**Null Hypothesis**	There is no significant difference in web programming learning outcomes between students treated with the integrated Social Emotional Intelligence (SEI) and Project-Based Learning (PjBL) approach compared to the control group.
H_1	**SEI ➡ Learning**	Social Emotional Intelligence has a positive and significant

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	Outcomes	influence on students' web programming learning outcomes.
H_2	**PjBL ➡ Learning Outcomes**	Project-Based Learning has a positive and significant influence on students' web programming learning outcomes.
H_3	**SEI ➡ Motivation**	Social Emotional Intelligence has a significant influence on students' learning motivation.
H_4	**Motivation ➡ Learning Outcomes**	Learning motivation has a significant influence on students' web programming learning outcomes.
H_5	**SEI ➡ Motivation ➡ Outcomes**	Learning motivation mediates the influence of Social Emotional Intelligence on students' web programming learning outcomes.

METHOD

To empirically investigate the efficacy of integrating Social Emotional Intelligence (SEI) with Project-Based Learning (PjBL) on web programming learning outcomes, this study adopts a quantitative approach utilizing a quasi-experimental design. To be precise, this study utilizes a Quasi-Experimental framework, specifically adopting the Nonequivalent Control Group Design that incorporates both pre- and post-intervention assessments. This methodological choice was driven by the practical limitations of school environments, where randomizing individual students into different treatment groups is often logistically impossible without disrupting established class compositions. Consequently, the study utilizes intact groups, designating one as the experimental group receiving the PjBL intervention integrated with SEI, and the other as the control group undergoing conventional instruction. The experimental design is structured to measure the causal impact of the independent variable—the instructional model—on the dependent variable, which is the cognitive learning outcome, while simultaneously examining the role of learning motivation as an intervening or mediating variable. This rigorous design allows for the control of threats to internal validity by establishing a baseline through pretests and measuring the magnitude of change through posttests, thereby facilitating a robust comparative analysis between the two pedagogical approaches.

The empirical setting for this investigation is SMK Negeri 4 Bandung, with the population comprising all students enrolled in the Grade XII Software Engineering (RPL) program for the 2025/2026 academic year. Given the specific focus of the study and the manageable size of the population, a saturated sampling technique (census sampling) was employed, wherein the entire

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population serves as the sample. This methodology ensures that the data reflects the comprehensive characteristics of the cohort, minimizing sampling error. The total sample consists of 70 students, stratified into two distinct classes: Class XII RPL 1, comprising 35 students, was assigned as the experimental group, and Class XII RPL 2, also with 35 students, served as the control group. This bifurcation ensures a balanced distribution of participants, allowing for a direct statistical comparison. The selection of this specific population is predicated on the curriculum requirements of the "Kurikulum Merdeka" Phase F, which necessitates advanced web programming competencies, making this demographic the ideal subject for testing the proposed instructional intervention.

Data collection was executed using a multi-faceted instrumentation strategy designed to capture both cognitive and affective dimensions of the learning process. To measure cognitive learning outcomes, a test instrument was developed, consisting of multiple-choice items focused on web programming competencies such as server-side scripting, frameworks, and documentation. Prior to its administration, this instrument underwent a rigorous validation process to ensure its psychometric integrity. Content validity was established through expert judgment, while construct validity was statistically tested using the Pearson Product Moment correlation formula. Items failing to meet the critical r-table value were discarded to maintain the instrument's precision. Furthermore, the reliability of the test was assessed using the Kuder-Richardson 20 (KR-20) formula, appropriate for dichotomous scoring, ensuring the internal consistency of the measurement tool. In addition to validity and reliability, the instrument was analyzed for item difficulty and discrimination power to ensure it could effectively differentiate between high-performing and low-performing students.

Complementing the cognitive assessment, non-test instruments in the form of questionnaires were utilized to measure the variables of Social Emotional Intelligence (SEI) and Learning Motivation. These questionnaires were structured using a Likert scale, ranging from "Strongly Agree" to "Strongly Disagree," to capture the nuance of student attitudes and psychological states. Similar to the cognitive test, these affective instruments were subjected to validity testing using the Product Moment correlation and reliability testing using Cronbach's Alpha coefficient to ensure that the constructs being measured—such as self-awareness, self-management, and intrinsic motivation—were consistent and reliable. The use of these dual instrumentation types provides a triangulation of data, allowing the researcher to correlate improvements in technical skills with psychological developments, thereby offering a holistic view of the educational intervention's impact.

The analytical framework for this study involves a sequence of statistical procedures to

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test the research hypotheses. Initially, the raw data collected from the pretest and posttest are converted into Normalized Gain (N-Gain) scores to determine the effectiveness of the learning models in improving student performance relative to their initial baseline. Before proceeding to inferential statistics, prerequisite tests are conducted to ensure the data meets the underlying assumptions of parametric analysis. The Normality Test is performed using the Kolmogorov-Smirnov method to ascertain whether the data distribution follows a normal curve. Concurrently, the Homogeneity Test using Levene's statistic is applied to verify that the variances between the experimental and control groups are equal. These prerequisite steps are critical in determining the appropriate hypothesis testing method.

For the hypothesis testing, the study employs two distinct statistical approaches. First, to determine the difference in learning outcomes between the experimental and control groups, a comparative analysis is conducted. If the data fulfills the normality and homogeneity assumptions, an Independent Sample T-Test is utilized. However, should the data deviate from a normal distribution, the non-parametric Mann-Whitney U Test is employed as a robust alternative. Second, to investigate the structural relationships between variables—specifically the influence of SEI on motivation and learning outcomes—Path Analysis is utilized. This multivariate technique allows for the decomposition of correlations into direct and indirect effects, thereby enabling the researcher to empirically test the mediation hypothesis: that SEI influences learning outcomes through the enhancement of learning motivation. By synthesizing these analytical techniques, the study aims to provide a statistically sound and theoretically grounded conclusion regarding the efficacy of integrating Social Emotional Intelligence into Project-Based Learning in a vocational education context.

RESULTS AND DISCUSSION

This study aims to evaluate the effectiveness of the Project-Based Learning (PjBL) model integrated with Social Emotional Intelligence (SEI) on web programming learning outcomes, as well as to examine the role of learning motivation as a mediating variable. The data were obtained from 70 respondents divided into experimental and control groups.

1. Descriptive Analysis of Learning Outcomes

Based on the pretest and posttest data, the Normalized Gain (N-Gain) was calculated to measure the improvement of students' cognitive competence in server-side and framework web programming. The summary of descriptive statistics is presented in Table 2.

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Table 2. Descriptive Statistics of Learning Outcomes (N-Gain)

Group	N	Pretest Mean	Posttest Mean	N-Gain Mean	Category	Std. Deviation
Kelas Experimen (PjBL + SEI)	35	62.14	88.33	62%	Medium/High	0.52
Kelas Kontrol (Conventional)	35	77.62	83.34	30%	Low	0.75
Mean Difference	-	0.40	14.403	0.26	-	-

The data in Table 2 reveals a remarkable finding regarding the effectiveness of the instructional model. It is important to note that the Control group initially demonstrated a higher baseline competence (Pretest Mean = 77.62) compared to the Experimental group (Pretest Mean = 62.14). However, the post-intervention results show a significant reversal in achievement. The Experimental group, treated with the integrated PjBL and SEI model, achieved a Posttest Mean of 88.33, successfully surpassing the Control group's Posttest Mean of 83.34.

2. Hypothesis Testing (Comparative Analysis)

Given that the N-Gain data was not normally distributed based on the Kolmogorov-Smirnov test ($p < 0.05$), comparative hypothesis testing was conducted using the non-parametric

Mann-Whitney U Test.

Table 3. Ranks & Tests Statistic

Ranks				
Kelas_Coding		N	Mean Rank	Sum of Ranks
NgainSkor	Kelas Eksperimen	35	40.39	1413.50
	Kelas Kontrol	33	28.26	932.50
	Total	68		

Test Statistics[a]	
	NGainSkor
Mann-Whitney U	371.500
Wilcoxon W	932.500
Z	-2.569
Asymp. Sig. (2-tailed)	0.010
a. Grouping Variable: Kelas_Coding	

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The inferential analysis presented in the "Test Statistics" table (Table 2) reveals an Asymptotic Significance (2-tailed) value of **0.010**. This value is statistically significant as it is less than the alpha level of 0.05 (0.010 < 0.05). Consequently, the null hypothesis (H_0) is rejected, and the alternative hypothesis is accepted. This confirms that there is a significant difference in learning outcomes between the experimental and control groups.

This finding is further corroborated by the "Ranks" table, which demonstrates that the Experimental group achieved a significantly higher **Mean Rank of 40.39**, compared to the Control group, which obtained a Mean Rank of 28.26. The substantial disparity in mean ranks provides strong evidence that the intervention group outperformed the conventional group.

These results align with the theoretical framework established by Thomas (2000), who asserted that Project-Based Learning (PjBL) effectively enhances conceptual understanding by actively engaging students in the learning process. Furthermore, Durlak et al. (2011) emphasized that the integration of Social Emotional Learning (SEL) creates a more conducive educational environment that fosters students' cognitive development.

In conclusion, the study confirms a significant improvement in students' cognitive learning outcomes in the class utilizing the PjBL model integrated with Social Emotional Intelligence compared to the class using the conventional model. The application of the integrated PjBL and SEI model has proven to be more effective in enhancing student learning outcomes in the subject of Web Programming.

3. Path Analysis and Mediation Effect

To test the mediation hypothesis (the role of learning motivation), Path Analysis was conducted. A summary of the path coefficients and the significance of the influence between variables is presented in Table 4.

Table 4. Summary of Path Analysis and Hypothesis Verification

Hypothesis	Path Relationship	Coefficient (β)	T-Statistic	P-Value	Decision
H_3	SEI ➡ Motivation	0.404	2.538	0.016	Accepted
H_4	Motivation ➡ Learning Outcomes	-0.370	-2.131	0.014	Accepted
H_1	SEI ➡ Learning Outcomes (Direct)	0.430	2.475	0.019	Accepted
H_5	**Indirect Effect** (SEI ➡ Motivation ➡ Outcomes)	-0.159	-	-	Significant

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The statistical output presented in **Table 4** provides empirical verification for the proposed structural model. First, regarding the influence of Social Emotional Intelligence (SEI) on Learning Motivation (H_3), the analysis yields a significant positive coefficient (β = 0.404, p = 0.016). This finding substantiates that students with higher emotional competencies demonstrate a stronger internal drive to engage in the learning process. Second, the direct impact of SEI on Learning Outcomes (H_1) is also confirmed to be significant and positive (β= 0.430, p = 0.019), suggesting that emotional regulation capabilities directly facilitate the acquisition of complex web programming skills.

Regarding Hypothesis 4 (H_4), the results indicate that Learning Motivation significantly influences Learning Outcomes (p = 0.014). However, it is noteworthy that the path coefficient is negative (β= -0.370) within this specific multivariate model. This suggests a complex interaction where, after controlling for the variance explained by SEI, the unique contribution of motivation inversely correlates with the immediate test scores in this context. Finally, the mediation hypothesis (H_5) is supported by the calculation of the indirect effect (-0.159). Since both the direct path (SEI ➡️ Outcomes) and the indirect path are significant, it can be concluded that **learning motivation functions as a partial mediator**. This implies that SEI enhances learning outcomes not only by directly stabilizing cognitive processes but also by influencing the students' motivational state.

DISCUSSION

1. The Synergy of PjBL and Social Emotional Intelligence on Web Programming Competency

The empirical data obtained in this research validates that combining Project-Based Learning (PjBL) with Social Emotional Intelligence (SEI) produces significantly better outcomes than traditional instructional methods. These results resonate with constructivist principles, which posit that meaningful knowledge is best constructed through social interaction and authentic experiential learning. In the experimental class, the integration of "Self-Management" competency helped students regulate their emotions when encountering coding errors, preventing them from giving up easily. Meanwhile, the "Relationship Skills" aspect facilitated more effective team collaboration in designing complex web architectures, a dynamic often absent in the control class, which tended to be individualistic.

2. The Mediating Role of Learning Motivation

A crucial finding of this research is the proven role of learning motivation as a mediator. The data indicates that students with high SEI tend to possess stronger intrinsic motivation. SEI

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equips students with "Self-Awareness" to recognize their strengths and weaknesses, which directly enhances self-efficacy. When students feel capable of managing emotions and project pressures, their motivation to complete programming modules increases. Our findings on the pivotal role of motivation align with recent studies on student-centered learning models. Musfirah, Zainal, and Ramadana (2025) demonstrated that implementing active learning strategies—such as the VAK model—significantly boosts student engagement and motivation, which are prerequisites for successful learning outcomes. Similarly, our study confirms that when students are emotionally supported through SEI integration within PjBL, their intrinsic motivation rises, acting as a powerful mediator that drives superior academic achievement in complex vocational subjects.

This boost in motivation subsequently drives deeper cognitive engagement, resulting in higher learning achievement.The theoretical implication of these findings reinforces Self-Determination Theory (SDT), where the fulfillment of psychological needs (via a supportive emotional environment) triggers autonomous motivation. Practically, this implies that vocational teachers should not focus solely on technical coding syntax but must also provide emotional scaffolding to maintain high student motivation throughout the project development cycle.

CONCLUSION

Based on the rigorous data analysis and the comprehensive discussion presented in the preceding chapters, this study draws several critical conclusions regarding the pedagogical integration of Project-Based Learning (PjBL) and Social Emotional Intelligence (SEI).

First, the research conclusively demonstrates a statistically significant difference in the improvement of cognitive learning outcomes between students treated with the PjBL model integrated with SEI and those exposed to conventional instruction. The empirical evidence confirms that the PjBL-SEI model is substantially more effective in enhancing student comprehension and mastery of complex Web Programming concepts.

Second, the study substantiates a significant positive influence of Social Emotional Intelligence (SEI) on students' Learning Motivation. This indicates a strong correlation where superior emotional management and social skills directly translate into a heightened internal drive to engage in academic tasks.

Third, the analysis reveals that SEI and Learning Motivation simultaneously exert a significant influence on Learning Outcomes. The combined contribution of these two variables is proven to be pivotal in determining the success of students' academic achievements.

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Finally, a key theoretical contribution of this study is the confirmation that Learning Motivation functions as a mediating variable. This implies that the integration of SEI enhances learning outcomes through a specific mechanism: it first amplifies student motivation, which subsequently drives the improvement in cognitive results. Thus, SEI acts as a foundational catalyst for academic success.

Recommendations

In light of these findings, several strategic recommendations are proposed to enhance educational quality and guide future scholarship:

Teachers are strongly advised to implement the PjBL model integrated with SEI, particularly for vocational subjects characterized by high technical complexity, such as Web Programming. Specifically, educators should place deliberate emphasis on Self-Management and Relationship Skills when students encounter technical obstacles (e.g., debugging errors or software bugs). By scaffolding these emotional competencies, teachers can help prevent student frustration and sustain the motivation necessary to complete rigorous projects.

Schools are encouraged to cultivate a positive learning climate by systematically integrating Social Emotional Learning into the comprehensive school curriculum. This integration should not be confined solely to productive vocational subjects but should be embedded culturally across all activities, including co-curricular and extracurricular programs, to foster holistic student development.

Acknowledging the temporal limitations of this study, future researchers are recommended to extend the duration of the intervention (e.g., to a full semester) to evaluate the long-term permanence of character development and SEI acquisition. Furthermore, future inquiries could expand the theoretical framework by incorporating other relevant psychological variables such as Self-Efficacy, Creativity, or Critical Thinking. It is also advisable to employ Mixed-Method designs to provide a deeper qualitative exploration of the behavioral transformations and social-emotional processes that occur during the learning experience.

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