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Self-Efficacy, Numerical Literacy, and Problem-Solving Skills in Statistics: A Quantitative Study in Jayapura

Eka Pravitasari Putri [1*]
[1] Sekolah Tinggi Ilmu Ekonomi Port Numbay Jayapura, Indonesia
* Author Correspondence

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Abstract
Problem-solving skills in statistics are crucial for development economics students as a foundation for analytical thinking and evidence-based decision-making. This study analyzes students' problem-solving abilities and examines the influence of two internal factors: self-efficacy and numerical literacy. Using a descriptive quantitative approach with inferential analysis through SEM-PLS assisted by SmartPLS 4, data were collected from 200 purposively selected students in the third to fifth semesters. Instruments included a problem-solving test based on Pólya's four-step model, a Likert-scale questionnaire, and limited interviews to complement the findings. Results show that self-efficacy ($\beta = 0.244$; $p < 0.01$) and numerical literacy ($\beta = 0.186$; $p < 0.05$) significantly influence problem-solving skills, while the R^2 value (0.119) indicates that other factors also play a role. These results align with Bandura's (1997) Social Cognitive Theory, emphasizing that belief systems affect effort and cognitive performance. This study integrates affective (self-efficacy) and cognitive (numerical literacy) factors in one analytical framework, which remains underexplored in Development Economics education. The novelty lies in mapping both psychological and cognitive predictors of problem-solving simultaneously. Practically, the study recommends contextual, problem-based learning, the integration of statistical software (SPSS, Stata, R), and strategies to enhance students' academic confidence. Overall, the findings contribute to improving statistical education aligned with Sustainable Development Goals (SDG 4 – Quality Education and SDG 8 – Inclusive Economic Growth) and strengthening students' readiness for digital transformation and data-driven policy environments

Contact : Corresponding author e-mail: nusantaraedu25@gmail.com

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Introduction

Statistics is a fundamental competency for Development Economics students because it serves as a tool for data analysis, decision-making, and evidence-based policy formulation. However, learning Statistics often becomes a challenge, particularly when students are confronted with abstract concepts such as probability, regression, and data interpretation. These difficulties are further compounded by low levels of numerical literacy, limited practical experience, and persistent obstacles in online learning. Such conditions result in weak problem-solving skills among students, even though Statistics courses are expected to strengthen critical and analytical thinking, which are essential for addressing contemporary development issues (Utami & Usman, 2021; Asiah et al., 2022; Husna et al., 2025).

From a theoretical perspective, problem-solving ability can be explained through George Pólya's four-step model, which includes understanding the problem, planning a strategy, executing the plan, and evaluating the results (Pólya, 1945). This model is highly relevant in Statistics learning as it trains students to think systematically and reflectively when dealing with real-world problems. Previous studies have demonstrated the effectiveness of innovative learning models such as Problem-Based Learning (PBL), Collaborative Problem Solving (CPS), flipped classrooms, and Realistic Mathematics Education (RME) in enhancing students' analytical skills (Amanda et al., 2023; Xu et al., 2023; Susanto et al., 2024). However, most of these studies emphasize instructional design, while fewer have examined internal student factors related to statistical problem-solving ability, particularly in the context of Development Economics.

International studies have explored the relationship between numerical literacy and problem-solving in economics and management education (Makwakwa et al., 2023; Muerza et al., 2024). Similarly, several studies in Indonesia highlight students' difficulties in mastering statistical concepts (Asiah et al., 2022; Santia & Handayani, 2023). Nevertheless, the majority of these works tend to focus on cognitive aspects, such as concept mastery or numerical literacy, without considering affective factors like self-efficacy. In fact, self-efficacy has been shown to influence students' self-regulation and persistence in learning (Ningrum & Rafsanjani, 2024). This situation reveals a research gap: the lack of integration between affective and cognitive factors in explaining problem-solving ability in Statistics courses among Development Economics students.

Despite these advancements, there remains limited understanding of how affective and cognitive factors interact to influence students' statistical performance. Integrating both self-efficacy and numerical literacy within one analytical framework is expected to enrich the explanation of students' problem-solving skills in Statistics courses (Hair et al., 2021; Ningrum & Rafsanjani, 2024).

This study seeks to address that gap by simultaneously examining the influence of self-efficacy (affective factor) and numerical literacy (cognitive factor) on students' statistical problem-solving skills. The urgency of this research lies in its potential contribution to curriculum development in Development Economics, particularly in preparing students for 21st-century competencies such as data literacy, critical thinking, and evidence-based decision-making. In terms of novelty, this study does not merely emphasize learning design but also maps students' internal factors that shape statistical problem-solving skills. Practically, the

findings are expected to provide pedagogical recommendations, including problem-solving-based Statistics learning, the integration of statistical software, and the application of contextual PBL. Thus, this research contributes to achieving the Sustainable Development Goals (SDG 4 and SDG 8) and strengthens graduates' readiness to face digital transformation and data-driven policies.

Method

This study employed a descriptive quantitative approach with inferential analysis to examine students' problem-solving abilities and the influence of self-efficacy and numerical literacy. The sample consisted of 200 Development Economics students in their third to fifth semesters, selected purposively to ensure adequate exposure to Statistics courses. Data were collected using three instruments, namely a problem-solving test based on Pólya's four-step model, a Likert-scale questionnaire on self-efficacy and numerical literacy, and limited interviews to enrich the findings. The research procedure began with instrument preparation and pilot testing, followed by data collection conducted both in-person and online, and concluded with analysis using Structural Equation Modeling–Partial Least Squares (SEM-PLS) with SmartPLS 4. This analysis included measurement model testing to ensure validity and reliability, followed by structural model evaluation to examine path coefficients, explanatory power, and predictive relevance. The use of SEM-PLS was considered appropriate due to its ability to process moderate sample sizes and non-normal data, while also ensuring empirical rigor in line with the study's objectives. The determination of the sample size (n = 200) followed the recommendation of Hair et al. (2021), suggesting that SEM-PLS requires at least ten times the largest number of indicators per construct to ensure model stability and representativeness.

Results and Discussion

Results

Descriptive analysis showed variations in the level of self-efficacy, numerical literacy, and problem-solving skills of students. In general, the average value of problem-solving ability is in the medium category, with a relatively homogeneous standard deviation, so the data deserves further analysis. The results of the validity test showed that all indicators had *an outer loading* value above 0.80. Cronbach's Alpha and Composite Reliability (CR) values are also over 0.90, while Average Variance Extracted (AVE) is above 0.80. Thus, research instruments can be declared valid and reliable. A summary of the test results is shown in Table 1.

Table 1. Construct Validity and Reliability Test Results

Construct	Cronbach's Alpha	R	VE	Outer Loading Range
Self-Efficacy	0.954	.965	.845	0.893 – 0.935
Numerical Literacy	0.953	.963	.840	0.889 – 0.947
Problem Solving	0.971	.977	.894	0.927 – 0.959

The value of the determination coefficient (R^2) for the Problem Solving variable is 0.119. This shows that self-efficacy and numerical literacy are able to explain 11.9% of variations in problem-solving ability, while the rest are influenced by other factors outside the model.

The results of the path coefficient analysis showed that self-efficacy ($\beta = 0.244$; $p < 0.01$) and numerical literacy ($\beta = 0.186$; $p < 0.05$) had a significant positive effect on students' problem-solving ability. A summary of the results is shown in Table 3.

Table 2. Structural Model Test Results (Path Coefficients and Bootstrap)

Relationships Between Variables	Line Coefficient (β)	t-Statistics	p-Value	Information
Self-Efficacy → Problem Solving	0.244	3.379	0.001	Signifikan
Literasi Numerik → Problem Solving	0.186	2.556	0.011	Signifikan

The results of the SEM-PLS analysis are also visualized in the path model which shows the direction and magnitude of the influence of self-efficacy and numerical literacy on problem-solving ability.

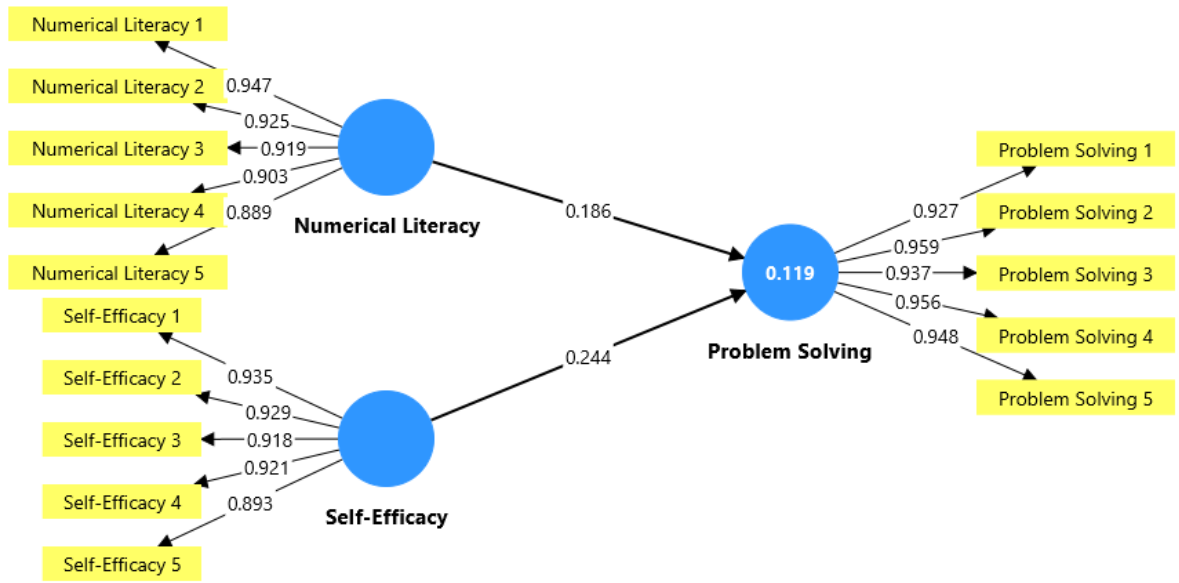

Figure 1. Research Structural Model (SEM-PLS Output)

Figure 1 shows the structural model of the SEM-PLS analysis that illustrates the relationship between self-efficacy, numerical literacy, and student problem-solving ability in the Statistics course. The pathway that connects self-efficacy with problem solving shows a coefficient of $\beta = 0.244$ with a p< value of 0.01, which means that self-efficacy has a significant positive effect on problem-solving skills. This confirms that students with higher self-confidence tend to be more confident, diligent, and able to explore solving strategies when facing complex statistical problems. Meanwhile, the path from numerical literacy to problem solving has a coefficient of $\beta = 0.186$ with a p< value of 0.05, so it can be concluded that basic numerical skills, including the skills of interpreting graphs and analyzing probabilities, also contribute significantly to increasing problem-solving capacity. A determination coefficient value (R^2) of 0.119 indicates that these two factors are simultaneously able to explain 11.9%

variation in students' problem-solving abilities, while the rest is influenced by other factors outside the model.

Although both variables were found to be significant, the relatively small R^2 value indicates that there may be mediating or moderating factors that were not captured in this model. Variables such as students' attitude toward statistics (Phurikultong & Kantathanawat, 2022) or learning trust in collaborative settings (He et al., 2023) might explain indirect pathways that contribute to students' statistical problem-solving capacity. Thus, the visualization in Figure 3 confirms that students' statistical problem-solving skills are not only determined by the mastery of cognitive concepts, but also by affective factors in the form of self-efficacy, although the contribution is not completely dominant so that it requires the study of other external factors as a complement.

Discussion

The findings of this study indicate that self-efficacy has a significant positive effect on students' statistical problem-solving abilities. This is consistent with Bandura's social-cognitive theory, which emphasizes that self-efficacy influences individuals' effort, strategy, and perseverance in facing academic challenges. Students with high levels of self-efficacy tend to be more confident, willing to explore solution strategies, and persistent when dealing with complex statistical problems. These results align with Ningrum and Rafsanjani (2024), who highlight that self-efficacy enhances problem-solving skills through self-regulation and critical thinking. In the context of development economics, the role of self-efficacy is increasingly crucial, as statistical data analysis serves as the foundation for evaluating public policies, measuring inequality, and designing sustainable development strategies. Low self-efficacy can hinder students' ability to apply statistical knowledge to real-world development cases, despite its importance in the era of evidence-based policy (Yusuf & Widodo, 2022). Therefore, self-efficacy can be regarded as psychological capital that directly influences the readiness of development economics graduates.

In addition to self-efficacy, the study confirms that numerical literacy significantly affects problem-solving skills. Numerical literacy serves as a cognitive foundation for understanding abstract concepts, interpreting data, and drawing evidence-based conclusions. Previous studies have also found that numerical literacy is a strong predictor of student success in data-driven courses (Amalina & Vidákovich, 2023; Santia & Handayani, 2023). From a development economics perspective, numerical literacy is a key competency for analyzing macroeconomic issues, assessing fiscal policy effectiveness, and evaluating the achievement of the Sustainable Development Goals (SDGs). As Kurnia et al. (2023) emphasize, mastery of numerical literacy is also closely related to data literacy and technology literacy, which are now considered strategic competencies in supporting inclusive and sustainable development. Thus, numerical literacy is not merely a technical skill but also a strategic foundation for strengthening human resource capacity in the field of development economics.

Although self-efficacy and numerical literacy were proven to be significant, the R^2 value of 11.9% indicates the existence of other factors that also influence problem-solving ability. Previous studies have shown that learning styles (Arifanti et al., 2024), personality types (Nasution et al., 2025), and cognitive executive functions such as working memory (Liu, 2024)

play important roles. In addition, socio-economic factors, including access to digital devices, also shape the quality of students' learning experiences (Amalina & Vidákovich, 2023). In the context of development, these external factors can distinguish between students with adequate learning opportunities and those with limited access. Therefore, students' problem-solving skills result from the interaction between internal and contextual factors.

Several supporting factors for problem-solving ability include the implementation of innovative learning models such as Problem-Based Learning (PBL) and Collaborative Problem Solving (CPS). Xu et al. (2023) demonstrated that CPS enhances critical thinking and collaboration skills, while Rismayanti et al. (2024) proved the effectiveness of project-based learning in addressing complex development problems. The integration of educational technology, such as flipped classrooms and interactive media, has also been shown to strengthen students' statistical literacy (Lu & Xie, 2023). On the other hand, the most common obstacles include math anxiety, which reduces students' focus and confidence (Gunadi et al., 2022), as well as the lack of practical experience, especially in online learning environments (Asiah et al., 2022; Husna et al., 2025). Hence, pedagogical strategies must balance cognitive, affective, and experiential aspects to produce holistically competent students.

The implications of this study are significant for curriculum development in Development Economics. First, statistics learning should be contextualized with development issues such as poverty, inequality, and inflation to increase its relevance to students' needs (Mahmuti et al., 2025). Second, integrating professional statistical software (e.g., SPSS, Stata, R, EViews) into the curriculum can better prepare students for data analysis in development contexts (Domu et al., 2023; Susanto et al., 2024). Third, improving students' self-efficacy can be achieved by fostering a supportive classroom climate, providing positive feedback, and implementing scaffolding. Fourth, incorporating big data and artificial intelligence (AI) into statistical learning can broaden students' analytical skills in line with the demands of the digital transformation era.

Furthermore, statistical problem-solving skills are directly linked to 21st-century competencies, which emphasize data literacy, critical thinking, and evidence-based decision-making. Muerza et al. (2024) highlight that mastery of statistics is essential for preparing students to meet the challenges of digitalization and a data-driven economy. At the global level, these competencies align with the Sustainable Development Goals, particularly SDG 4 (quality education) and SDG 8 (inclusive economic growth). Thus, this study contributes not only to the academic discourse but also to strengthening human resource capacity for sustainable development. Moreover, this research addresses a gap in the literature, which has often focused only on numerical literacy or self-efficacy separately. In Indonesia, studies on the simultaneous relationship between affective and cognitive factors in statistical problem solving among Development Economics students remain limited (Asiah et al., 2022; Santia & Handayani, 2023). Meanwhile, international studies tend to discuss problem solving within the fields of business and management (Makwakwa et al., 2023; Muerza et al., 2024), without linking it to the context of development.

The main contributions of this study are: (1) the simultaneous integration of affective (self-efficacy) and cognitive (numerical literacy) factors, (2) the connection between statistical problem-solving and development analysis, and (3) pedagogical recommendations relevant to higher education in the digital era. In addition, the findings align with Hair et al. (2021),

confirming that low R^2 values in behavioral SEM-PLS models often reflect the influence of unobserved constructs, such as motivation or digital readiness. Hence, future models could incorporate these constructs to increase predictive accuracy while capturing students' broader learning contexts.

Conclusion

This study concludes that self-efficacy and numerical literacy significantly influence the problem-solving ability of Development Economics students in Statistics courses, thereby confirming the research objectives of mapping students' skill levels and testing the role of internal factors. The novelty of this research lies in the simultaneous integration of affective (self-efficacy) and cognitive (numerical literacy) aspects, which are rarely examined together in the Indonesian context of Development Economics education. Theoretically, the findings contribute to the literature by emphasizing that statistical problem-solving is shaped not only by cognitive mastery but also by psychological capital in the form of academic confidence. Practically, the results provide pedagogical recommendations for designing Statistics learning that is contextualized with development issues, incorporates statistical software, and applies problem-based approaches to strengthen analytical skills. These insights are also relevant to supporting evidence-based policy making and preparing graduates with 21st-century competencies in the era of digital transformation. Nevertheless, the relatively low explanatory power (R^2 = 0.119) highlights the need for further exploration of intervening variables, such as learning motivation, digital literacy, and environmental support. Future research could employ a mixed-method approach or multi-group analysis to validate these relationships across different educational settings. In broader terms, the study reinforces the alignment of statistical education with the Sustainable Development Goals, particularly SDG 4 (quality education) and SDG 8 (inclusive economic growth). However, as the model only explained a limited proportion of the variance in problem-solving ability, further studies are recommended to investigate additional factors such as intrinsic motivation, executive cognitive functions, and the integration of digital technology, ensuring a more comprehensive understanding of the determinants of students' statistical problem-solving skills.

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Author's Notes

The author declares that there is no conflict of interest regarding the publication of this article. The author confirms that this article is original and free from any form of plagiarism.

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