

Academic stress, self-efficacy, and digital literacy as determinants of vocational students' critical thinking

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Abstrak

Penelitian ini dilatarbelakangi oleh tuntutan kompetensi abad ke-21 pada era Industri 4.0 yang mengharuskan siswa Sekolah Menengah Kejuruan (SMK) menguasai kemampuan berpikir kritis. Kemampuan tersebut belum optimal akibat tingginya tekanan akademik serta belum matangnya literasi digital dan keyakinan diri. Penelitian ini bertujuan menganalisis pengaruh stres akademik, efikasi diri akademik, dan literasi digital terhadap berpikir kritis, serta pengaruh literasi digital terhadap efikasi diri akademik. Metode kuantitatif korelasional diterapkan pada 106 siswa program keahlian manajemen perkantoran yang dipilih melalui teknik penarikan sampel acak berstrata. Data dikumpulkan menggunakan kuesioner tertutup dan dianalisis dengan pemodelan persamaan struktural berbasis varians. Hasil analisis membuktikan bahwa stres akademik berpengaruh negatif dan signifikan terhadap berpikir kritis. Sebaliknya, efikasi diri akademik dan literasi digital berpengaruh positif dan signifikan terhadap berpikir kritis. Literasi digital juga berpengaruh positif dan signifikan terhadap efikasi diri akademik. Sekolah dan guru disarankan mengelola beban tugas guna menekan stres akademik serta mengintegrasikan pembelajaran berbasis masalah untuk mendorong kemandirian analitis siswa.

Kata kunci: beban kognitif; keterampilan abad ke-21; pemodelan persamaan struktural; pendidikan vokasi; tekanan belajar

Abstract

This study responds to the 21st-century competency demands of the Industry 4.0 era, which require vocational high school students to master critical thinking. In practice, this competence remains suboptimal because of high academic pressure and underdeveloped digital literacy and self-belief. The study analyzes the effects of academic stress, academic self-efficacy, and digital literacy on critical thinking, as well as the effect of digital literacy on academic self-efficacy. A quantitative correlational method was applied to 106 office management students selected through stratified random sampling. Data were collected using closed-ended questionnaires and analyzed with variance-based structural equation modeling. The results show that academic stress has a significant negative effect on critical thinking, whereas

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academic self-efficacy and digital literacy have significant positive effects on it. Digital literacy also exerts a significant positive effect on academic self-efficacy. Schools and teachers are advised to manage the academic workload to reduce academic stress and to integrate problem-based learning to foster students' analytical independence.

Keywords: 21st-century skills; cognitive load; learning pressure; structural equation modeling; vocational education

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Introduction

In the era of globalization and digitalization that defines the twenty-first century, critical thinking has become an essential competency for navigating the dynamics of Industry 4.0, in which education curricula are increasingly oriented toward producing graduates equipped with the core 4C competencies (Herlinawati et al., 2024). The technological revolution has further positioned critical thinking as a fundamental, disruption-resistant skill for the future of work (Dumitru & Halpern, 2023). Field realities, however, indicate that this competency has not developed optimally. Observations conducted at SMK Negeri 1 Karanganyar within the Office Management and Business Services (MPLB) program revealed that most students still tend to be passive, struggle to formulate logical arguments, and are unable to evaluate the validity of information independently. This phenomenon aligns with international evidence from the 2022 Programme for International Student Assessment (PISA), which indicates that the critical and creative reasoning capacity of secondary students in Indonesia remains relatively low and vulnerable to misinformation in digital spaces.

Critical thinking does not develop in isolation; rather, it emerges from a complex interaction between psychological and environmental factors (Zhong & Song, 2024). Conceptually, critical thinking is the reflective and systematic cognitive capacity through which students process administrative information to reach logical operational decisions (Gómez et al., 2025). One psychological factor that impedes this cognitive process is academic stress, a negative emotional condition arising from the gap between learning demands and an individual's capacity to meet them (Munir et al., 2020). In contrast, a psychological factor that drives it is academic self-efficacy, which refers to the affective-cognitive appraisal of one's learning ability that shapes students' academic motivation and engagement (Zysberg & Schwabsky, 2021). Beyond psychological factors, the external environment particularly digital literacy plays an essential role in the modern era. Digital literacy is defined as the intellectual capacity of students to use the internet to manage and produce information effectively and responsibly; it demands not only technical mastery of devices but also critical and strategic thinking (Zakir et al., 2025). Sound digital literacy equips students with a crucial means of evaluating digital sources critically.

Although the urgency of developing critical thinking is widely acknowledged, a significant research gap persists. Most prior studies examining academic stress and self-efficacy in relation to critical capacity have focused on higher education or university settings (Acosta-Enriquez et al., 2025; Bay et al., 2025; Febriani et al., 2024; Vachova et al., 2023). Research that specifically and simultaneously examines the relationships among academic stress, academic self-efficacy, and digital literacy in shaping critical thinking among vocational high school (SMK) students remains scarce. The novelty of this study lies in the simultaneous integration of these three variables within the MPLB vocational education context a setting characterized by the dual burden of mastering practical vocational competencies while maintaining the academic analytical ability required to face the complexity of the world of work.

Based on this background and research gap, the study is guided by four principal questions. First, does academic stress significantly affect the critical thinking of MPLB students at SMK Negeri

1 Karanganyar? Second, does academic self-efficacy significantly affect their critical thinking? Third, does digital literacy significantly affect critical thinking? Fourth, does digital literacy significantly affect students' academic self-efficacy within this vocational education setting?

In line with these questions, the study aims to examine and analyze the significance of the effects of academic stress, academic self-efficacy, and digital literacy on critical thinking, as well as the effect of digital literacy on the academic self-efficacy of MPLB students at SMK Negeri 1 Karanganyar. Theoretically, the findings are expected to contribute to the development of social cognitive theory by mapping the interaction between psychological factors and digital skills in vocational education. Practically, the study is expected to offer insights for educators and schools as a basis for designing reflective learning strategies, strengthening digital literacy meaningfully, and providing appropriate stress-management support, thereby producing adaptive, resilient, and critical vocational graduates ready for the workplace.

Research Methods

This study was conducted at SMK Negeri 1 Karanganyar, focusing on Grade X and XI students of the Office Management and Business Services (MPLB) program, from September 2025 to June 2026. The research proceeded through three systematic stages: a preparation stage involving title submission and permit processing; an implementation stage focusing on field data collection and processing; and a final stage comprising the comprehensive preparation of the research report.

The study employed a quantitative approach with a correlational research design. The correlational design was used to examine the relationships and magnitude of effects among variables objectively, based on numerical data and without manipulating the observed subjects. Within this framework, academic stress and digital literacy were positioned as exogenous variables, academic self-efficacy served a dual role as both an endogenous variable and an intervening exogenous variable, and critical thinking was designated as the primary endogenous variable.

The population comprised all Grade X and XI students of the MPLB program, distributed across four study groups, totaling 143 students. The sample size was determined using the Slovin formula with a 5% margin of error, yielding a representative sample of 106 students. Proportional stratified random sampling was applied. Through this proportional calculation, the sample was distributed evenly between Grade X (52 students) and Grade XI (54 students), ensuring balanced representation of each grade and equal probability of selection for every student.

Data were collected using a closed-ended questionnaire distributed online via a Google Form link. The measurement instruments were adopted from empirically validated prior studies: the instrument developed by Acosta-Enriquez et al. (2025) was used to measure academic stress, academic self-efficacy, and critical thinking, while the instrument developed by Donaldson et al. (2025) was used to measure digital literacy. In their original studies, both instruments demonstrated construct validity and high internal reliability, with Cronbach's alpha values consistently exceeding the 0.70 threshold. All questionnaire items were rated on a five-point Likert scale ranging from strongly disagree to strongly agree, capturing variation in respondents' perceptions in a standardized manner.

Because the original instruments were formulated in English, a cross-linguistic and cross-cultural adaptation was conducted before administration. This process involved forward translation, back-translation, and a readability check validated through expert judgment by subject-matter and language specialists. Once the instruments were deemed appropriate for the Indonesian vocational student context, a pilot test was administered to a small group outside the main sample. The results of the adapted instruments confirmed highly adequate validity and reliability: all indicators had loading coefficients above 0.70 and Cronbach's alpha values consistently exceeding 0.70, confirming the instruments' suitability for field data collection.

Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS version 4.1.1.8, supported by IBM SPSS Statistics version 27 for preliminary descriptive statistics. PLS-SEM was selected for its strength in analyzing complex structural models, its variance-based predictive orientation, and its robustness in not requiring the assumption of normally distributed data (Hair & Alamer, 2022). Testing proceeded in two stages. The first

evaluated the outer model as a prerequisite instrument-adequacy test, establishing validity (convergent and discriminant) and reliability (Cronbach's alpha and composite reliability) for all indicators. The second evaluated the inner model to measure the coefficient of determination (R^2) and to test the research hypotheses inferentially by examining path coefficients, the t-statistic significance threshold (> 1.96), and p-values (< 0.05) through a bootstrapping procedure.

Results and Discussion

Research Results

This study involved 106 respondents from Grade X and XI of the MPLB program at SMK Negeri 1 Karanganyar, the majority of whom were female (98.1%). This demographic imbalance reflects the natural characteristics of the MPLB program population at the research site, which is specifically dominated by female students. Descriptive statistical analysis showed that academic stress had the highest mean (3.796), followed by academic self-efficacy (3.756) and digital literacy (3.443). By contrast, critical thinking had a mean of 3.347 with the highest standard deviation (1.125). The high standard deviation for this variable indicates a fairly wide variation in critical thinking ability among students at the school.

The outer model assessment using SmartPLS showed that all indicators met the validity and reliability criteria, as presented in Table 1. Further evaluation confirmed that discriminant validity was well established based on the Fornell-Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio, all of which fell below the critical threshold of 0.90.

Table 1
Results of the Outer Model Evaluation

Construct	Average Variance Extracted (AVE)	Cronbach's Alpha	Composite Reliability
Academic Stress	0,789	0,933	0,949
Academic Self-Efficacy	0,731	0,939	0,950
Digital Literacy	0,642	0,814	0,877
Critical Thinking	0,614	0,843	0,888

Subsequently, the model fit test and the structural (inner) model evaluation confirmed that the conceptual model represented the field data empirically at a moderate level. The detailed results are presented in Table 2.

Table 2
Hasil evaluasi inner model dan kesesuaian model

Testing Indicator	Value	Description
Model Fit		
Standardized Root Mean Square Residual (SRMR)	0,063	Fit
Normed Fit Index (NFI)	0,830	Marginal Fit
Coefficient of Determination (R^2)		
Critical Thinking	0,590	Moderate
Academic Self-Efficacy	0,340	Moderate

Hypothesis testing using the bootstrapping procedure (based on the significance criteria of $p < 0.05$ and $t > 1.96$) demonstrated that all research hypotheses were supported. Academic stress had a significant negative effect on critical thinking ($\beta = -0.403$; $t = 7.426$; $p = 0.000$). Conversely, academic self-efficacy ($\beta = 0.396$; $t = 5.252$; $p = 0.000$) and digital literacy ($\beta = 0.317$; $t = 3.959$; $p = 0.000$) had significant positive effects on critical thinking. Finally, digital literacy also had a significant positive effect on the formation of students' academic self-efficacy ($\beta = 0.583$; $t = 11.305$; $p = 0.000$). A complete summary of these hypothesis-testing results is presented in Table 3.

Table 3
Hasil uji hipotesis penelitian

Hypothesis	Path	Coefficient	t-statistics	p-values	Description
H1	Academic stress -> Critical thinking	-0,403	7,426	0,000	Significant / Accepted
H2	Academic Self-Efficacy -> Critical thinking	0,396	5,252	0,000	Significant / Accepted
H3	Digital Literacy -> Critical thinking	0,317	3,959	0,000	Significant / Accepted
H4	Digital Literacy -> Academic Self-Efficacy	0,583	11,305	0,000	Significant / Accepted

Discussion

The first hypothesis confirmed that academic stress exerts a significant negative effect on students' critical thinking. This finding indicates that the additional cognitive load generated by high theoretical and vocational-practice demands depletes students' working memory, diverting the brain's capacity for higher-order reasoning toward merely coping with anxiety. The result aligns with Dosista et al. (2025) and Bay et al. (2025), who emphasize that accumulated academic pressure damages analytical flexibility and pushes students toward learning shortcuts. Although the direction of the relationship is likewise negative, the magnitude of the stress effect in this study appears stronger than in several earlier studies of general university students, which sometimes reported only weak correlations. This difference in strength is likely attributable to differing subject characteristics: MPLB vocational students must simultaneously bear the dual burden of meeting academic competency standards and mastering work-ready technical skills.

The second hypothesis demonstrated that academic self-efficacy has a significant positive effect on students' critical thinking. Academic self-belief functions as an essential motivational foundation: students with strong confidence in their abilities proactively perceive learning difficulties as intellectual challenges rather than threats. Consequently, they possess more stable mental courage to persist in drawing rational conclusions and to filter information thoroughly. This finding is consistent with and reinforces the empirical results of Vachova et al. (2023) and Febriani et al. (2024), who indicate that open-mindedness and the courage to evaluate information depend heavily on an individual's level of self-efficacy. This underscores that vocational education institutions must cultivate learning environments capable of fostering mastery experiences, because self-confidence is a prerequisite before students can apply their analytical reasoning capacity in the field.

For the third hypothesis, digital literacy was found to have a significant positive effect on the critical thinking of vocational students. Within the modern educational ecosystem, digital literacy is no longer a mechanical ability to operate software but has evolved into a metacognitive instrument for validating information and filtering misinformation from the dense data of cyberspace. Digitally literate students proved more reflective and skeptical in sorting data before settling on a theoretical basis or making practical decisions. These field results fully support the findings of Furbani et al. (2025) and Haryanto et al. (2022), who stress that habitually testing the validity of electronic references responsibly trains the mind to think more logically and analytically. This highlights that integrating technological tools into vocational learning is no longer optional but must be embedded as a fundamental medium for sharpening logic.

Analysis of the fourth hypothesis convincingly confirmed that digital literacy simultaneously exerts a significant positive effect on students' academic self-efficacy. Technical fluency in using digital office applications and independently exploring open reference systems successfully created a robust sense of control (locus of control) among learners. Each technical success achieved while navigating digital devices cumulatively generated mastery experiences, directly boosting students' confidence that they could complete the vocational curriculum without anxiety. This discussion is reinforced by Zakir et al. (2025) and Yuan et al. (2024), who highlight that leveraging digital features

plays a central role in reducing procrastination and building learning confidence. Strengthening digital literacy in vocational settings is therefore not merely an investment in technological literacy but a psychological intervention proven effective in cultivating a generation of confident, independent learners.

Conclusion

This study concludes that academic stress has a significant negative effect on critical thinking, whereas academic self-efficacy and digital literacy consistently exert significant positive effects on critical thinking and on the enhancement of academic self-efficacy among MPLB students at SMK Negeri 1 Karanganyar. Theoretically, these findings extend Social Cognitive Theory in the vocational education context by demonstrating that the dynamic interaction between an external environmental resource (digital literacy) and internal psychological conditions (stress and self-efficacy) crucially shapes students' higher-order cognitive capacity. As practical implications and recommendations for SMK Negeri 1 Karanganyar, the school should evaluate the distribution of academic and vocational-practice workloads and intensively optimize the role of guidance and counseling services to reduce student stress. In addition, teachers are strongly encouraged to integrate digital literacy through problem-based learning models that require students to select information independently, so that their analytical independence and self-confidence can develop optimally. Accordingly, several specific suggestions are offered for future research: (a) replicating the study in other programs with more balanced gender proportions to test the consistency of the findings; (b) adding mediating or moderating variables such as personality traits or motivation to explain the 41.0% of variance left unaccounted for in the current model; and (c) applying a mixed-methods design to explore students' subjective experiences more holistically.

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