

Digital literacy and peer support as predictors of twenty-first-century competencies among MPLB students

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Abstrak

Kompetensi abad ke-21 lulusan SMK masih belum berkembang secara optimal, yang tercermin dari tingkat pengangguran lulusan SMK sebesar 8,63% berdasarkan Badan Pusat Statistik (2026). Tujuan penelitian ini yaitu menganalisis pengaruh kemampuan literasi digital dan dukungan teman sebaya terhadap kompetensi abad ke-21 siswa Manajemen Perkantoran dan Layanan Bisnis (MPLB) SMK Negeri 1 Sukoharjo secara parsial maupun simultan. Penelitian ini menggunakan pendekatan kuantitatif dengan metode survei. Populasi penelitian adalah seluruh siswa kelas XII MPLB SMK Negeri 1 Sukoharjo, dengan sampel 84 siswa yang dipilih menggunakan teknik proportionate stratified random sampling. Data dikumpulkan melalui kuesioner dan dianalisis menggunakan regresi linear berganda. Hasil penelitian menunjukkan bahwa: (1) Kemampuan literasi digital berpengaruh positif dan signifikan terhadap kompetensi abad ke-21 ($\text{sig. } 0,000 < 0,05$; $t_{\text{hitung}} 5,689 > t_{\text{tabel}} 1,990$) dengan sumbangan efektif 40,67% dan sumbangan relatif 94%; (2) Dukungan teman sebaya tidak berpengaruh signifikan ($\text{sig. } 0,587 > 0,05$; $t_{\text{hitung}} 0,546 < t_{\text{tabel}} 1,990$); (3) secara simultan kedua variabel berpengaruh positif dan signifikan ($\text{sig. } 0,000 < 0,05$; $F_{\text{hitung}} 31,058 > F_{\text{tabel}} 3,105$) dengan kontribusi sebesar 43,4%. Temuan penelitian ini memperkuat kajian Isini et al. mengenai kemampuan literasi digital sebagai faktor yang memengaruhi kompetensi abad ke-21. Disarankan agar sekolah memperkuat program literasi digital dan mendorong interaksi produktif antarsiswa.

Kata kunci: dukungan sosial teman sebaya; keterampilan 4C; kompetensi digital; pendidikan vokasi

Abstract

Twenty-first-century competencies among vocational high school graduates remain insufficiently developed, as evidenced by the 8.63% unemployment rate reported by Statistics Indonesia (BPS, 2026). This study analyzed the influence of digital literacy skills and peer support on the twenty-first-century competencies of Office Management and Business Services (MPLB) students at SMK Negeri 1 Sukoharjo, both partially and simultaneously. A quantitative approach with a survey method was employed. The population comprised all twelfth-grade MPLB students at SMK

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Negeri 1 Sukoharjo, with a sample of 84 students selected through proportionate stratified random sampling. Data were collected using a four-point Likert-scale questionnaire and analyzed through multiple linear regression. The results indicated that: (1) digital literacy skills exerted a positive and significant effect on twenty-first-century competencies ($p = .000 < .05$; $t = 5.689 > t_{table} 1.990$), with an effective contribution of 40.67% and a relative contribution of 94%; (2) peer support showed no significant effect ($p = .587 > .05$; $t = 0.546 < t_{table} 1.990$); and (3) both variables simultaneously exerted a positive and significant effect ($p = .000 < .05$; $F = 31.058 > F_{table} 3.105$), accounting for 43.4% of the variance. These findings corroborate the work of Isini et al. regarding digital literacy as a determinant of twenty-first-century competencies. Schools are encouraged to strengthen digital literacy programs and foster productive peer interactions.

Keywords : 4C skills; digital competence; peer social support; vocational education

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Introduction

The rapid advancement of information and communication technology in the era of Industry 4.0 demands that every individual possess competencies relevant to twenty-first-century requirements. Competency is understood as an individual's ability to perform tasks effectively and efficiently (Rosmaini & Tanjung, 2019). In the educational context, twenty-first-century competencies have become a primary focus to equip students with the capacity to face competition in the workforce and navigate global change. Mahmud and Wong (2022) defined twenty-first-century competencies as a set of abilities considered essential by educators, education reformers, and employers for students to achieve success in modern settings, encompassing both higher education and professional environments. According to Maulidah (2021), the Partnership for 21st Century Skills identified four core skills known as the 4Cs critical thinking, communication, collaboration, and creativity as the competencies required for twenty-first-century learning. Critical thinking refers to an individual's ability to examine, analyze, and evaluate problems rationally to arrive at sound decisions (Mulyani, 2022). Communication encompasses the skills involved in conveying information effectively, interactively, and with mutual understanding within the learning process (Widiyanto et al., 2018). Collaboration denotes students' capacity to work together, exchange ideas, and solve problems collectively to achieve learning objectives (Saleh, 2020). Creativity refers to students' ability to develop novel ideas and produce beneficial innovations aligned with technological progress (Zulkarnain et al., 2020). These four competencies form a critical foundation that enables students not only to grasp academic content but also to adapt and contribute positively in both social and professional environments.

Despite the recognized importance of these competencies, field evidence suggests that the competencies of vocational high school (SMK) graduates have not adequately met the demands of the industry. Data from Statistics Indonesia (BPS) indicate that the open unemployment rate in February 2026 reached 4.68%, with vocational high school graduates contributing the highest proportion at 8.63%, followed by general high school graduates at 6.88% (BPS, 2026). The persistently high unemployment rate among SMK graduates signals a gap between the competencies possessed by graduates and those required by the labor market. Setiyana and Oktora (2024) found that many SMK graduates experience horizontal mismatch working in fields unrelated to their training resulting in diminished productivity. Fadhillatuzzahro et al. (2024) further highlighted that vocational education curricula have not been fully aligned with the needs of modern industry. These findings collectively demonstrate that the mastery of technical skills (hard skills) alone is

insufficient, underscoring the need to strengthen twenty-first-century competencies so that graduates can adapt to the changing demands of the contemporary workplace (Fitriana, 2020).

The prevailing conditions confirm that technical competency alone cannot fulfill workforce demands. In addition to technical proficiency, today's labor market requires graduates who possess twenty-first-century competencies namely critical thinking, communication, collaboration, and creativity to adapt to technological developments and evolving work environments. The OECD report on Skills Strategy Southeast Asia: Skills for a Post-COVID Recovery and Growth (OECD, 2023) underscored a significant gap between the skills provided by educational institutions and the needs of industry across Southeast Asia, including Indonesia. This gap highlights the urgency of strengthening competencies relevant to workforce demands, including twenty-first-century competencies. Consequently, it is important to ascertain the extent to which vocational high school students have acquired these competencies as preparation for entering the workforce. Based on these conditions, a preliminary study was conducted among students of the Office Management and Business Services (MPLB) specialization at SMK Negeri 1 Sukoharjo to obtain an initial picture of their twenty-first-century competencies.

The preliminary study revealed that twenty-first-century competencies among MPLB students at SMK Negeri 1 Sukoharjo remained at a moderate level. Specifically, the ability to analyze, evaluate, and solve problems scored 60%; the capacity to generate new ideas and works scored 55%; the ability to collaborate effectively scored 64%; and the skill of expressing ideas orally with clarity and confidence scored 56%. These data indicate that all four aspects of the 4C framework have not developed optimally and that a gap persists between the demands of twenty-first-century competencies and the actual conditions of students in the field. This situation necessitates empirical investigation into the factors influencing students' twenty-first-century competencies, particularly within the context of vocational education.

Students' twenty-first-century competencies are influenced by both internal factors originating from within the student and external factors originating from outside. According to Isini et al. (2025), internal factors include intelligence, motivation, mental and physical health, self-confidence, and learning interest, whereas external factors encompass family support, school environment, socioeconomic conditions, social interaction, and teaching quality. In the context of the present study, digital literacy skills constitute an internal factor related to students' intelligence and interest in utilizing technology and learning resources, while peer support constitutes an external factor associated with students' social interactions during the learning process.

Supporting this classification, Syafi'i et al. (2018), drawing on Ahmadi and Supriyono, categorized the factors influencing student competencies into internal and external dimensions. Internal factors include physical aspects, psychological aspects such as intelligence, interest, motivation, and aptitude, as well as students' physical and psychological maturity. External factors include social, cultural, and physical environmental aspects. Within this framework, digital literacy skills fall under the internal category, specifically the intellectual factor related to students' proficiency in utilizing technology and learning resources, whereas peer support belongs to the external category within the peer group environment that can create a learning atmosphere conducive to developing twenty-first-century competencies.

Digital literacy skills refer to an individual's competence in searching for and evaluating information, making critical decisions, and fostering creativity, collaboration, and effective communication while adhering to digital safety principles (Zamista & Charona, 2023). Gilster, as cited in Mega (2020), defined digital literacy as the ability to access, understand, and analyze various information sources available in digital form. Isabella et al. (2023) described digital literacy as the ability to use digital technology to access, process, evaluate, and produce information effectively and safely to support professional activities and entrepreneurship. Data from the 2022 Indonesian Digital Literacy Index showed a score of 3.54 on a 1–5 scale, indicating that the digital literacy of the Indonesian population still requires improvement (Ministry of Communication and Information Technology, 2022). In the context of vocational education, digital literacy constitutes an important skill for SMK students because it positively influences work readiness in meeting the demands of a technology-driven industry (Syawalia et al., 2025). Mastery of digital literacy can enhance students'

twenty-first-century competencies through the development of critical thinking, creativity, communication, and collaboration skills.

Peer support serves as an external factor in the formation of students' twenty-first-century competencies. Peer support is defined as a process of mutual giving and receiving of assistance grounded in shared understanding, mutual respect, and efforts to empower individuals in similar conditions, manifested through friendship, empathy, shared experiences, and psychological support (Dani et al., 2022). Sarafino and Smith, as cited in Jannah and Netrawati (2025), added that peer support comprises four main forms emotional support, informational support, instrumental support, and esteem support which collectively contribute to individual well-being and development. Carvalho and Santos (2021) affirmed that peer-based learning not only promotes collaboration but also creates academic and emotional support that contributes to improved communication and cooperation among students. This aligns with research on Indonesian secondary school students showing that collaborative interaction among students enhances learning engagement and develops communication and cooperation skills as components of twenty-first-century competencies (Putri et al., 2024). Thus, peer support functions not merely as a social factor but also plays a role in supporting the development of students' twenty-first-century competencies.

Various prior studies have demonstrated that digital literacy skills and peer support make important contributions to the learning process in the digital era. However, research that specifically examines the simultaneous influence of digital literacy skills and peer support on twenty-first-century competencies remains limited. This limitation indicates a knowledge gap that warrants further investigation through more in-depth research. Several studies have reported a positive relationship between digital literacy and learning outcomes, including Haryaka et al. (2025), who argued that the integration of digital literacy, critical thinking, and collaborative learning constitutes a key element in addressing twenty-first-century challenges; Ananda et al. (2025), who demonstrated that digital literacy contributes to enhancing student creativity; and Aryanti et al. (2024), who found that ICT literacy and peer support positively influence self-directed learning as a component of twenty-first-century competencies. Nevertheless, research findings have not always been consistent, as improvements in digital literacy are not invariably accompanied by enhanced collaboration and communication abilities. This is consistent with the finding of Nurmala et al. (2024) that the integration of digital literacy and group work in learning does not always yield consistent improvements in communication and collaboration competencies when character strengthening and the quality of social interaction among students have not been optimized. These research gaps indicate the need for a more comprehensive examination of the influence of digital literacy skills and peer support on twenty-first-century competencies, both partially and simultaneously, particularly within the context of MPLB vocational education programs, which remain underresearched.

This study aimed to: (1) examine the effect of digital literacy skills on the twenty-first-century competencies of MPLB students at SMK Negeri 1 Sukoharjo; (2) examine the effect of peer support on the twenty-first-century competencies of MPLB students at SMK Negeri 1 Sukoharjo; and (3) examine the simultaneous effect of digital literacy skills and peer support on the twenty-first-century competencies of MPLB students at SMK Negeri 1 Sukoharjo. The study was directed toward uncovering the extent to which both factors contribute to enhancing students' twenty-first-century competencies in support of their readiness to adapt to changes in the labor market and ongoing technological advancement.

The following hypotheses were formulated: (H1) digital literacy skills have a significant effect on the twenty-first-century competencies of MPLB students at SMK Negeri 1 Sukoharjo; (H2) peer support has a significant effect on the twenty-first-century competencies of MPLB students at SMK Negeri 1 Sukoharjo; and (H3) digital literacy skills and peer support simultaneously exert a positive and significant effect on the twenty-first-century competencies of MPLB students at SMK Negeri 1 Sukoharjo.

Research Methods

This study was conducted at SMK Negeri 1 Sukoharjo during the odd and even semesters of the 2025/2026 academic year. A quantitative approach employing a causal associative research design was adopted to examine the relationships among variables based on numerical data analyzed statistically. This approach enables the objective testing of variable relationships without any treatment or intervention being applied to the research variables (Tuti & Meidiyustiani, 2024).

The population of this study comprised all twelfth-grade students enrolled in the Office Management and Business Services (MPLB) specialization at SMK Negeri 1 Sukoharjo during the 2025/2026 academic year, totaling 107 students distributed across three classes. The sample size was determined using the Slovin formula with a 5% margin of error, yielding a total of 84 respondents. Sampling was conducted using proportionate stratified random sampling to ensure that each class had an equal opportunity of being sampled and was proportionally represented (Sugiyono, 2022).

Data were collected through a closed-ended questionnaire using a four-point Likert scale. The use of four response options without a neutral alternative was intended to encourage respondents to provide more decisive answers for each statement item. Setiawan et al. (2022) argued that a four-point Likert scale is more appropriate because it reduces the tendency of respondents to select the neutral option, which may introduce data ambiguity.

The research instrument was developed based on the indicators of each variable. The digital literacy skills variable (X_1) was measured using indicators developed by Gilster (1997, as cited in Mega, 2020), encompassing internet searching, hypertext navigation, content evaluation, and knowledge assembly. The peer support variable (X_2) employed indicators from Chen (2005), covering interpersonal, cognitive, emotional, and instrumental support. The twenty-first-century competencies variable (Y) was measured using indicators from Syarifuddin et al. (2023), which include critical thinking, creativity, communication, and collaboration.

The instrument was pilot-tested with 30 twelfth-grade MPLB students at SMK Negeri 1 Karanganyar, who shared similar characteristics with the study population and were not included in the actual sample. This number was selected because it meets the minimum respondent threshold for the data distribution to approximate normality. Instrument testing was conducted through Pearson Product Moment validity testing with an r -table value of 0.361 and Cronbach's Alpha reliability testing with a criterion of $\alpha > 0.60$. The validity test results indicated that of the initial 16 statement items per variable, 14 items were valid for digital literacy skills, 9 items were valid for peer support, and 11 items were valid for twenty-first-century competencies. Invalid items were eliminated because each indicator was still represented by other valid items. The reliability test yielded Cronbach's Alpha values of 0.821 for digital literacy skills, 0.633 for peer support, and 0.690 for twenty-first-century competencies. All Cronbach's Alpha values exceeded the 0.60 threshold, confirming that all instruments were reliable and suitable for data collection.

Data processing and analysis were performed using multiple linear regression with the assistance of IBM SPSS Statistics version 27. Hypothesis testing was preceded by the execution of prerequisite tests, consisting of the normality test using the One-Sample Kolmogorov-Smirnov test, the linearity test using the Test for Linearity, the multicollinearity test using Tolerance and Variance Inflation Factor (VIF) values, and the heteroscedasticity test using the Glejser method. The autocorrelation test was not conducted in this study because the data were cross-sectional, collected at a single point in time, and thus lacked the temporal ordering (time series) that could give rise to autocorrelation in the residuals.

Hypothesis testing was carried out using the t -test to determine the partial effect of each independent variable on the dependent variable, with a t -table value of 1.990, and the F -test to examine the simultaneous effect of both independent variables on the dependent variable. Additionally, the coefficient of determination (R^2) was used to measure the magnitude of the contribution of digital literacy skills and peer support to students' twenty-first-century competencies, supplemented by the calculation of effective contribution and relative contribution for each variable.

Results and Discussion

Research Results

Pilot data were obtained through questionnaire distribution following validity and reliability testing among students at SMK Negeri 1 Karanganyar. The questionnaire that met validity and reliability criteria was subsequently distributed online to 84 twelfth-grade MPLB students at SMK Negeri 1 Sukoharjo. Respondents were drawn from three classes XII MPLB 1, XII MPLB 2, and XII MPLB 3 with sample allocation determined proportionally in accordance with proportionate stratified random sampling. The distribution of respondents by class is presented in Table 1.

Table 1
Distribution of Research Respondents

Class	Population	Sample Calculation	Sample Size
XII MPLB 1	35	$35/107 \times 84$	28
XII MPLB 2	36	$36/107 \times 84$	28
XII MPLB 3	36	$36/107 \times 84$	28
Total			84

The descriptive analysis results for each research variable are presented in Table 2.

Table 2
Descriptive Statistics of Research Variables

	Statistics		
	21st-Century Competencies	Digital Literacy Skills	Peer Support
Valid	84	84	84
Missing	0	0	0
Mean	34.9167	47.1905	29.9881
Median	35.0000	48.5000	31.0000
Mode	32.00	55.00	33.00
Std. Deviation	4.22046	6.42562	4.08197
Variance	17.812	41.289	16.663
Range	18.00	23.00	15.00
Minimum	26.00	33.00	21.00
Maximum	44.00	56.00	36.00
Sum	2933.00	3964.00	2519.00

Data on students' twenty-first-century competencies were obtained through a questionnaire comprising 11 statement items on a 1-4 Likert scale. As shown in Table 2, respondent scores ranged from a minimum of 26 to a maximum of 44, with a mean of 34.917, a standard deviation of 4.220, and a total score of 2,933. Digital literacy skills were measured using a questionnaire containing 14 statement items on the same scale. The analysis revealed a minimum score of 33 and a maximum score of 56, with a mean of 47.190, a standard deviation of 6.426, and a total score of 3,964. Peer support data were collected through a questionnaire consisting of 9 statement items on a 1-4 Likert scale. Respondent scores ranged from 21 to 36, with a mean of 29.988, a standard deviation of 4.082, and a total score of 2,519.

Prior to hypothesis testing, prerequisite tests were conducted to verify the appropriateness of the multiple linear regression model. The normality test using the Kolmogorov-Smirnov test yielded an asymptotic significance value of $0.056 > 0.05$, confirming that the data were normally distributed and satisfied the normality assumption. The linearity test showed significance values for Deviation from Linearity of $0.606 > 0.05$ between digital literacy skills and twenty-first-century competencies, and $0.421 > 0.05$ between peer support and twenty-first-century competencies, indicating linear

relationships among the variables. The multicollinearity test revealed Tolerance values of 0.590 for both digital literacy skills and peer support (> 0.10) and VIF values of 1.695 for each (< 10), confirming the absence of multicollinearity. The heteroscedasticity test using the Glejser method yielded significance values of $0.176 > 0.05$ for digital literacy skills and $0.140 > 0.05$ for peer support, confirming that no heteroscedasticity was present in the regression model. The fulfillment of all assumptions confirmed that the regression model was suitable for hypothesis testing.

The research hypotheses were tested using multiple linear regression analysis, comprising the t-test (partial), the F-test (simultaneous), the coefficient of determination (R^2), and the calculation of effective and relative contributions to determine the magnitude of each independent variable's contribution to the dependent variable, both partially and simultaneously. The hypothesis test results are presented below.

Table 3
Results of the t-Test (Partial Test)

Model	Coefficients ^a				Sig.
	Unstandardized Coefficients		Standardized Coefficients	t	
	B	Std. Error	Beta		
(Constant)	13.883	2.883		4.816	.000
Digital Literacy Skills	.407	.071	.619	5.689	.000
Peer Support	.061	.113	.059	.546	.587

The partial effect of each independent variable on the dependent variable was analyzed using the t-test with a t-table value of 1.990. As shown in Table 3, digital literacy skills (X_1) yielded a significance value of $.000 < .05$ and a t-value of $5.689 > 1.990$, leading to the rejection of H_0 and the acceptance of H_1 . Thus, digital literacy skills exerted a significant effect on students' twenty-first-century competencies. Peer support (X_2) obtained a significance value of $.587 > .05$ and a t-value of $0.546 < 1.990$. These findings indicate that H_2 was rejected and H_0 was accepted, demonstrating that peer support did not exert a significant effect on students' twenty-first-century competencies.

Table 4
Results of the F-Test (Simultaneous Test)

Model	ANOVA ^a				
	Sum of Squares	df	Mean Square	F	Sig.
Regression	641.667	2	320.833	31.058	.000 ^b
Residual	836.750	81	10.330		
Total	1478.417	83			

The F-test was conducted to examine the simultaneous effect of digital literacy skills (X_1) and peer support (X_2) on students' twenty-first-century competencies (Y). As presented in Table 4, the significance value was $.000 < .05$, and the F-value was $31.058 > F_{table} 3.105$, leading to the rejection of H_0 and the acceptance of H_3 . This indicates that digital literacy skills and peer support simultaneously exerted a significant effect on the twenty-first-century competencies of MPLB students at SMK Negeri 1 Sukoharjo.

Table 5
Multiple Linear Regression Coefficients

Variable	Coefficient (B)
Konstanta	13,883
Digital Literacy Skills (X_1)	0,407
Peer Support (X_2)	0,061

Multiple linear regression analysis was performed to determine the direction and magnitude of the effects of digital literacy skills (X_1) and peer support (X_2) on students' twenty-first-century competencies (Y). Based on Table 5, the regression equation obtained was $\hat{Y} = 13.883 + 0.407X_1 + 0.061X_2$. The constant value of 13.883 indicates that when both independent variables equal zero, students' twenty-first-century competencies are at a value of 13.883. The regression coefficient for digital literacy skills of 0.407 is positive, meaning that each one-unit increase in digital literacy skills is associated with a 0.407-unit increase in twenty-first-century competencies, holding other variables constant. The regression coefficient for peer support of 0.061 is also positive, meaning that each one-unit increase in peer support is associated with a 0.061-unit increase in twenty-first-century competencies, holding other variables constant.

Table 6
Coefficient of Determination

Model Summary			
R	R Square	Adjusted R Square	Std. Error of the Estimate
.659 ^a	.434	.420	3.21407

The magnitude of the independent variables' contribution to the dependent variable was determined through the coefficient of determination. As presented in Table 6, the R^2 value of .434 indicates that digital literacy skills and peer support simultaneously explained 43.4% of the variance in students' twenty-first-century competencies, while the remaining 56.6% was influenced by factors outside the scope of this study.

The effective and relative contributions were calculated based on the correlation and regression results. The correlation and regression results that served as the basis for these calculations are presented in Table 7.

Table 7
Correlation and Regression Results

Variable	Standardized Coefficient (Beta)	Correlation Coefficient	R Square (%)
Digital Literacy Skills	0.619	0.657	43.4
Peer Support	0.059	0.456	

Table 8
Effective Contribution

Variable	SE Formula: $SE(X)\% = \text{Beta} \times \text{Correlation} \times 100$	Value (%)
Digital Literacy Skills (X_1)	$= 0.619 \times 0.657 \times 100$	40.67
Peer Support (X_2)	$= 0.059 \times 0.456 \times 100$	2.69
Total		43.4

Effective contribution measures the degree to which each independent variable contributes to the dependent variable while accounting for the other variables. As shown in Table 8, digital literacy skills contributed an effective contribution of 40.67%, while peer support contributed 2.69%, totaling 43.4%, which is consistent with the R^2 value.

Table 9
Relative Contribution

Variable	SR Formula: $SR(X)\% = SE(X)\% / R \text{ Square} \times 100$	Value (%)
Digital Literacy Skills (X_1)	$= (40.67 / 43.4) \times 100$	94
Peer Support (X_2)	$= (2.69 / 43.4) \times 100$	6
Total		100

Relative contribution measures the proportion of each variable's contribution within the overall model. As presented in Table 9, digital literacy skills had a relative contribution of 94%, while peer support had a relative contribution of 6%, indicating that digital literacy skills constituted the most dominant variable in the research model.

Pembahasan

The first hypothesis posited that digital literacy skills exert a significant effect on the twenty-first-century competencies of MPLB students at SMK Negeri 1 Sukoharjo. The t-test results yielded a significance value of $.000 < .05$ and a t-value of $5.689 > 1.990$, leading to the acceptance of H₁. This finding indicates that as students' digital literacy skills improve, their twenty-first-century competencies also increase. Digital literacy skills assist students in acquiring, comprehending, evaluating, communicating, and utilizing digital information effectively within the learning process. Through these skills, students can obtain relevant information, assess the credibility of information sources, resolve problems more rationally, and develop new ideas that support communication, collaboration, critical thinking, and creativity as core components of twenty-first-century competencies. This finding is consistent with Silvhiany et al. (2021), who stated that digital literacy assists students in accessing and utilizing relevant information to support learning. The present finding is further supported by several prior studies demonstrating the importance of digital literacy in developing student competencies. Digital literacy enables students to evaluate information more critically and thoroughly, thereby supporting the development of critical thinking skills (Van Laar et al., 2020). The reinforcement of digital literacy has also been shown to contribute to the improvement of twenty-first-century competencies (Hilmiatussadiah et al., 2024). Furthermore, digital literacy has been found to be associated with the growth of positive attitudes, increased self-confidence, and enhanced student engagement in learning activities (Getenet et al., 2024). In line with these findings, Zamista and Charona (2023) and Tandiwarra et al. (2025) demonstrated that digital literacy skills make a significant contribution to the development of communication, collaboration, critical thinking, and creativity as components of twenty-first-century competencies. Within the vocational education environment, these skills also play a role in enhancing SMK students' work readiness to meet the demands of an increasingly technology-dominated industry (Syawalia et al., 2025). Therefore, digital literacy skills can be regarded as playing a critical role in supporting the development of students' twenty-first-century competencies both within the learning process and in preparing them to face the challenges of the workforce in the digital era.

The second hypothesis predicted that peer support would exert a significant effect on the twenty-first-century competencies of MPLB students at SMK Negeri 1 Sukoharjo. However, the t-test results showed a significance value of $.587 > .05$ and a t-value of $0.546 < 1.990$, leading to the rejection of H₂. This finding indicates that peer support did not have a significant influence on students' twenty-first-century competencies. This result diverges from the findings of Shao et al. (2024), who reported that positive peer relationships significantly influence student learning engagement and motivation. Similarly, Wahyuanda (2025) found that a twenty-first-century learning environment encompassing peer factors contributes to student academic achievement, and Khoerunnisa et al. (2025) revealed that peer group interaction significantly affects creativity through collaborative activities. The non-significant result in the present study is suspected to stem from the possibility that peer support does not directly influence twenty-first-century competencies. This interpretation is consistent with Shi et al. (2025), who found that peer support does not directly affect creative thinking but operates through the mediation of emotional intelligence. Furthermore, Fedesco et al. (2019) found that peer closeness does not serve as a significant direct predictor of academic competency outcomes, while Utvær et al. (2022) explained that social support from peers operates indirectly by first affecting students' emotional states before impacting competency development. The non-significant effect of peer support may also be attributed to the presence of other factors that exert a greater contribution to twenty-first-century competencies, such as self-efficacy and problem-solving ability (Alturki & Aldraiweesh, 2023) and learning motivation (Han et al., 2021). Consequently, within the context of this study, peer support has not emerged as a factor capable of significantly enhancing students' twenty-first-century competencies.

The third hypothesis proposed that digital literacy skills and peer support simultaneously exert a positive and significant effect on the twenty-first-century competencies of MPLB students at SMK Negeri 1 Sukoharjo. The F-test yielded a significance value of $.000 < .05$ and an F-value of $31.058 > F_{table} 3.105$, resulting in the acceptance of H_3 . This finding demonstrates that digital literacy skills and peer support simultaneously exerted a significant effect on students' twenty-first-century competencies. The multiple linear regression analysis produced the equation $Y = 13.883 + 0.407X_1 + 0.061X_2$, indicating that both digital literacy skills and peer support positively influenced twenty-first-century competencies. Additionally, the coefficient of determination (R^2) of .434 indicates that both variables simultaneously accounted for 43.4% of the variance in students' twenty-first-century competencies, while the remaining 56.6% was attributable to factors beyond the scope of this research model. The effective contribution analysis revealed that digital literacy skills contributed 40.67%, whereas peer support contributed 2.69%. Meanwhile, the relative contribution analysis showed that digital literacy skills accounted for 94% and peer support accounted for 6%, confirming that digital literacy skills constituted the more dominant factor in enhancing students' twenty-first-century competencies. These findings suggest that the development of twenty-first-century competencies is influenced not only by individual factors in the form of the ability to utilize digital technology but also by social factors in the form of support from the peer environment. This result is consistent with Haryaka et al. (2025), who argued that the integration of digital literacy, critical thinking, and collaborative learning represents a critical component in meeting twenty-first-century challenges. This finding is further reinforced by Kartika et al. (2025), who reported that technology-based learning can enhance students' social interaction through discussion and cooperation activities. Similarly, Hoe et al. (2024) found that peer interaction in technology-based learning enhances collaboration, communication, and problem-solving skills. Furthermore, Díaz-García et al. (2023) affirmed that the development of twenty-first-century competencies is influenced by a combination of individual and social environmental factors. Accordingly, the enhancement of students' twenty-first-century competencies should be pursued through the strengthening of digital literacy skills as the primary factor, supported by the creation of a positive social environment through peer support.

Overall, the results of this study demonstrate that digital literacy skills constitute a factor that plays a role in enhancing students' twenty-first-century competencies. Peer support has not yet demonstrated a significant effect on students' twenty-first-century competencies. Therefore, the development of twenty-first-century competencies should be focused on strengthening digital literacy through the optimal utilization of technology and digital learning resources.

Kesimpulan

This study concludes that digital literacy skills exerted a significant effect on the twenty-first-century competencies of MPLB students at SMK Negeri 1 Sukoharjo, whereas peer support did not exert a significant effect. Simultaneously, digital literacy skills and peer support had a positive and significant effect on students' twenty-first-century competencies, with a combined contribution of 43.4%. These findings indicate that the enhancement of students' twenty-first-century competencies is predominantly determined by digital literacy skills in acquiring, evaluating, and utilizing digital information effectively, while peer support serves as a complementary factor in the development process. The theoretical implication of this study is the reinforcement of the theory that digital literacy skills constitute a critical factor in shaping students' twenty-first-century competencies, particularly in supporting critical thinking, communication, collaboration, and creativity skills. The practical implication suggests that schools should strengthen digital literacy programs through the optimal utilization of technology and digital learning resources to support the enhancement of students' twenty-first-century competencies. This study has several limitations. First, the scope of the study was confined to twelfth-grade MPLB students at SMK Negeri 1 Sukoharjo, which means the findings cannot be broadly generalized. Second, data collection relied solely on a questionnaire instrument, which may introduce respondent perception bias. Third, the coefficient of determination of 43.4% indicates that 56.6% of the variance in twenty-first-century competencies is influenced by other factors not included in the research model, such as self-efficacy, learning motivation, and

problem-solving ability, which were not examined in this study. Based on these limitations, future research is recommended to expand the respondent base across various specialization programs or different schools to achieve a higher level of generalizability. Future studies are also encouraged to investigate the influence of self-efficacy, learning motivation, problem-solving ability, or other relevant variables on students' twenty-first-century competencies.

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