Information Technology Education Journal
E-ISSN: 2809-798X; P-ISSN: 2809-7971
https://journal.unm.ac.id/index.php/INTEC/index

The Role of Learning Website Integration, Teacher Support, and Student Independence in Enhancing Mathematics Competence at Vocational Schools

Lilis Stianingsih[1], Ferawati[2*], Fiqih Hana Saputri[3], Detin Sofia[4]
[1,2,3,4] *Institut Teknologi dan Bisnis Bina Sarana Global, Indonesia*

Corresponding e-mail : ferawati@global.ac.id

ARTICLE INFO

Keywords:

Mathematics competence;
Learning website integration;
Teacher support;
Student independence;
Vocational education

Article History

Received: September 30, 2025
Revised : October 14, 2025
Accepted : November 05, 2025

ABSTRACT

Mathematics competence is essential for developing students' analytical and problem-solving abilities in vocational education. However, many students still face challenges in mastering mathematical concepts effectively. This study aims to examine the influence of Learning Website Integration, Teacher Support, and Student Independence on students' mathematics competence using a quantitative ex post facto design. The research involved 100 respondents from SMK Bina Mandiri. Data were collected through questionnaires and mathematics competency tests, then analyzed using descriptive statistics and multiple linear regression. The results show that the regression model meets all classical assumption tests and is statistically appropriate for explaining the relationships among variables. Simultaneous testing indicates that all three independent variables significantly influence students' mathematics competence. Partial testing reveals that each variable has a significant positive effect, with Teacher Support identified as the most dominant factor. The coefficient of determination (R^2) is 0.572, meaning that 57.2% of the variation in mathematics competence can be explained by the three variables, while the remaining 42.8% is influenced by other factors outside the model. These findings highlight the importance of integrating technology, strengthening teacher support, and fostering student independence to improve mathematics learning outcomes in vocational education. The results of this study provide guidance for implementing technology-based pedagogy in vocational education.

This is an open access article under the CC BY-SA license

To cite this article : Stianingsih, L., Ferawati, F., Saputri, F. H., & Sofia, D. (2025). The role of learning website integration, teacher support, and student independence in enhancing mathematics competence at vocational schools. Information Technology Education Journal, 4(4), 645–653. https://doi.org/10.59562/intec.v4i4.9909

INTRODUCTION

Vocational education in Indonesia aims to prepare graduates with not only practical expertise but also essential competencies such as mathematics, language, and critical thinking. In Vocational High Schools (SMK), mathematics plays a key role in supporting various productive subjects, including accounting, mechanical engineering, information technology, and business administration [1]-[2]. Strong mathematical competence helps students develop problem-solving abilities, make informed decisions, and apply logical reasoning in real-world work contexts [3]. However, national examinations and minimum competency assessments reveal that SMK students' mathematical competence remains relatively low.

The rapid advancement of information technology offers alternative approaches to enhance learning quality, including the integration of learning websites. These platforms provide

rich media, interactivity, flexibility, and accessibility anytime and anywhere [4]. By utilizing learning websites, students can study independently, deepen their understanding of difficult material, and gain more varied learning experiences than through conventional lecture-based methods. Moreover, the integration of web-based technology aligns with blended and e-learning approaches, which have become increasingly relevant in the digital era and the post-COVID-19 education landscape.

Despite these advantages, the effective use of learning websites is influenced by both external and internal factors. Externally, teacher support plays a pivotal role. Teachers act not only as instructors but also as facilitators, motivators, and guides in leveraging technology [5]. Clear guidance, appropriate content preparation, and timely assistance from teachers can significantly increase the effectiveness of website-based learning. Without this active role, learning websites risk becoming passive information sources that are underutilized by students.

Internally, students' learning independence is equally critical. This includes the ability to manage time, select strategies, maintain motivation, and evaluate learning progress autonomously. High levels of independence enable SMK students to master mathematical concepts more effectively because they actively engage with materials, practice problem-solving, and explore alternative solutions through digital platforms [6]. However, many SMK students still exhibit low learning independence, often waiting for teacher instructions and struggling with self-directed study. Limited technological infrastructure and inadequate teacher capacity in developing digital media further exacerbate this challenge.

Few studies simultaneously examine technological, pedagogical, and self-directed factors in vocational mathematics learning. This research addresses that gap by investigating the influence of learning website integration, teacher support, and student learning independence on mathematical competence among vocational high school students. The purpose of this study is to examine the influence of Learning Website Integration, Teacher Support, and Student Independence in enhancing mathematics competence at vocational schools

METHOD

This study employs a quantitative approach with an ex post facto design to analyze the influence of Learning Website Integration, teacher roles, and student learning independence on the mathematical competence of vocational high school (SMK) students. The research was conducted at SMK Bina Mandiri, involving 100 students selected through purposive sampling, which was justified based on their access to and active use of the learning website [7]. The research instruments include a questionnaire on Learning Website Integration, a questionnaire on teacher roles, a questionnaire on learning independence, and a mathematics competence test, all of which were tested for validity and reliability [8]. Data collection was conducted through questionnaires, tests, and classroom observations to verify student engagement and teacher–student interactions during the learning process. Ethical procedures were applied throughout the study; all participants provided informed consent, and data confidentiality was maintained. The collected data were analyzed using descriptive statistics to determine distribution, mean, and standard deviation, as well as simple and multiple regression analyses to examine the individual and simultaneous effects of the independent variables on students' mathematical competence [9]. Prior to the multiple regression analysis, classical assumption tests—including normality, multicollinearity, and heteroscedasticity—were conducted to ensure the suitability of the analytical model [26]-[27].

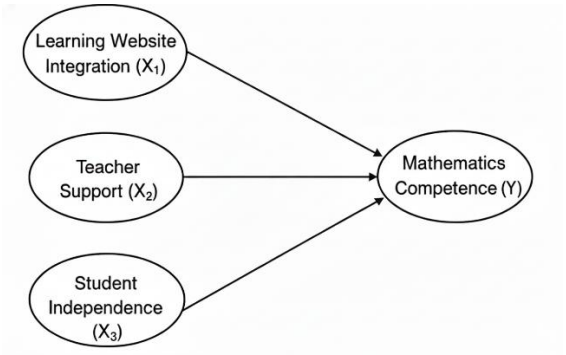


Figure 1. Conceptual Framework

Figure 1 presents the conceptual framework of the study, illustrating the relationships between the independent and dependent variables. The three independent variables—Learning Website Integration (X_1), Teacher Support (X_2), and Student Independence (X_3)—are hypothesized to influence the dependent variable, Mathematics Competence (Y). This framework serves as the basis for examining both simultaneous and partial effects through statistical analysis. It provides a clear visualization of the directional relationships explored in this research.

RESULTS AND DISCUSSION

Preliminary Data Analysis

This study involved 100 students from SMK Bina Mandiri as research subjects, selected to obtain a comprehensive overview of the variables under investigation. The data collection process was carried out through the distribution of questionnaires designed to explore information related to specific aspects, as well as a mathematics competency test used to objectively measure students' cognitive abilities. The collected data were then processed and analyzed descriptively to provide an initial understanding of the characteristics of each research variable. The detailed results of the descriptive analysis are presented in table 1.

Table 1. Preliminary Data

No	Variable	Mean	STD	Min	Max	Assumption Test
1	Learning Website Integration (X_1)	72.8	10.5	50	95	Normality $p > 0.05$; Tolerance > 0.10; VIF < 10
2	Teacher Support (X_2)	81.4	9.8	55	98	Normality $p > 0.05$; Tolerance > 0.10; VIF < 10
3	Student Independence (X_3)	76.7	11.2	48	94	Normality $p > 0.05$;

						Tolerance > 0.10; VIF < 10
4	Mathematics Competence (Y)	75.5	12.3	45	95	Normality p > 0.05; Durbin–Watson = 1.87

Source: Author (2025)

Based on Table 1, the Learning Website Integration (X1) variable has a mean score of 72.8 with a standard deviation of 10.5, with scores ranging from 50 to 95. This shows variation in how students integrate learning websites. The Teacher Support (X2) variable has the highest mean score of 81.4 and a standard deviation of 9.8, with scores between 55 and 98, indicating generally high support from teachers. Student Independence (X3) has a mean of 76.7 with a standard deviation of 11.2, and scores between 48 and 94, reflecting medium to high levels of learning independence. Mathematics competence (Y) has a mean score of 75.5 with a standard deviation of 12.3, with scores ranging from 45 to 95, indicating considerable variation in students' mathematical abilities. The validity test results show that all questionnaire items for X1, X2, X3, and Y have r-count values greater than the r-table value (0.196) and significance levels below 0.05. This means all items are valid and accurately measure their intended constructs. The reliability test results also indicate that all variables have Cronbach's Alpha values above 0.70, meeting the reliability criteria and demonstrating good internal consistency. Therefore, the questionnaire used in this study is both valid and reliable for data collection and analysis.

The results of the classical assumption tests presented in Table 1 show that all data meet the required criteria for multiple linear regression analysis. The normality test using the Kolmogorov–Smirnov method indicates that all variables have significance values greater than 0,05, which means that the data are normally distributed. The multicollinearity test shows that all tolerance values are greater than 0,10 and all VIF values are less than 10, indicating that there is no multicollinearity problem among the independent variables. The heteroscedasticity test results show significance values greater than 0,05 for all variables, meaning that there is no heteroscedasticity in the model. Lastly, the autocorrelation test shows a Durbin–Watson value of 1,87, which falls within the acceptable range, indicating no autocorrelation problem in the residuals.

Multiple Linear Regression Analysis

Since all classical assumption tests have been fulfilled, the analysis can proceed to the multiple linear regression test to examine the influence of the independent variables on the dependent variable.

Table 2. Multiple Regression Analysis Summary

Variable	B	t-value	Sig.
Constant	12.315		
Learning Website Integration (X_1)	0.215	2.756	0.007
Teacher Support (X_2)	0.328	3.859	0.000
Student Independence (X_3)	0.294	3.231	0.002

Source: Author (2025)

Based on Table 2, the multiple linear regression equation obtained in this study is Y = 12.315 + 0.215X1 + 0.328 X2 + 0.294X3. This equation indicates that the constant value of 12.315 represents the predicted score of students' mathematics competence (Y) when the variables of Learning Website Integration (X1), Teacher Support (X2), and Student Independence (X3) are at zero. The regression coefficient of X1, which is 0.215, suggests that every one-unit increase in Learning Website Integration is associated with a 0.215 increase in students' mathematics competence scores, assuming the other variables remain constant. Furthermore, the regression coefficient of X2 is 0.328, indicating that a one-unit increase in Teacher Support has the potential to improve students' mathematics competence by 0.328 points. Meanwhile, the coefficient of X3 is 0.294, showing that a one-unit increase in student independence contributes an additional 0.294 points to mathematics competence. Overall, these results confirm that the three independent variables have a positive influence on mathematics competence.

Simultaneous Effect (F-Test) and Coefficient of Determination (R^2)

The higher the level of technology integration in learning, teacher support, and student independence, the better students' mathematics achievement will be.

Table 3. Simultaneous Test (F-Test)

F-value	Sig.
41.823	0.000

Source: Author (2025)

Based on table 3, the F-test produced an F-value of 41.823 with a significance level of 0.000 ($p < 0.05$). These results indicate that, simultaneously, the three independent variables have a significant effect on students' mathematics competence. Therefore, the regression model used in this study is appropriate for explaining the relationships among the variables. The results of the F-test show an F-value of 41.823 with a significance level of 0.000 ($p < 0.05$), indicating that simultaneously, the three independent variables significantly affect students' mathematics competence. This finding implies that the regression model used is statistically appropriate for explaining the relationships among the variables. The simultaneous significance of the regression model indicates that the independent variables, when considered together, have explanatory power in predicting the dependent variable. In educational research, this suggests that the combination of technological, pedagogical, and learner-centered factors can collectively contribute to students' learning outcomes [10]-[13].

Table 4. Coefficient of Determination (R^2)

R	R^2
0.756	0.72

Source: Author (2025)

Based on table 4, the results of the multiple linear regression analysis show that the regression model used in this study can explain the relationship between the independent variables (X1, X2, X3) and the dependent variable (Y). The coefficient of determination (R^2) value of 0.572 indicates that 57.2% of the variation in students' mathematics competence can be explained by the variables Learning Website Integration (X1), Teacher Support (X2), and Student

Independence (X3). Meanwhile, the remaining 42.8% is influenced by other factors outside the model.

Partial Effect Analysis (t-Test)

a) Learning Website Integration

Partial t-test results also reveal that each independent variable has a significant effect on students' mathematics competence. The Learning Website Integration (X1) variable has a regression coefficient of 0.215 with a t-value of 2.756 and a significance level of 0.007, indicating a significant positive influence. This finding aligns with the Technology Integration Theory by Mishra and Koehler through the TPACK framework, which emphasizes that the integration of technology into the learning process can enhance students' understanding by providing interactive and varied learning resources [13]-[15]. Digital learning platforms allow students to access materials independently, visualize abstract mathematical concepts, and receive immediate feedback, all of which contribute to better learning outcomes [16]-[17].

b) Teacher Support

The Teacher Support (X2) variable has the highest regression coefficient, at 0.328, with a t-value of 3.859 and a significance level of 0.000, indicating that teacher Support is the dominant factor influencing students' mathematics competence. This supports Vygotsky's Sociocultural Theory, which highlights the role of teachers as facilitators who guide learners through their Zone of Proximal Development (ZPD) [18]-[20]. When teachers provide structured support, feedback, and motivation, students are more likely to internalize knowledge and develop higher-order thinking skills. Similarly, found in his meta-analysis that teacher-student interaction and feedback are among the most influential factors on student achievement [21]-[22].

c) Student Independence

The Student Independence (X3) variable also significantly affects mathematics competence, with a regression coefficient of 0.294, a t-value of 3.231, and a significance level of 0.002. This supports theories of Self-Regulated Learning, which suggest that students who take responsibility for their own learning by setting goals, monitoring progress, and applying strategies tend to achieve better academic outcomes. Independent learners are more proactive in exploring materials, practicing skills, and engaging in deep learning, which leads to improved mathematical understanding and problem-solving ability [23].

Overall, these findings emphasize that technology integration, teacher support, and student independence each play a crucial role in enhancing students' mathematics competence. The results are consistent with previous studies which highlight that effective learning in the twenty-first century requires the interplay of technological tools, pedagogical approaches, and learner characteristics [24]-[25]. This synergy creates a learning environment that not only facilitates knowledge transfer but also encourages critical thinking, motivation, and self-directed learning, all of which are essential for mastering mathematical concepts. These findings align with recent studies emphasizing the synergy between digital learning tools and pedagogical support. For instance, [28] found that teacher facilitation amplifies the impact of e-learning platforms on students' mathematical achievement. Similarly, [29] showed that student autonomy combined with structured digital guidance improves problem-solving and critical thinking skills in vocational contexts. In addition, [30] highlighted that sustained integration of technology with

active teacher involvement significantly boosts students' engagement and long-term retention in mathematics learning. This suggests that the integration of technology, strong teacher engagement, and the development of student independence are complementary components in modern mathematics education.

Limitations, Implications, and Future Research Directions

This study has several limitations. It was conducted in one vocational school with 100 students, limiting the generalizability of the findings. The ex post facto design identifies relationships but not causality, and the study focused only on three variables, excluding other potential factors such as motivation or school policies. Despite these limitations, the findings have practical implications for strengthening digital learning integration, enhancing teacher training, and fostering student independence. Schools should provide adequate infrastructure and mentoring programs to support effective implementation. Future research should involve multiple schools, include more variables, and use longitudinal or mixed-method approaches to gain a broader understanding of factors affecting mathematics competence.

CONCLUSIONS

The study concludes that learning website integration, teacher support, and student independence significantly improve students' mathematics competence. Both the F-test and t-test results confirm positive and significant effects, with teacher support identified as the most influential factor. This underscores the essential role of teachers in guiding and motivating students, while technology integration fosters interactive learning, and student independence promotes deeper understanding. These findings suggest that schools should strengthen digital learning initiatives and implement teacher mentoring programs to maximize learning outcomes. Future research could expand this study across multiple schools or adopt a longitudinal design to examine long-term effects.

REFERENCES

[1] E. M. Mulenga and J. M. Marbán, "Prospective teachers' online learning mathematics activities in the age of COVID-19: A cluster analysis approach," *Eurasia J. Math. Sci. Technol. Educ.*, vol. 16, no. 9, p. em1872, 2020, doi: 10.29333/ejmste/8345.

[2] R. Bringula, A. M. de Leon, R. L. P. M. Moreno, and R. S. Serrano, "Mathematics self-concept and challenges of learners in an online mathematics classroom (Summer 2020)," *Smart Learn. Environ.*, vol. 8, no. 1, 2021, doi: 10.1186/s40561-021-00168-5.

[3] M. Husin, M. Giatman, N. Jalinus, Usmeldi, and H. Hidayat, "Learning in vocational education during the COVID-19 outbreak: A systematic review and meta-analysis," in *Advances in Social Science, Education and Humanities Research*, Atlantis Press, 2021.

[4] I. W. Sumandya, I. M. Candiasa, I. G. P. Suharta, and I. M. Sugiarta, "Development of a vocational-based mathematics e-module," *Int. J. Sci. Technol. Res.*, vol. 10, no. 6, pp. 303–310, 2021.

[5] S. A. Courtney, "The impact of COVID-19 on teachers' integration of digital technologies into mathematics instruction," *ERIC Document*, 2022.

[6] T. K. F. Chiu, W. H. Lim, and J. Y. Chen, "School learning support for teacher technology integration: Evidence from a longitudinal study," *Int. J. Educ. Technol. High. Educ.*, vol. 19, 2022.

[7] K. Ikonen, S. Suominen, A. Viholainen, and M. A. Asikainen, "New vocational school students' views and expectations concerning online learning and studying mathematics," *Online J. Distance Educ. e-Learning*, vol. 10, no. 4, pp. 483–507, 2022.

[8] D. Dalby, "Mathematics curriculum waves within vocational education: Exploring new models," *Int. J. Res. Math. Educ.*, 2022.

[9] D. Rohendi, "Online learning using STEM-based media: Effects on vocational high school students' mathematics ability," *Eur. Int. J. Sci. Technol.*, vol. 12, no. 2, pp. 55–64, 2023.

[10] Y. H. Jung, "Teacher factors affecting students' math class engagement: The role of academic support and teacher–student relationships," *Educ. Res. J.*, 2023.

[11] J. Engelbrecht, M. Borba, G. Llinares, and M. Kaiser, "Recent developments in using digital technology in the teaching and learning of mathematics," *ZDM Math. Educ.*, vol. 56, no. 1, pp. 1–15, 2024, doi: 10.1007/s11858-023-01547-y.

[12] A. A. Putrawan, D. S. Nugraha, and N. L. D. Dewi, "Mathematics blended learning system based on a website: Prototype development and limited testing," in *Proc. 6th Int. Conf. Educ. Technol.*, Atlantis Press, 2024.

[13] M. K. Budiarto and A. P. Setiawan, "E-learning platform for enhancing 21st-century skills for vocational students," *ERIC Conf. Proc.*, 2024.

[14] S. Suominen, "Vocational school students' use and opinions of voluntary online learning opportunities: Implications for mathematics teaching in VET," *Online J. Distance Educ. e-Learning*, vol. 11, no. 1, pp. 42–59, 2024.

[15] E. B. Witherspoon, "Teacher use of an online platform to support independent practice in mathematics: Usage patterns and implications," *J. Comput. Math. Educ.*, vol. 38, no. 2, 2024.

[16] L. Morrison, "Promising practices for online professional learning aimed at mathematics teachers," *Teach. Teach. Educ.*, vol. 135, 2024, doi: 10.1016/j.tate.2023.104279.

[17] J. Liu, Y. Zhao, and L. Zhang, "Leveraging professional learning communities to link teacher PD and classroom digital instructional integration," *Int. J. STEM Educ.*, vol. 11, no. 5, 2024.

[18] A. S. Evmenova, J. W. Behrmann, and P. T. Ralabate, "Evidence-based technology tools to support diverse learners in K–12 mathematics," *Focus Except. Child.*, vol. 56, no. 7, pp. 1–14, 2024.

[19] A. Hidayat, "Navigating the tech frontier: A systematic review of technology integration in Indonesian mathematics education," *Asian J. Educ. Res.*, vol. 12, no. 4, pp. 77–89, 2024.

[20] S. Parker and J. Reynolds, "Math teacher actions that promote autonomy among students in mathematics classrooms," *J. Math. Teach. Educ.*, vol. 27, no. 3, pp. 445–467, 2024.

[21] T. P. Mensah and C. Amoako, "Mathematics content and technical and vocational education training: A systematic review," *J. Tech. Vocat. Educ. Train.*, vol. 4, no. 2, pp. 112–128, 2024.

[22] T. C. Ion and A. Putnam, "An innovative distance learning platform for mathematics: Design and evaluation," *Comput. Educ.*, vol. 208, p. 104913, 2024, doi: 10.1016/j.compedu.2024.104913.

[23] A. Marini, "Developing a website integrated with project-based learning: Effects on creativity and engagement," *Int. J. Innov. Learn.*, vol. 39, no. 3, pp. 221–238, 2025.

[24] M. Husin, M. Giatman, and N. Jalinus, "Implementation models for vocational learning during COVID-19: Implications for teacher support and student independence," in *Proc. 4th Int. Conf. Educ. Res. Innov.*, Atlantis Press, 2021.

[25] G. A. D. Sugiharni, N. K. P. Wirastini, and I. P. A. J. Wibawa, "Development of web-based mathematics learning media for vocational students," *J. Digit. Instrum. Media Educ.*, vol. 5, no. 1, pp. 25–34, 2023.

[26] A. Field, *Discovering Statistics Using IBM SPSS Statistics*, 5th ed. London, U.K.: SAGE Publications, 2018.

[27] D. N. Gujarati, *Basic Econometrics*, 4th ed. New York, NY, USA: McGraw-Hill Education, 2004.

[28] L. Zhang and J. Li, "Teacher facilitation and digital learning platforms in mathematics education," *Computers & Education*, vol. 195, pp. 104763, 2023.

[29] B. Prasetyo, A. Nugroho, and S. Widodo, "Student autonomy and structured digital guidance in vocational mathematics learning," *Education and Information Technologies*, vol. 29, pp. 1150–1167, 2024.

[30] M. Hernández, R. López, and P. Gómez, "Blended digital–pedagogical models to enhance mathematics engagement," *International Journal of Educational Research Open*, vol. 8, pp. 100276, 2025.