The Effect of Digital Learning Facilities and Technology Use on Learning Motivation of Junior and Senior High School Students with Digital Literacy as an Intervening Variable at Global Nusantara School Jakarta

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Abstract
This study investigates the influence of digital learning facilities and technology use on the learning motivation of junior and senior high school students, with digital literacy serving as an intervening variable, at Global Nusantara School Jakarta. Conducted in the context of the industrial revolution 4.0, where technology integration in education is imperative, the research adopts a quantitative approach utilizing path analysis via Smart PLS. The entire population of 69 students was sampled using saturated sampling. Results revealed that digital learning facilities significantly enhance digital literacy, which, in turn, indirectly boosts learning motivation. While technology use positively affects digital literacy, its direct impact on learning motivation was not significant. Digital literacy emerged as a critical mediating factor, linking digital learning facilities to enhanced student motivation. This study contributes theoretically by highlighting the importance of digital infrastructure in multicultural educational settings and practically by recommending inclusive technology policies, optimizing digital resources, and fostering teacher-student collaboration to improve learning outcomes. These findings are intended to guide modern educational management in addressing digital-era challenges effectively.

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Abstrak
Penelitian ini menyelidiki pengaruh fasilitas pembelajaran digital dan penggunaan teknologi terhadap motivasi belajar siswa SMP dan SMA, dengan literasi digital sebagai variabel intervening, di Global Nusantara School Jakarta. Dilakukan dalam konteks revolusi industri 4.0, di mana integrasi teknologi dalam pendidikan sangat penting, penelitian ini mengadopsi pendekatan kuantitatif yang memanfaatkan analisis jalur melalui Smart PLS. Seluruh populasi yang berjumlah 69 siswa diambil sampelnya menggunakan sampel jenuh. Hasil penelitian mengungkapkan bahwa fasilitas pembelajaran digital secara signifikan meningkatkan literasi digital, yang pada gilirannya, secara tidak langsung meningkatkan motivasi belajar. Sementara penggunaan teknologi berdampak positif pada literasi digital, dampak langsungnya pada motivasi belajar tidak signifikan. Literasi digital muncul sebagai faktor mediasi penting, yang menghubungkan fasilitas pembelajaran digital dengan peningkatan motivasi siswa. Penelitian ini berkontribusi secara teoritis dengan menyoroti pentingnya infrastruktur digital dalam lingkungan pendidikan multikultural dan secara praktis dengan merekomendasikan kebijakan teknologi yang inklusif, mengoptimalkan sumber daya digital, dan mendorong kolaborasi guru-siswa untuk meningkatkan hasil belajar. Temuan ini dimaksudkan untuk memandu manajemen pendidikan modern dalam mengatasi tantangan era digital secara efektif.

I. INTRODUCTION

Introduction typed The rapid advancement of technology in the Industrial Revolution 4.0 has transformed education, requiring schools to integrate digital tools to enhance learning processes. UNESCO highlights the urgency of this shift, emphasizing the need to utilize digital tools in fostering critical thinking, problem-solving, and preparing students for global challenges.

Digital literacy, the capacity to access, evaluate, and use digital information effectively, has become an indispensable skill in the 21st century. Maryani affirms that the integration of digital devices in classrooms fosters more engaging, interactive, and efficient learning environments, promoting student motivation and academic achievement (Maryani, 2023).

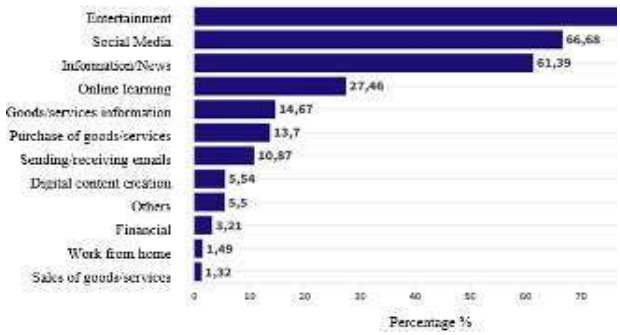

Figure 1. Percentage of Learners aged 5-24 years who access the internet based on their usage (March 2023)

Despite these technological advancements, Indonesia faces a significant gap in its national digital literacy index, particularly in the educational sector. Although internet penetration among students is high, the data reveals that 86.65% of students use the internet primarily for entertainment, and only 27.46% leverage it for online learning. This discrepancy underscores the need for educational institutions to redirect digital usage from non-educational activities to learning-centric applications. Such a transformation is critical for equipping students with the competencies required to thrive in the knowledge economy.

Global Nusantara School in Jakarta exemplifies the challenges and opportunities of integrating digital literacy in a multicultural learning environment. By blending the Cambridge International Curriculum with Indonesia's Merdeka curriculum, the school caters to students from diverse social, cultural, and linguistic backgrounds. While research by Wulandari and Aslam highlights the positive influence of digital literacy on academic outcomes, its application in multicultural settings remains underexplored. This study addresses this gap by examining how digital learning facilities and technology use affect student motivation, with digital literacy serving as a mediating variable (Wulandari & Aslam, 2022).

The study builds on findings from Holm (2024), who demonstrated the importance of digital literacy in enhancing academic performance, particularly in online learning environments that require self-directed learning and technological proficiency. Similarly, Kholid and Wahyuni emphasized the role of digital literacy in improving learning motivation and fostering collaborative learning (Kholid et al., 2024; Wahyuni et al., 2023). However, these studies lacked a comprehensive examination of managerial strategies essential for optimizing the synergy between digital literacy, technology, and learning motivation in culturally diverse schools.

To address these gaps, the research employs a quantitative approach using path analysis with Smart-PLS, drawing data from 69 junior and senior high school students at GNS through saturated sampling. The findings aim to reveal the dynamic interplay of digital learning tools, student motivation, and digital literacy in a multicultural context. Building on Muntu's assertion that digital infrastructure is critical for effective learning environments, this study highlights the need for strategic management of digital tools to foster both digital literacy and learning motivation (Muntu et al., 2023).

Theoretically, the research bridges a critical gap in the literature by emphasizing digital literacy as a key mediator between technological tools and student motivation. This aligns with Gillen and Barton's argument that digital literacies are essential for navigating a rapidly evolving digital society (Gillen & Barton, 2010), as well as Yang and Ding's emphasis on the integration of pedagogical strategies with digital tools to promote innovation and collaboration (Yang & Ding, 2021). The study offers a nuanced perspective on how digital tools can enhance educational outcomes in multicultural schools.

Practically, the research proposes actionable strategies for educational institutions, including equitable access to digital tools, teacher training for technological proficiency, and the development of supportive digital learning ecosystems. These strategies aim to enhance digital literacy while maintaining cultural inclusivity, addressing key challenges in technological integration. Moreover, the study offers valuable insights for modern educational management in leveraging digital tools to improve learning outcomes.

Finally, the research has significant implications for policy development, particularly in formulating national strategies to enhance digital literacy. Policymakers and educators can benefit from understanding how the alignment of digital infrastructure with effective management practices fosters motivated and digitally literate students. By examining the interplay between digital tools, literacy, and motivation, this study equips educational stakeholders with the frameworks needed to cultivate inclusive, technology-driven learning environments in multicultural contexts.

II. METHOD

This research employed a quantitative approach with a case study at Global Nusantara School, Jakarta. The study involved 55 junior high school students and 14 senior high school students, who served as the respondents, collected through a saturated sampling technique given the small population size. Data collection was conducted between November and December 2024. Primary data were gathered using a structured questionnaire designed with 29 closed statements on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire was distributed in online formats, through digital platforms such as Google Forms and WhatsApp.

The variables examined in this study were X1 (Digital Learning Facilities), X2 (Technology Use), Z (Digital Literacy) as an intervening variable, and Y (Learning Motivation). The research employed path analysis using Smart PLS 4 to analyze the direct and indirect effects of the independent variables on the dependent variable through the intervening variable. Before conducting the main analysis, the data were coded, and the validity and reliability of the constructs were tested using outer loading measurements. The inner model measurement was then used to evaluate the structural model and test the research hypotheses. The findings of this study were interpreted using a descriptive quantitative approach, providing insights into how digital literacy mediates the relationship between digital learning facilities, technology use, and learning motivation in a multicultural school setting.

III. RESULT AND DISCUSSION

A. Result

Based on the results of the research questionnaire, the characteristics of respondents presented in Table 1 can be described.

Table 1. Characteristic of respondent

Characteristics of Respondents	Total (People)	Percentage %
Gender		
Female	45	65.2%
Male	24	34.8%
Total	69	100
Grade		
Grade 7	24	34.8%
Grade 8	19	27.5%
Grade 9	12	17.4%
Grade 10	9	13.0%
Grade 11	5	7.3%
Total	69	100%
Nationality		
Indonesian Citizen	59	85.5%
Foreigner	10	14.5%
Total	69	100%

The study's respondents consist of 69 students, predominantly Indonesian citizens (85.5%), with 14.5% being foreign nationals, reflecting the multicultural context of Global Nusantara School. Females make up the majority (65.2%), and junior high school students (Grades 7–9) account for 79.7% of the sample, indicating a focus on this cohort's digital literacy and learning motivation. These demographics underscore the need for tailored digital learning strategies that address gender and cultural diversity, aligning with the broader goals of integrating education technology to enhance equitable and effective learning in multicultural environments.

1. Measurement Model

The measurement model test assesses the validity and reliability of a construct. Validity is evaluated through convergent and discriminant validity, while reliability is determined usingCronbach's alpha and composite reliability. The following are the results of the convergent and discriminant validity testing.

2. Convergent Validity Test

Convergent validity is assessed using the outer loading and Average Variance Extracted (AVE) values. Indicators are considered valid if the outer loading value exceeds 0.70, and the AVE value is greater than 0.50. If any indicator falls below these thresholds, it should be removed from the model. The following are the results of the outer loading and AVE value tests.

The structural model illustrates the relationships between Digital Learning Facilities, Technology Use, Digital Literacy, and Student Learning Motivation. Path coefficients and outer loadings confirm the strength and significance of these relationships, highlighting the mediating role of Digital Literacy in this framework.

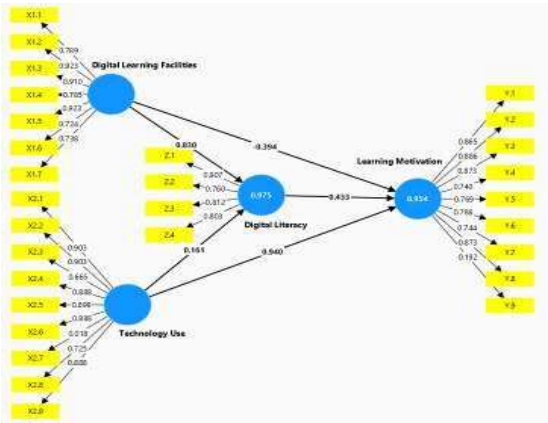

Figure 2. Outer Model

Table 2. Outer Loading Value

Indicator	Outer Loading Value	Information
Digital Learning Facilities		
X1.1	0.789	Valid
X1.2	0.923	Valid
X1.3	0.910	Valid
X1.4	0.785	Valid
X1.5	0.923	Valid
X1.6	0.724	Valid
X1.7	0.739	Valid
Technology Use		
X2.1	0.903	Valid
X2.2	0.903	Valid
X2.3	0.665	Valid
X2.4	0.888	Valid
X2.5	0.899	Valid
X2.6	0.888	Valid
X2.7	0.018	Invalid
X2.8	0.725	Valid
X2.9	0.888	Valid
Learning Motivation		
Z.1	0.907	Valid
Z.2	0.760	Valid
Z.3	0.812	Valid
Z.4	0.803	Valid
Digital Literacy		
Y.1	0.865	Valid
Y.2	0.886	Valid
Y.3	0.873	Valid
Y.4	0.740	Valid
Y.5	0.769	Valid
Y.6	0.786	Valid
Y.7	0.744	Valid
Y.8	0.873	Valid
Y.9	0.192	Invalid

Based on the outer loading values presented in Table 2, the indicators used to measure Digital Learning Facilities (X1) are predominantly valid, with outer loading values ranging from 0.724 to 0.923, except for X1.7, which is marginally valid at 0.739. Similarly, for Technology Use (X2), most indicators show strong validity, with values between 0.665 and 0.903, although X2.7 is invalid with a value of 0.018 and should be excluded from the model. Learning Motivation (Z) indicators demonstrate solid convergent validity, with outer loading values ranging from 0.760 to 0.907. For Digital Literacy (Y), while most indicators meet the validity threshold, with values from 0.740 to 0.886, Y9 is invalid with a value of 0.192 and should also be removed. These results indicate that the majority of the indicators are suitable for inclusion in the structural model, but invalid indicators need to be excluded to ensure the robustness of the measurement model.

3. Reliability Test

The second evaluation is reliability to show its consistency. Reliability can be seen from the Cronbach's Alpha and Composite Reliability values which are in the criteria for values above 0.7 (Hair, 2018).

Table 3. Cronbach's Alpha and Composite Reliability Value

Variable	Cronbach's Alpha	Composite Reliability	Information
Digital Learning Facilities (X1)	0.924	0.940	Reliable
Technology Use (X2)	0.910	0.934	Reliable
Digital Literacy (Z)	0.839	0.893	Reliable
Learning Motivation (Y)	0.904	0.926	Reliable

Based on the reliability test results presented in Table 3, all four variables in this study—Digital Learning Facilities (X1), Technology Use (X2), Digital Literacy (Z), and Learning Motivation (Y)—have Cronbach's alpha and composite reliability values exceeding 0.70. Specifically, Cronbach's alpha values range from 0.839 to 0.924, and composite reliability values range from 0.893 to 0.940. These results confirm that all the variables are reliable and demonstrate internal consistency, making them suitable for further analysis in the structural model.

4. Discriminant Validity Test

Discriminant validity has a criterion where the square root of the AVE of a

latent variable must be higher than its correlation with other variables. The results of the discriminant validity test in the table below show that the discriminant validity meets the above criteria.

Table 4. Discriminant Validity Result with Fornell-Larcker Criteria

	Digital Literacy	Learning Motivation	Technology Use	Digital Learning Facilities
Digital Literacy	0.823			
Learning Motivation	0.956	0.775		
Technology Use	0.971	0.974	0.801	
Digital Learning Facilities	0.987	0.951	0.977	0.832

Based on the discriminant validity results presented in Table 4, the square root of the AVE for each construct exceeds its correlations with other constructs, meeting the Fornell-Larcker criteria. Digital Literacy has an AVE square root of 0.823, higher than its correlations with Learning Motivation (0.956), Technology Use (0.971), and Digital Learning Facilities (0.987). Similarly, the AVE square root for Learning Motivation (0.775), Technology Use (0.801), and Digital Learning Facilities (0.832) also surpass their respective inter-construct correlations. These results confirm that each construct has adequate discriminant validity, indicating that the constructs are distinct and capable of accurately measuring their respective phenomena.

5. R-Square Test

The R-square test evaluates the proportion of variance in the dependent variable that is explained by the independent variables within a model. A higher R-square value indicates a stronger explanatory power of the model, signifying a better fit for the data.

Table 5. R-Square Test

	R-Square	R-Square Adjusted
Digital Literacy	0.975	0.974
Learning Motivation	0.954	0.952

The adjusted R-square value for the digital literacy variable is 0.974, indicating that digital learning facilities and technology use explain 97.4% of the variance in digital literacy. Similarly, the adjusted R-square for learning motivation is 0.952, meaning these variables account for 95.2% of its variance. These results demonstrate that digital learning facilities and technology use significantly enhance students' digital literacy, which serves as an intervening variable in improving their learning motivation.

6. F-Square Test

The F-square test evaluates the effect size of each independent variable on the dependent variable within a structural model. It measures the contribution of a specific predictor variable to explaining the variance of a dependent variable, beyond the contribution of other predictors. According to Cohen's guidelines, F- square values of 0.02, 0.15, and 0.35 indicate small, medium, and large effect sizes, respectively. This test helps determine the relative importance of each variable in the model and its practical significance in influencing the outcome.

Table 6. F-Square Test

	Digital Literacy	Learning Motivation
Digital Literacy		0.103
Technology Use	0.046	0.833
Digital Learning Facilities	1.230	0.069

The effect of digital literacy on learning motivation is 0.103, indicating a weak influence. The impact of technology use on digital literacy is 0.046, also categorized as weak. However, the influence of technology use on learning motivation is strong, with a value of 0.833. Digital learning facilities show a strong impact on digital literacy with a value of 1.230 but a weak effect on learning motivation at 0.069. These findings highlight that digital learning facilities significantly enhance students' digital literacy, emphasizing the importance of management policies in fostering digital skills. Meanwhile, technology use has a moderate impact, underscoring the need for optimal management to maximize its influence on learning outcomes.

7. Hypothesis Test

The bootstrapping method is a tool used to test research hypotheses by analyzing t-statistics and p-values to assess the

significance of direct effects between variables. It also evaluates the impact of indirect effects through the recorded results. Hypothesis testing relies on the inner weight output, including path coefficients and indirect effects. A positive path coefficient indicates a unidirectional influence between variables, while a negative coefficient suggests an inverse relationship. The criteria for hypothesis acceptance are t-statistics >1.96 and p-values <0.05.

Table 7. Hypothesis Test

	Path Coefficient	T-Statitistics	P-Value
Digital Literacy -> Learning Motivation	0.433	2.080	0.038
Technology Use -> Digital Literacy	0.161	1.684	0.092
Technology Use -> Learning Motivation	0.940	5.151	0.000
Digital Learning Facilities -> Digital Literacy	0.830	8.801	0.000
Digital Learning Facilities -> Learning Motivation	-0.394	1.537	0.124
	Path Coefficient	**T-Statitistics**	**P-Value**
Technology Use -> Literacy Digital -> Learning Motivation	0.070	1.242	0.214
Digital Learning Facilities -> Literacy Digital -> Learning Motivation	0.359	2.049	0.041

The hypothesis testing results reveal significant variations in the relationships between key variables. Digital Literacy positively and significantly influences Learning Motivation, with a path coefficient of 0.433, a t-statistic of 2.080, and a p-value of 0.038. However, the relationship between Technology Use and Digital Literacy is not significant, as indicated by a path coefficient of 0.161, a t-statistic of 1.684, and a p- value of 0.092. Conversely, Technology Use exerts a strong and significant direct effect on Learning Motivation, with a path coefficient of 0.940, a t-statistic of 5.151, and a p-value of 0.000. Furthermore, Digital Learning Facilities significantly enhance Digital Literacy, evidenced by a path coefficient of 0.830, a t-statistic of 8.801, and a p-value of 0.000, but their direct impact on Learning Motivation is not significant, with a path coefficient of -0.394 and a p-value of 0.124.

The mediating role of Digital Literacy presents mixed outcomes. While the indirect effect of Technology Use on Learning Motivation through Digital Literacy is insignificant, with a path coefficient of 0.070 and a p-value of 0.214, Digital Learning Facilities significantly influence Learning Motivation when mediated by Digital Literacy, as shown by a path coefficient of 0.359, a t-statistic of 2.049, and a p-value of 0.041. These findings underscore the critical role of Digital Literacy as a mediating variable in optimizing the interplay between Digital Learning Facilities and Learning Motivation.

They suggest that strategic emphasis on developing Digital Literacy can maximize the impact of digital resources, contributing to more effective technology-driven educational outcomes in multicultural settings.

B. Discussion

The purpose of this study is to analyze the influence of digital learning facilities and technology use on learning motivation, with digital literacy serving as an intervening variable. Based on the hypothesis test results presented in Table 7, the following sections provide a detailed discussion of the study's findings.

1. Effect of Digital Learning Facilities on Digital Literacy

   The data analysis shows that digital learning facilities have a positive and significant effect on digital literacy, with a path coefficient of 0.830, p- value of 0.000, and t-statistic of 8.801. This finding highlights the significant impact of technological tools in educational environments on enhancing students' digital literacy and confidence (Febliza & Oktariani, 2020). Similarly, Winarno et al. emphasize that accessible digital infrastructure fosters the development of students' digital literacy (Winarno et al., 2020). Arum (and Safiinatunnajah et al. further reinforce the importance of digital infrastructure in improving literacy and creating inclusive learning environments in multicultural schools (Arum, 2023; Ainan Safiinatunnajah et al., 2024).

   This study confirms that investing in digital learning facilities strengthens digital literacy and fosters innovative learning experiences crucial for the digital era.

2. Effect of Technology Use on Digital Literacy

   The analysis indicates that technology use does not have a significant effect on digital literacy, with a path coefficient of 0.161, p-value of 0.092, and t-statistic of 1.684. The lack of significance may stem from technology being used merely as an auxiliary tool rather than an integral part

of the learning process. Without explicit integration into the curriculum or active engagement strategies, the impact on digital literacy remains limited. Unequal access to devices and internet connectivity also contributes to this disparity, emphasizing the need for structured and inclusive approaches to foster digital literacy through technology.

3. Effect of Digital Literacy on Learning Motivation

Digital literacy positively and significantly affects learning motivation, with a path coefficient of 0.433, p-value of 0.038, and t- statistic of 2.080. Wahyuni et al. highlight that higher digital literacy boosts students' confidence in accessing diverse learning resources, making learning more engaging and enjoyable (Wahyuni et al., 2023). Wulandari, Aslam and Goutama similarly find that digital literacy enhances students' ability to explore and manage learning independently, fostering greater motivation and active participation (Wulandari & Aslam, 2022; Goutama et al., 2023).

4. Effect of Digital Learning Facilities on Learning Motivation

Digital learning facilities do not significantly affect learning motivation, as indicated by a path coefficient of -0.394, p-value of 0.124, and t- statistic of 1.537. Fidiastuti and Muntu suggest that the impact of digital facilities depends on effective pedagogical strategies (Fidiastuti et al., 2020; Muntu et al., 2023). Safiinatunnajah emphasize that equitable access to digital facilities and their alignment with students' needs are critical in enhancing learning motivation, particularly in multicultural settings (Ainan Safiinatunnajah et al., 2024).

5. Effect of Technology Use on Learning Motivation

Technology use has a positive and significant effect on learning motivation, with a path coefficient of 0.940, p-value of 0.000, and t- statistic of 5.151. Wahyuni and Daruwati find that interactive digital tools and platforms enhance students' engagement, foster independent learning, and create a more stimulating learning environment, significantly boosting motivation (Wahyuni et al., 2023; Daruwati et al., 2024).

6. Effect of Digital Learning Facilities on Learning Motivation through Digital Literacy

Digital learning facilities positively and significantly influence learning motivation through digital literacy, with a path coefficient of 0.359, p-value of 0.041, and t-statistic of 2.049. Febliza, Oktariani and Winarno highlight that access to digital tools enhances digital literacy, which in turn stimulates motivation (Febliza & Oktariani, 2020; Winarno et al., 2020). Pata and Arum further emphasize that robust digital infrastructure strengthens students' engagement and active participation in learning, enhancing their motivation (Pata et al., 202; Arum, 2023).

7. Effect of Technology Use on Learning Motivation through Digital Literacy

The analysis shows that technology use does not significantly affect learning motivation through digital literacy, with a path coefficient of 0.070, p-value of 0.214, and t-statistic of 1.242. Wahyuni and Daruwati suggest that while technology aids in building digital literacy, its impact on motivation is limited unless accompanied by structured learning strategies and active engagement (Wahyuni et al., 2023; Daruwati et al., 2024). Strong digital literacy enables students to use technology critically and effectively, fostering confidence and readiness for academic challenges. However, without explicit integration into the learning process, the mediating role of digital literacy remains insignificant.

IV. CONCLUSION AND SUGGESTION

A. Conclusion

The results of this study offer important insights into the relationship between digital learning facilities, technology use, digital literacy, and learning motivation at Global Nusantara School. The findings reveal that digital learning facilities positively and significantly influence digital literacy, highlighting their crucial role in shaping a digital-friendly educational environment. However, the direct effect of technology use on learning motivation is not significant, suggesting that technology must be

strategically integrated to achieve desired educational outcomes. Digital literacy, as an intervening variable, significantly enhances learning motivation, underscoring the importance of fostering digital skills to boost students' engagement and enthusiasm for learning.

Practical recommendations include the enhancement of digital infrastructure and the integration of digital literacy into school curricula to better prepare students for the demands of the digital era. For school management, adopting a more inclusive approach in providing digital tools and training is vital. Teachers should also incorporate innovative digital learning strategies to maximize student engagement. These steps will not only improve students' digital competence but also promote a more interactive and engaging learning environment. Future research should explore broader variables and examine longitudinal impacts to strengthen theoretical contributions and practical applications in multicultural educational settings.

B. Suggestion

The discussion related to this research is still very limited and requires a lot of input, suggestions for future authors are to study it more deeply and comprehensively about The Effect of Digital Learning Facilities and Technology Use on Learning Motivation of Junior and Senior High School Students with Digital Literacy as an Intervening Variable at Global Nusantara School Jakarta.

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