The Influence of Technology Utilization and Learning Motivation on Learning Concentration: SEM Analysis

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Keywords

Technology Utilization; Learning Motivation; Learning Concentration

ABSTRACT

This study aims to analyze the influence of technology utilization and learning motivation on students' learning concentration. The study used a quantitative explanatory approach with the Structural Equation Modeling method based on Partial Least Squares (SEM-PLS). Data were collected through a Likert-scale questionnaire with 100 PGMI students as respondents. The research instrument consisted of 14 statement items divided into three variables: 4 statement items for the technology utilization variable, 5 statement items for the learning motivation variable, and 5 statement items for the learning concentration variable. Data were analyzed through evaluation of the measurement model and the structural model. The results of the validity and reliability tests showed that all constructs met the required criteria. Bootstrapping results show that learning motivation has a positive and significant effect on learning concentration ($\beta = 0.748$; $T = 13.235$; $p < 0.001$) with a very strong effect, while technology utilization also has a positive and significant effect on learning concentration ($\beta = 0.127$; $T = 1.898$; $p = 0.029$), although with a smaller influence strength. The R-square value of 0.689 (adjusted R-square = 0.682) indicates that 68.9% of the variation in learning concentration can be explained by learning motivation and technology utilization. The results of the effect size analysis (f-square) show that learning motivation has a very large effect on learning concentration (f-square = 1.155). In contrast, technology utilization has a small effect on learning concentration (f-square = 0.033). In conclusion, learning motivation is a dominant factor in improving learning concentration, while technology utilization plays a supporting role. Effective technology integration needs to be accompanied by motivation-enhancing strategies so that student learning concentration can be optimized.

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INTRODUCTION

Digital technology in education has changed how learning is designed and delivered. In this study, technology use refers to the use of digital devices, learning apps, online platforms, and internet-based systems to support academics, boost engagement, and help students meet learning goals.[1] explains that digital technology is closely linked to engagement and learning quality when used strategically and pedagogically.[2] shows that integrating augmented reality into learning can enrich the learning experience and increase student participation.[3] emphasized that the use of mobile learning applications can form a positive mindset towards technology-based learning.[4] States that information technology-based learning design has an impact on learning outcomes if it is designed systematically.[5] also emphasized that acceptance and literacy of AI-based technology are crucial factors in optimizing its use in learning. Therefore, technology utilization does not simply mean the use of digital devices, but reflects the quality of use, including analyzing digital information, evaluating the credibility of sources, utilizing learning platforms, and productively producing academic content.

However, the literature also shows that technology can be a source of distraction if not managed properly.[6] examines the phenomenon of banning mobile phones in the classroom as a response to increasing attention deficit disorder and technology addiction.[7] examines the phenomenon of banning mobile phones in the classroom as a response to increasing attention deficit disorder and technology addiction.[8] summarizes various factors that distract from online learning, including social media notifications and less-controlled digital learning environments.[9] found that the use of personal technology in the classroom had an ambivalent impact on students' learning focus.[10] Research shows that using monitoring technology can help minimize digital distractions on school devices. Therefore, technology utilization in this

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[1]Sean Kearney and Julie Maakrun, "Let's Get Engaged: The Nexus Between Digital Technologies, Engagement and Learning," *Education Sciences* 10, no. 12 (2020): 357, https://doi.org/10.3390/educsci10120357.

[2]Alex Eder da Rocha Mazzuco et al., "A Systematic Review of Augmented Reality in Chemistry Education," *Review of Education* 10, no. 1 (2022), https://doi.org/10.1002/rev3.3325.

[3]Lúcia Pombo and Margarida Marques, "An App That Changes Mentalities About Mobile Learning—The EduPARK Augmented Reality Activity," *Computers* 8, no. 2 (2019): 37, https://doi.org/10.3390/computers8020037.

[4]Ika Kartika, Iqbal Fabianza, and Arman A Sunasa, "Analisis Pengaruh Desain Pembelajaran Berbasis Teknologi Informasi Dan Persepsi Guru Terhadap Hasil Belajar Sejarah Kebudayaan Islam Siswa Madrasah Tsanawiyah Islam Terpadu Bogor," *Eduinovasi Journal of Basic Educational Studies* 4, no. 2 (2024): 1–16, https://doi.org/10.47467/edu.v4i2.238.

[5]Iris H Y Yim and Rupert Wegerif, "Teachers' Perceptions, Attitudes, and Acceptance of Artificial Intelligence (AI) Educational Learning Tools: An Exploratory Study on AI Literacy for Young Students," *Future in Educational Research* 2, no. 4 (2024): 318–45, https://doi.org/10.1002/fer3.65.

[6]Alexander J Dontre, "The Influence of Technology on Academic Distraction: A Review," *Human Behavior and Emerging Technologies* 3, no. 3 (2020): 379–90, https://doi.org/10.1002/hbe2.229.

[7]Neil Selwyn and Jesper Aagaard, "Banning Mobile Phones From Classrooms—An Opportunity to Advance Understandings of Technology Addiction, Distraction and Cyberbullying," *British Journal of Educational Technology* 52, no. 1 (2020): 8–19, https://doi.org/10.1111/bjet.12943.

[8]Chenghao Wang, "Comprehensively Summarizing What Distracts Students From Online Learning: A Literature Review," *Human Behavior and Emerging Technologies* 2022 (2022): 1–15, https://doi.org/10.1155/2022/1483531.

[9]Christina L Iluzada, Robin L Wakefield, and Allison M Alford, "Personal Technology in the Classroom," *Journal of Effective Teaching in Higher Education* 4, no. 3 (2022): 111–31, https://doi.org/10.36021/jethe.v4i3.229.

[10]Cyprian S Pungong, Scott Marakovits, and Angela Lee, "Using GoGuardian Teacher Technology to Combat Students' Digital Distractions on School-Issued Devices," *European Journal of Education and Pedagogy* 4, no. 5 (2023): 56–59, https://doi.org/10.24018/ejedu.2023.4.5.758.

study is understood as a variable that can have a positive or negative impact on learning concentration, depending on the quality of its regulation and management.

The issue of learning concentration is currently critical in digital learning because students often struggle to concentrate, are easily distracted by social media, lose focus during online learning, and tend to multitask during lectures. These conditions result in students' suboptimal understanding of learning materials and reduce the quality of academic engagement during the learning process.

Learning motivation in this study is defined as the internal and external drives that drive students to actively, diligently, and consistently engage in the learning process.[11] emphasizes the synergy between technological innovation, motivation, and engagement in creating effective learning.[12] explains that motivation and interest in learning can be increased through appropriate teaching competencies and strategies.[13] shows that the use of technology in foreign language learning can significantly increase student motivation.[14] found that the use of technology in learning positively affects students' learning motivation.[15] emphasizes that the motivational approach to technology use by teachers affects students' learning experiences.[16] Research shows that the technology-based flipped classroom model can increase student motivation and active participation. Therefore, learning motivation in this study encompasses perseverance, tenacity in the face of difficulties, interest in learning, and determination to achieve academic goals.

The relationship between technology utilization and learning motivation can be explained by technology's ability to create more interactive, flexible, and engaging learning experiences, thereby encouraging students to be more actively engaged in the learning process. Appropriately used technology can increase students' curiosity, engagement, and interest in the learning material. Furthermore, high learning motivation contributes to greater learning concentration, as students tend to be more focused, diligent, and better able to control distractions during learning. Therefore, technology utilization and learning motivation are strongly linked in shaping student learning concentration.

Learning concentration in this study is defined as an individual's ability to focus attention, control thoughts and feelings, and avoid distractions during the learning process. In the context of technology-based learning, concentration becomes increasingly crucial as

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[11]Emybel M Alegre, "Technology-Driven Education: Analyzing the Synergy Among Innovation, Motivation, and Student Engagement," *International Journal of Membrane Science and Technology* 10, no. 2 (2023): 1477–85, https://doi.org/10.15379/ijmst.v10i2.1507.

[12]Siti Aminah, "Patterns of Increasing Student Motivation and Learning Interest Through Lecturer Competencies at Uniska Kediri," *Didaktika Religia* 8, no. 2 (2020): 285–310, https://doi.org/10.30762/didaktika.v8i2.2140.

[13]Alina G Negoescu and Corina M Mitrulescu, "Using Technology to Increase Students' Motivation for Learning a Foreign Language," *International Conference Knowledge-Based Organization* 29, no. 2 (2023): 210–14, https://doi.org/10.2478/kbo-2023-0059.

[14]Septian N F Pratama, Basori Basori, and Kurniasari Kurniasari, "The Effect of Technology Utilization in Learning on Learning Motivation of Grade 11 PPLG Students of State Vocational Schools in Surakarta," *Ijie (Indonesian Journal of Informatics Education)* 7, no. 2 (2024): 127, https://doi.org/10.20961/ijie.v7i2.81712.

[15]Loukia David and Netta Weinstein, "The How and How Much of Technology Use in the Classroom: A Motivational Approach to Teachers' Technology Use," *European Journal of Education* 59, no. 4 (2024), https://doi.org/10.1111/ejed.12674.

[16]Xiaoying Lü and Norazrena A Samah, "The Effectiveness, Benefits and Challenges of the Implementation of Flipped Classroom in English Teaching and Learning: A Systematic Review," *Sains Humanika* 16, no. 3 (2024): 113–21, https://doi.org/10.11113/sh.v16n3.2164.

students are exposed to various digital stimuli that can disrupt focus.[17] emphasizes the importance of strengthening executive functions in improving students' attention.[18] shows that self-regulation helps students maintain focus and reduce digital distractions.[19] emphasizes that without good self-control, technology can exacerbate attention disorders.[20] Also links technology use with the potential for distractions that affect the quality of learning focus. Therefore, learning concentration in this study encompasses aspects of thought control, emotional control, attention, focus during learning, and the ability to avoid distractions.

This research was conducted on students in the Elementary Madrasah Teacher Education (PGMI) Study Program. The selection of research subjects was based on students' increasingly intensive use of digital technology in learning activities, such as Learning Management Systems, academic social media, AI-based applications, and online learning platforms. However, based on the researchers' initial observations, various academic problems persisted, including students lacking focus during lectures, late assignment submissions, low active participation in discussions, and high levels of distraction from digital devices outside of learning. These conditions indicate that technology use has not been fully matched by the optimal ability to manage focus and learning motivation.

To understand the simultaneous relationships among technology use, learning motivation, and learning concentration, a structural analysis approach capable of comprehensively examining latent constructs is necessary.[21] confirms that PLS-SEM is effective for testing models with latent constructs and complex predictive relationships. Therefore, this study uses the SEM-PLS approach to simultaneously and structurally analyze the influence of technology utilization and learning motivation on learning concentration.

As initial research data, the researchers conducted preliminary observations of PGMI students and found that some students still had difficulty maintaining concentration during learning. Students tended to open applications outside of academic needs during lectures, were less active in learning discussions, and exhibited unstable learning focus while using digital media. Furthermore, some students had low learning motivation, resulting in suboptimal use of technology as a learning support tool. These initial findings demonstrate the importance of research on the influence of technology utilization and learning motivation on student learning concentration.

Based on these theoretical and empirical studies, further research is needed that simultaneously examines the contributions of technology utilization and learning motivation to learning concentration within a single, integrated structural model. Therefore, this study aims to answer the following research questions: (1) Does technology utilization significantly influence learning concentration? (2) Does learning motivation significantly influence learning concentration? (3) to what extent the simultaneous use of technology and learning motivation can explain variations in learning concentration in the structural model; and (4)

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[17]Fabian Gunnars, "A Systematic Review of Special Educational Interventions for Student Attention: Executive Function and Digital Technology in Primary School," *Journal of Special Education Technology* 39, no. 2 (2023): 264–76, https://doi.org/10.1177/01626434231198226.

[18]Xintian Wang, Zhangchi Wang, and Yan Li, "Internet Use on Closing Intention–Behavior Gap in Green Consumption—A Mediation and Moderation Theoretical Model," *International Journal of Environmental Research and Public Health* 20, no. 1 (2022): 365, https://doi.org/10.3390/ijerph20010365.

[19]Dontre, "The Influence of Technology on Academic Distraction: A Review."

[20]Selwyn and Aagaard, "Banning Mobile Phones From Classrooms—An Opportunity to Advance Understandings of Technology Addiction, Distraction and Cyberbullying."

[21]Ned Kock, "Methods Showcase—Using PLSF-SEM in Business Communication Research," *International Journal of Business Communication* 62, no. 1 (2024): 187–205, https://doi.org/10.1177/23294884241233281.

how much contribution each exogenous variable makes to learning concentration based on the effect size (f-square) value. This research is expected to provide a theoretical contribution by clarifying the relationships among constructs in the context of technology-based learning, as well as a practical contribution by designing learning strategies that optimally increase student motivation and concentration.

RESEARCH METHOD

This study employed a quantitative explanatory design using a survey approach to examine the effects of technology use and learning motivation on learning concentration. The explanatory design was chosen because this study aims to empirically explain the causal relationships between latent constructs in a structural model. The quantitative approach is considered appropriate for measuring predictive relationships between variables through statistical testing based on structural models. The use of SEM-PLS in educational research is considered effective because it can analyze simultaneous relationships among latent constructs and remains optimal even at moderate sample sizes.[22] Furthermore, the PLS-SEM approach is widely used in educational and technology research due to its flexibility in handling data distributions and in developing predictive models.[23] The research population comprised PGMI Study Program students, with a sample of 100 respondents. The sample was selected using a simple random sampling technique because the research population has relatively homogeneous characteristics, ensuring that each member of the population has an equal opportunity to become a research respondent. This technique was chosen to minimize sample selection bias and increase the representativeness of the data in describing the general population condition. The use of simple random sampling is also appropriate for explanatory quantitative research oriented towards objectively testing the relationship between variables. The research instrument was a closed questionnaire using a five-point Likert scale, with scores ranging from 1 = strongly disagree to 5 = strongly agree. The research instrument consisted of 14 items, divided into three variables: 4 for the technology utilization variable, 5 for the learning motivation variable, and 5 for the learning concentration variable. The preparation of indicators was carried out based on theoretical studies and adapted to the learning context of PGMI students. The construct of technology utilization was measured through indicators of digital information analysis, source credibility evaluation, digital learning platform utilization, and digital content production. The construct of learning motivation was measured through learning persistence, tenacity in the face of difficulties, learning interest, liking challenges, and steadfastness.

Meanwhile, the construct of learning concentration was measured through thought control, emotional control, attention, focus during learning, and the ability to avoid distractions. The research procedure began with the preparation of an instrument based on the indicators of each research variable. Next, the researcher distributed questionnaires both in person and online to PGMI students who met the criteria for being research respondents. Before completing the questionnaire, respondents were informed of the research objectives, the filling procedure, and the guarantee of data confidentiality. After all data was collected, the researcher conducted a data selection process to ensure the completeness of respondents' answers. Data that met the criteria were then coded and input into SmartPLS software for

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[22] Ishwar Singh, "Statistical Role of CB-SEM vs PLS-SEM in the Field of Social Science," *International Journal of Research and Scientific Innovation* XII, no. VIII (2025): 345–49, https://doi.org/10.51244/ijrsi.2025.120800031

[23] Putu G Subhaktiyasa, "PLS-SEM for Multivariate Analysis: A Practical Guide to Educational Research Using SmartPLS," *Eduline Journal of Education and Learning Innovation* 4, no. 3 (2024): 353–65, https://doi.org/10.35877/454ri.eduline2861.

further analysis. Data analysis was carried out in two main stages: evaluation of the measurement model (outer model) and evaluation of the structural model (inner model). The outer model evaluation was conducted by testing convergent validity through outer loading and Average Variance Extracted (AVE) values, discriminant validity, and construct reliability using Composite Reliability and Cronbach's Alpha.

Furthermore, the inner model evaluation was conducted by testing the path coefficients (R^2) and effect sizes (f^2) to determine the strength of the influence between variables. Hypothesis testing was conducted using a bootstrapping procedure to obtain T-statistics and p-values as a basis for determining the significance of the relationship between constructs. This approach allows for comprehensive simultaneous testing of predictive relationships between variables in the context of social and educational research.[24]

RESULTS AND DISCUSSION

Research results

The research results were obtained using Structural Equation Modeling based on Partial Least Squares (SEM-PLS) to test both direct and indirect relationships among the model's variables. Analysis involved evaluating the measurement (outer) and structural (inner) models to ensure the validity, reliability, and significance of construct relationships. The image below shows the model analyzed in this study.

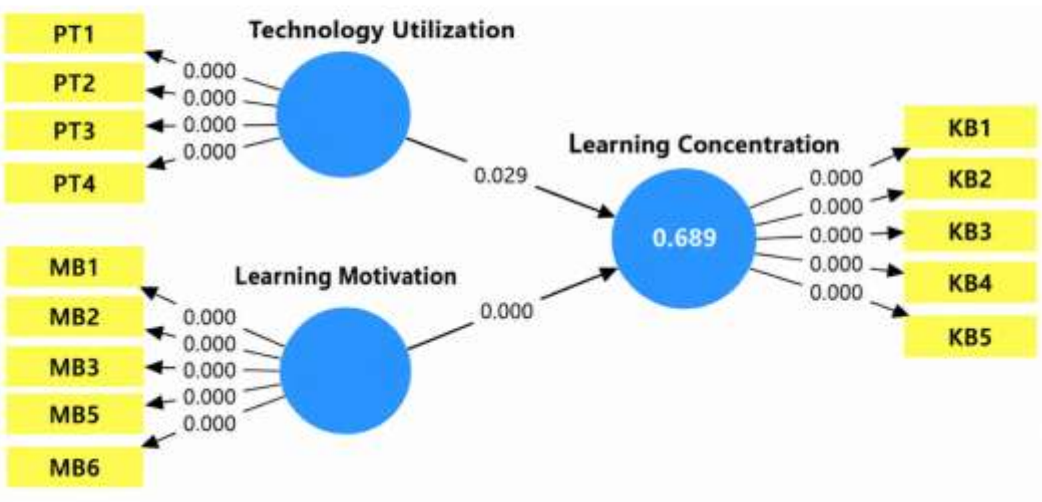

Figure 1. Latent Model of Research Variables from Bootstrap Results

The structural model results indicate that Learning Motivation and Technology Utilization both have a positive and significant influence on Learning Concentration. However, the influence of Learning Motivation appears to be stronger than that of Technology Utilization. Furthermore, the research model also explains Learning Concentration in a good category; thus, the relationship between the variables in the study is considered quite strong.

Outer Model

[24]Pham D Long et al., "Employability Model Evaluation of Engineering Technology Graduates: A PLS-SEM Approach," *Vnu Journal of Science Education Research*, 2024, https://doi.org/10.25073/2588-1159/vnuer.4973; Layal Rabih and Elie Yammine, "E-Learning Success Evaluation in Lebanon During Wartime: An Extension of Delone and McLean IS Success Model," *F1000research* 14 (2025): 468, https://doi.org/10.12688/f1000research.163914.1.

An outer model evaluation was conducted to assess the validity and reliability of the construct by testing convergent validity and discriminant validity, as well as Cronbach's alpha and composite reliability for each research indicator.

Convergent Validity

Outer Loading

The output of the outer loading estimation results is measured by the correlation between the indicator (instrument) score and its construct (variable). An indicator is considered valid if its correlation coefficient is above 0.70.

Table 1. Outer Loading Score

Indicators	Technology Utilization	Learning Motivation	Learning Concentration
TU1	0.817		
TU2	0.792		
TU3	0.826		
TU4	0.864		
LM1		0.819	
LM2		0.875	
LM3		0.886	
LM5		0.855	
LM6		0.787	
LC1			0.916
LC2			0.908
LC3			0.864
LC4			0.923
LC5			0.818

The outer-loading results indicate that all indicators for the variables Technology Utilization, Learning Motivation, and Learning Concentration meet the criteria for convergent validity. Each indicator represents the construct being measured well and consistently; the measurement model is considered of adequate quality. Furthermore, the indicators in the Learning Concentration variable show a very strong contribution in explaining the construct. Thus, all indicators are worthy of being retained, and the model can proceed to the structural testing stage.

AVE

The output from the average variance extracted (AVE) estimation is shown in the table below. A variable is considered valid if its average variance extracted (AVE) value is > 0.5.

Table 2. AVE Score

Variabel	Average variance extracted (AVE)
Technology Utilization	0.681
Learning Motivation	0.714
Learning Concentration	0.786

The AVE values indicate that all constructs meet the criteria for convergent validity. Each variable adequately explains the variance in its indicators; thus, the indicators used are deemed to adequately represent the research constructs. This finding indicates that the measurement model is of good quality and suitable for use in further analysis of the structural model.

Discriminant Validity

Discriminant validity is used to ensure that the constructs or variables in a measurement model truly measure distinct things and do not overlap. In other words, discriminant validity measures the extent to which different constructs in a measurement model can be distinguished from each other. Discriminant validity can be measured using one of three evaluation criteria: cross-loading, HTMT, and/or Fornell-Larcker, and latent variables.

Cross loading

An indicator/statement is declared valid if the relationship between the indicator/statement and its construct/variable (cross-loading value) is higher than its relationship with other constructs. The following are the results of data processing using SmartPLS version 4, with cross-loadings shown in Table 3 below.

Table 3. Cross Loading Score

Indicators	Technology Utilization	Learning Motivation	Learning Concentration
TU1	**0.817**	0.549	0.494
TU2	**0.792**	0.430	0.369
TU3	**0.826**	0.493	0.500
TU4	**0.864**	0.489	0.507
LM1	0.373	**0.819**	0.645
LM2	0.454	**0.875**	0.777
LM3	0.623	**0.886**	0.698
LM5	0.581	**0.855**	0.682
LM6	0.493	**0.787**	0.666
LC1	0.527	0.762	**0.916**
LC2	0.522	0.775	**0.908**
LC3	0.566	0.714	**0.864**
LC4	0.469	0.714	**0.923**
LC5	0.453	0.679	**0.818**

The cross-loading results show that each indicator has the highest loading value on the construct it measures compared to other constructs. This indicates that each indicator is able to differentiate the latent variables well, and there is no overlap in measurement between constructs. Therefore, all variables in the model meet the criteria for discriminant validity and are suitable for use in the next stage of analysis.

HTMT

The Heterotrait-Monotrait Ratio (HTMT) test is used to measure the level of difference between latent variables in a model by comparing the correlation ratios between different constructs.

Table 4. HTMT Score

Variable	Technology Utilization	Learning Motivation	Learning Concentration
Learning Concentration			
Learning Motivation	0.897		
Technology Utilization	0.638	0.682	

The results of the HTMT test indicate that the relationships between constructs are within acceptable limits, so each variable has a good level of discrimination. This value indicates that each construct in the model can be clearly distinguished from the others and does not experience discriminant validity issues. Therefore, the measurement model is deemed to meet the criteria for discriminant validity and is suitable for use in subsequent analyses.

Former Larcker

The Fornell-Larcker Criterion test is used to assess discriminant validity by comparing the square root value of AVE of each construct with the correlation between other constructs in the model.

Table 5. Former Larcker Value Results

Variable	Technology Utilization	Learning Motivation	Learning Concentration
Learning Concentration	0.887		
Learning Motivation	0.824	0.845	
Technology Utilization	0.574	0.598	0.825

The Fornell-Larcker test results demonstrate that each construct possesses a higher AVE root value compared to its correlation with other constructs. This suggests that each variable effectively distinguishes itself from others within the model. Therefore, all constructs satisfy the requirements for discriminant validity, and the measurement framework is considered suitable for further investigation.

Latent Variable

Latent variable testing was conducted to ensure that each construct in the research model had adequate validity and reliability before being analyzed in the structural model.

Table 6. Latent Variable Values

Variable	Technology Utilization	Learning Motivation	Learning Concentration	AVE	$\sqrt{AVE}$
Learning Concentration	1	0.824	0.574	0.786	0.887
Learning Motivation	0.824	1	0.598	0.714	0.845
Technology Utilization	0.574	0.598	1	0.681	0.825

The latent variable values show that each construct has a higher AVE root value than the relationships between other constructs. This indicates that each variable is able to better represent its indicators compared to other variables in the model. Thus, all constructs have met the criteria for discriminant validity, and the measurement model is deemed suitable for use in structural analysis.

Construct Reliability

Construct Reliability can be analyzed using one of two methods: Cronbach's Alpha or Composite Reliability. Both methods are used to test the reliability of indicators in a variable.

Table 7. Cronbach's Alpha or Composite Reliability Value

Variabel	Cronbach's Alpha	Composite Reliability (rho_a)
Learning Concentration	0.931	0.934
Learning Motivation	0.899	0.903
Technology Utilization	0.844	0.853

The reliability test results indicate that all variables have excellent internal consistency. The Cronbach's Alpha and Composite Reliability values for each construct met the required criteria, indicating that the indicators used are capable of measuring the variables consistently and stably. Therefore, the measurement model can be declared reliable and suitable for use in further analysis.

FIT Model

Model fit is used to determine the extent to which a research model is able to represent the empirical data as a whole. A model is considered to have a good fit if the model fit index value falls within the recommended limits.

Table 8. FIT Model

FIT Model	Saturated model	Estimated model
SRMR	0.070	0.070
d_ULS	0.513	0.513
d_G	0.364	0.364
Chi-square	210.317 > 29.819	210.317 > 29.819
NFI	0.822	0.822

The model fit results indicate that the research model has a fairly good level of fit between the empirical data and the constructed model. The SRMR and NFI values indicate that the model is acceptable, while the d_ULS and d_G values indicate no significant deviations in the measurement model. Overall, the model fit evaluation results indicate that the research model is suitable for further analysis on the structural model.

Inner Model

The inner model in PLS-SEM describes the relationships between latent variables and is evaluated to determine the strength and significance of these relationships. The evaluation covers three main aspects: R-square, the significance of the relationship (Hypothesis Testing), and F-square/Effect Size, which are used for further analysis of the structural model.

Path Coefficients

Hypothesis testing was conducted to determine the direct influence of variables in the structural model. This test used path coefficients (β), T-statistics, and p-values from bootstrapping in SEM-PLS.

Table 9. Path Coefficients Results of Bootstrapping

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Learning Motivation -> Learning Concentration	0.748	0.746	0.057	13.235	0.000
Technology Utilization -> Learning Concentration	0.127	0.126	0.067	1.898	0.029

Bootstrap test results indicate that learning motivation has a positive and significant effect on learning concentration, with a more dominant influence. Meanwhile, technology utilization also has a positive effect on learning concentration, although its contribution is relatively smaller. These findings suggest that increasing learning motivation and technology utilization can support improved student learning concentration.

R Square and F Square

R^2 indicates the extent to which the independent variables explain the dependent variable in a research model. The higher the R^2 value, the greater the independent variable's contribution in explaining the variation in the dependent variable. Meanwhile, Q^2 is used to assess the model's predictive ability. A Q^2 value greater than zero indicates that the model has good predictive relevance and is able to adequately predict the data.

Table 10. R-square (R^2) and f-square (f^2) values

	R-Square	F-Square
Learning Concentration	0.689	
Learning Motivation		1.155
Technology Utilization		0.033

The test results show that the independent variables are able to explain the Learning Concentration variable with a strong category. Furthermore, Learning Motivation has a significant influence on Learning Concentration, while Technology Utilization shows a relatively small influence in the research model. These findings indicate that Learning Motivation is a more dominant factor in explaining changes in Learning Concentration than Technology Utilization.

Discussion

This study aims to analyze the influence of technology utilization and learning motivation on learning concentration using the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach. The results indicate that the two variables have different characteristics in explaining variations in learning concentration. Technology utilization exhibits a relatively weak influence on learning concentration, while learning motivation exhibits a strong and significant influence. When tested simultaneously using the R-square (R^2) value, both variables are able to explain variations in learning concentration in the strong category. This finding suggests that in the context of technology-based learning, internal psychological factors play a more dominant role than external instrumental factors.

The first research question asks how positive technology utilization influences learning concentration. Empirically, the results show that technology utilization has a positive but relatively low influence on students' learning concentration. This finding suggests that technology use has not fully improved students' ability to focus, control their thoughts, and avoid distractions during the learning process. Based on variable indicators, students have indeed utilized technology to search for digital information, use learning platforms, and access online learning resources. However, this technology use has not been fully accompanied by the ability to control digital distractions, thus its influence on learning concentration remains limited. This condition is evident from the fact that there are still students who are easily distracted by social media, digital notifications, and non-academic activities while learning is taking place.

These findings indicate that the success of technology utilization in improving learning concentration is significantly influenced by the quality of the technology itself. Students who use technology specifically for academic purposes tend to be better able to maintain focus compared to those who multitask. This aligns with the concept that technology can function as both a learning support tool and a source of distraction if its use is not properly controlled.

Theoretically, the influence of technology on learning concentration can be explained by its ability to provide flexible, interactive, and adaptive learning access. Technology allows students to quickly access learning resources and increases engagement in digital learning. However, when technology use is not balanced with self-regulation skills, students tend to experience decreased focus due to digital distractions. Therefore, the effect of technology utilization on learning concentration in this study tended to be small, although still statistically significant.

These research findings are supported by non-academic factors during learning[25] which explains that technology can increase student engagement when used in structured and interactive learning.[26] also found that the effectiveness of educational technology use is greatly influenced by the learning experience and user satisfaction in the digital learning process. Furthermore, it is structured and interactive,[27] confirms that the use of AI-based technology can increase user engagement when supported by appropriate digital interactions. Therefore, the influence of technology on learning concentration is highly dependent on the quality of digital learning implementation and management.

The second research question asks how learning motivation positively influences learning concentration. The results of the study indicate that learning motivation has a strong and significant influence on learning concentration. These findings indicate that students who demonstrate learning persistence, tenacity in the face of difficulties, interest in learning, and steadfastness in achieving academic goals tend to have better concentration abilities. Students with high learning motivation are better able to focus, control their thoughts and feelings, and maintain focus throughout the learning process. Conversely, students with low motivation tend to lose focus and become distracted more easily during the learning process.

Learning motivation is a crucial factor because it serves as the psychological energy that guides students' learning behavior. Students with high motivation will demonstrate persistence in learning, more actively seek solutions when facing difficulties, and have a greater commitment to completing academic assignments. This condition enables students to maintain attention and control distractions throughout the learning process.

Theoretically, learning motivation influences learning concentration because motivation is related to an individual's internal drive to achieve specific goals. When students

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[25]Nuril Huda et al., "The Influence of STEAM Education on Students' Interest in Technology at Middle Schools in Indonesia," *The Eastasouth Journal of Learning and Educations* 2, no. 01 (2024): 50–62, https://doi.org/10.58812/esle.v2i01.226.

[26]K Kavitha and V P Joshith, "Exploring Gen Z's Satisfaction and Continuance Intention Towards ChatGPT 4o in Higher Education: PLS-SEM Insights Using the ECM," *Journal of Educational Technology Systems* 54, no. 2 (2025): 407–30, https://doi.org/10.1177/00472395251380294.

[27]Cheng Wei, Yu Tian, and Meng Na, "Enhancing Marathon Enthusiast Engagement Through AI: A Quantitative Study on the Role of Social Media in Sports Communication," *Brain and Behavior* 15, no. 6 (2025), https://doi.org/10.1002/brb3.70593.

have clear learning goals, their mental energy and attention are more focused on academic activities. Conversely, low motivation can lead to students being passive, easily bored, and having difficulty maintaining attention during learning. Therefore, learning motivation is a key determinant in shaping student concentration.

The results of this study are supported by [28] which shows that students' motivation and readiness to learn have an impact on academic competence in the digital era.[29] also explains that self-efficacy and internal psychological factors contribute to individual engagement in technology use. In addition,[30] confirms that perceptual alignment and adaptive learning abilities can improve individual focus and engagement in both work and learning environments. These findings reinforce the strong relationship between internal motivation and the ability to maintain concentration in learning.

The third research question asks how the joint influence of technology utilization and learning motivation on learning concentration is based on the R-square (R^2) value. The analysis results show that both variables simultaneously explain 68.9% of the variation in learning concentration, while the remainder is influenced by variables outside the research model. The R-square value of 0.689 indicates that the research model has strong predictive power in explaining student learning concentration. This finding indicates that technology utilization and learning motivation together contribute significantly to improving learning concentration.

Simultaneously, the research results show that learning concentration is not only influenced by external factors such as technology, but also significantly influenced by internal factors such as learning motivation. Technology provides a learning environment that supports information access and interactivity in learning, while learning motivation helps students maintain attention and engagement throughout the learning process. The combination of these two factors leads to optimal student learning concentration.

The use of PLS-SEM in this study is relevant to the recommendations[31] which states that PLS-SEM is effective for analyzing latent relationships in predictive social and educational research. Subhaktiyasa[32] also explains that the PLS-SEM approach is capable of providing a comprehensive evaluation of relationships between constructs through structural model testing and predictive effect measurements.

In addition to the R-square value, this study also analyzed the effect size (f-square) to determine the contribution of each exogenous variable to learning concentration. The analysis results show that learning motivation has an F-squared value of 1.155, which is categorized as having a very large influence on learning concentration. This finding indicates that learning motivation is a dominant factor in shaping students' ability to focus, control their thoughts, and maintain focus during the learning process. Meanwhile, technology

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[28]Ernawati Ernawati et al., "The Empirical Study of Factors Affecting Students' Competence of Fashion Design Education in the Industrial Revolution 4.0 Era," *International Journal of Instruction* 15, no. 4 (2022): 259–76, https://doi.org/10.29333/iji.2022.15415a.

[29]Nguyen T Chinh et al., "Impact of Self-Efficacy and Mediating Factors on Fintech Adoption in the VUCA Era," *Journal of Eastern European and Central Asian Research (Jeecar)* 11, no. 4 (2024): 796–812, https://doi.org/10.15549/jeecar.v11i4.1740.

[30]Darmawan T Nugroho and Pri Hermawan, "Strengthening Collaboration Through Perception Alignment: Hybrid Workplace Leadership Impact on Member Awareness, Understanding, and Learning Agility," *International Journal of Management Entrepreneurship Social Sciences and Humanities* 5, no. 1 (2022): 118–34, https://doi.org/10.31098/ijmesh.v5i1.954.

[31]Ishwar Singh, "Statistical Role of CB-SEM vs PLS-SEM in the Field of Social Science," *International Journal of Research and Scientific Innovation* XII, no. VIII (2025): 345–49, https://doi.org/10.51244/ijrsi.2025.120800031.

[32]Subhaktiyasa, "PLS-SEM for Multivariate Analysis: A Practical Guide to Educational Research Using SmartPLS."

utilization has an f-square value of 0.033, which is categorized as having a small influence. This indicates that technology utilization still contributes to learning concentration, but its influence is much weaker than that of learning motivation. Thus, the effect size results confirm that internal psychological factors play a stronger role than external instrumental factors in improving student learning concentration.

The significance of this research lies in its ability to demonstrate that increased technology use does not automatically improve learning quality. The results demonstrate that successful technology-based learning still requires strong learning motivation to enable students to maintain concentration throughout the learning process.

This research's contribution to the fields of technology and education is theoretical, methodological, and practical. Theoretically, this research reinforces the view that the presence of technology does not solely influence learning concentration, but rather by students' psychological readiness to manage attention and learning engagement. Methodologically, this research demonstrates the ability of the PLS-SEM approach to comprehensively analyze predictive relationships between constructs. Practically, the research results recommend that digital learning development is accompanied by strategies to enhance learning motivation to optimally enhance student concentration.

The implications of this research point to the need for a holistic approach to technology-based learning. Teachers and educational institutions need to develop strategies that foster learning motivation while simultaneously managing technology use to prevent distraction. Technology integration needs to be designed interactively and oriented toward active student engagement. Furthermore, strengthening digital literacy and self-regulation skills is an important factor in maintaining learning concentration in the digital age.

However, this research has several limitations. The cross-sectional research design is not yet able to explain the dynamics of concentration changes over the long term. The variables used are still limited to two main predictors, thus not including other factors such as self-regulated learning or the learning environment. Furthermore, the use of data based on respondents' perceptions has the potential to introduce subjective bias. Therefore, further research is recommended to use a longitudinal design, expand the variables, and consider a mixed approach to gain a more comprehensive understanding.

Overall, this study shows that learning motivation is the primary determinant of learning concentration in technology-based learning environments. At the same time, technology utilization plays a supporting role, the effectiveness of which depends on the design and regulations of its use. These findings enrich the study of educational technology by confirming that effective digital transformation requires the simultaneous integration of technological and psychological aspects.

CONCLUSION

Based on the proposed research problem, this study concludes that technology utilization has a positive effect on learning concentration. However, the magnitude of this effect is relatively small compared to learning motivation. This indicates that technology can be a supporting tool for learning focus if used in a targeted manner and according to learning needs. Meanwhile, learning motivation has been shown to have a much stronger positive and significant effect on learning concentration. These findings confirm that internal student factors, such as intrinsic drive and the desire to achieve academic goals, are the main determinants of maintaining attention during the learning process. Simultaneously, technology utilization and learning motivation contribute strongly to variations in learning concentration, so both need to be considered simultaneously in learning design. Thus, this study contributes to strengthening the perspective that motivation-enhancing strategies for optimal results must accompany technology integration in education.

For future research, it is recommended that the model be expanded to include other variables such as self-regulated learning, digital distraction control, or learning engagement as mediating or moderating variables. Longitudinal research is also needed to examine the consistency of the influence of these variables over a longer period. Furthermore, a mixed methods approach can be used to deepen understanding of students' experiences in utilizing technology while managing their learning concentration. With this development, future research is likely to provide a more comprehensive picture of the dynamics of technology-based learning in the digital era.

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