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The Role of Family Influence, Digital Competence, and Attitudes in Shaping Student Engagement in Digital Learning Environments

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Abstract
The rapid integration of digital tools into the learning environment has made it essential to understand the factors that support sustained student engagement. This study investigates how family digital experience, perceived digital competence, and attitudes toward technology contribute to student engagement at Sinar Bijaksana Guang Ming Secondary and Senior High School in Jambi. A quantitative method was employed using an online questionnaire distributed to 248 students, with 205 valid responses analyzed through Partial Least Squares Structural Equation Modelling (PLS-SEM). The results indicate that family digital experience significantly influences students' attitudes toward technology ($p = 0.000$) and perceived digital competence ($p = 0.012$). Perceived digital competence ($p = 0.000$) and attitudes toward technology ($p = 0.025$) positively predict student engagement. However, the direct effect of family influence on student engagement was not significant ($p = 0.111$), suggesting that its contribution operates indirectly through attitudes and competence rather than as a direct determinant. These findings highlight that students' attitudes toward technology are the strongest predictor of engagement, underscoring the importance of fostering positive perceptions of digital learning environments. The study emphasizes the combined role of family support, digital confidence, and attitudinal readiness in enhancing sustained engagement and suggests further exploration of school- and peer-related factors in future research.

Keywords: Attitudes toward Technology, Family Influence, Perceived Digital Competence, Student Engagement

INTRODUCTION

In the midst of rapid changes in today's digital learning landscape, students are increasingly required to navigate a variety of technological tools as part of their everyday academic activities. This transformation makes it essential to understand what enables students to remain engaged over time, rather than only in isolated learning moments. In educational research, student engagement is understood as a multidimensional concept, encompassing behavioural, emotional, and cognitive involvement (Christenson, 2012; Kim et al., 2018). Engagement is considered sustainable when these dimensions are maintained consistently and continue to support students' participation, persistence, and learning interest across different contexts (Connell, 1991; Kim et al., 2018).

In digital learning settings, sustaining engagement means that students remain willing to explore technological tools, cope with challenges, and integrate digital resources into their learning routines (Scheel et al., 2022). This form of engagement is shaped by both internal and external conditions. Students' attitudes toward digital technology influence how open they are to trying new platforms and staying motivated during difficulties (Konrad & Štemberger, 2023; Štemberger & Konrad, 2021), while their perceived digital competence fosters confidence and reinforces their ability to participate actively across learning activities (Zhao et al., 2021). At the same time, external influences, particularly the family environment, provide early exposure, guidance, and digital habits that help shape students' readiness to engage with technology in school (Scheel et al., 2022; Kim et al., 2018).

At the same time, external influences, particularly the family environment, provide early exposure, guidance, and digital habits that help shape students' readiness to engage with technology in school (Kim et al., 2018; Zakaria et al., 2022). Family digital experiences serve as foundational elements that influence students' subsequent attitudes and competence development in educational contexts (Kim et al., 2018). Research indicates that students' positive prior digital experience significantly influences their perceived digital competence and their attitude toward digital technologies (Kim et al., 2018).

Although the roles of family support, digital competence, and attitudes toward technology have been examined in prior studies, existing research presents several limitations. Much of the literature tends to isolate these variables, focusing on either family involvement, digital literacy, or attitudes, without explaining how these factors interact to support sustained engagement. Theories commonly applied, such as digital literacy frameworks or technology acceptance models, offer partial explanations but do not fully capture the combined influence of external and internal factors on long-term engagement (Zhao et al., 2021; Kim et al., 2018). Theories commonly applied, such as digital literacy frameworks or technology acceptance models, offer partial explanations but do not fully capture the combined influence of external and internal factors on long-term engagement (Elayah, 2025; Scheel et al., 2022). In addition, findings across previous studies are not always consistent; some highlight strong links between family influence and engagement, while others report weak or indirect effects (González et al., 2022; Purnama et al., 2021). For instance, González et al. (2022) found that family conditions analyzed did not produce significant effects on digital competence, which contradicts other studies stating that students' previous experience with technology in their family context positively predicts their level of digital competence and attitude towards digital technology use. These limitations suggest the need for a more integrated approach that considers how family digital experience, perceived competence, and attitudes may work together to shape student engagement (Kim et al., 2018)

This gap is particularly relevant at Sinar Bijaksana Guang Ming Secondary and Senior High School in Jambi, where digital learning has become part of everyday instruction. Preliminary observations show variation in students' exposure to technology at home, differences in confidence when using digital tools, and diverse attitudes toward school-based digital platforms. These conditions raise an important research question: How do family digital experiences, perceived digital competence, and attitudes toward technology interact to influence students' sustained engagement in digital learning. The investigation of these interconnected factors is crucial for understanding sustainable student engagement in digital learning environments, as research demonstrates that digital competence, attitudes, and family influences collectively shape students' learning experiences and outcomes (Kim et al., 2018; Scheel et al., 2022; Štemberger & Konrad, 2021).

Based on this question, the objective of this study is to examine both the direct and indirect relationships among these variables and to determine which factors contribute most strongly to sustaining engagement. The conceptual model developed for this research integrates family influence, perceived digital competence, and attitudes as predictors of sustainable student engagement in digital learning. This model serves as the foundation for the hypotheses tested in the study.

To address the research problem and guide the analysis, this study developed a conceptual model that brings together the key variables identified in the literature. The model assumes that family influence shapes students perceived digital competence and their attitudes toward technology, which in turn contribute to sustainable engagement in digital learning. It also incorporates the possibility that family influence may operate indirectly through these internal factors rather than exerting a direct effect on engagement. This framework provides a basis for formulating the study's hypotheses and for examining the interconnected pathways through which external and internal influences shape students' digital engagement. The conceptual model used in this study is presented in Figure 1.

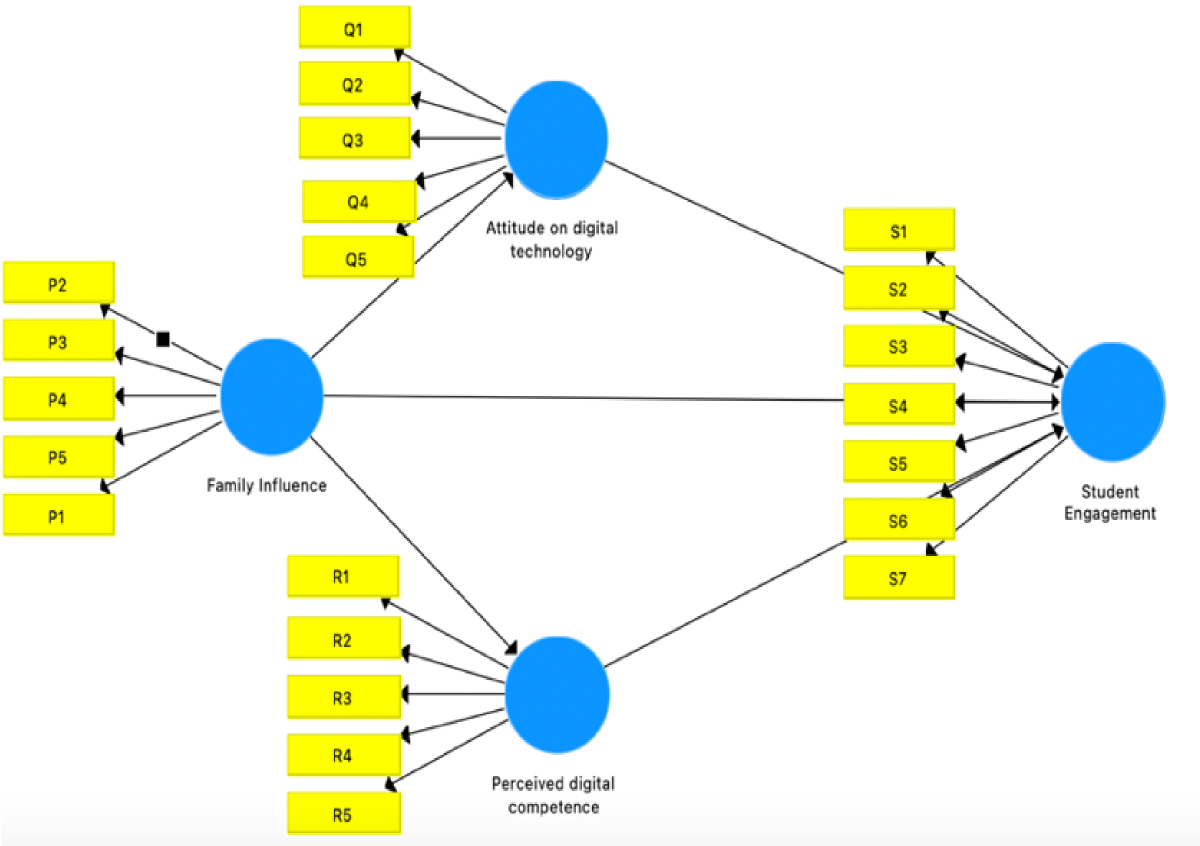

Figure 1. The Model Family Influence Shapes Students' Perceived Digital Competence and Attitudes toward Digital Technology

RESEARCH METHODS

This study used a quantitative survey approach to examine how family influence, perceived digital competence, and students' attitudes relate to their sustained engagement in digital learning. The research took place at Sinar Bijaksana Guang Ming Secondary and Senior High School in Jambi, involving students from both levels as the target population. Out of 248 students, 205 provided complete responses that were included in the analysis.

The data were gathered using an online questionnaire developed through Google Forms. The instrument consisted of demographic information and four sets of items measuring family digital experience, attitudes toward digital technology, perceived digital competence, and student engagement. These items were adapted from established scales and presented using a five-point Likert format, allowing students to indicate their level of agreement.

Data collection lasted for one week in October 2024. Before distributing the questionnaire, permission from the school administration was obtained, and teachers assisted in sharing the survey link through class WhatsApp groups and the school's digital learning channels. Students were encouraged to complete the questionnaire outside regular lesson hours to ensure their responses were voluntary and not influenced by classroom routines. Throughout the week, the research team monitored the incoming responses and, when necessary, coordinated with homeroom teachers to remind students who had not yet participated. Responses that were incomplete or duplicated were removed prior to analysis.

The completed data were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM) with SmartPLS 3.2.9. Following common analytical procedures, the measurement model was evaluated first to assess reliability and validity, followed by the structural model to test the hypothesized relationships among variables. Descriptive statistics were generated using SPSS 23 to provide an overview of participant characteristics and item distributions.

Participants were selected using convenience sampling, which was the most practical option considering the short data-collection period and the need to reach students through the school's digital communication channels. The population consisted of 248 students across the secondary and senior high school levels, representing diverse age groups, grade levels, and levels of familiarity with digital learning. Although this sampling technique made it possible to gather responses from students who were easily accessible and willing to participate, it may also introduce sampling bias, particularly because students who are more active online or more responsive to digital surveys could be overrepresented. These limitations were acknowledged when interpreting the results of the study. The survey instrument aimed to assess the characteristics, perceptions, attitudes, and behaviours of students in relation to digital technology and engagement. From a total population of 248, 205 complete responses were gathered and deemed valid for analysis.

The data analysis process incorporated multiple techniques. To evaluate reliability, the Cronbach's Alpha coefficient was used. Measures of central tendency (mean) and dispersion (standard deviation) were calculated for descriptive insights. Pearson correlation coefficients were employed to examine the strength and direction of associations between variables. Additionally, t-tests were used to assess the significance of moderating effects. The core analytical framework relied on Partial Least Squares Structural Equation Modelling (PLS-SEM) using SmartPLS version 3.2.9. PLS-SEM was chosen due to its suitability for small to medium-sized samples and for testing complex models with multiple constructs. The analysis followed a two-stage process:

1. Measurement model evaluation, which examined the validity and reliability of constructs;
2. Structural model assessment, which tested the direct and indirect relationships among exogenous and endogenous variables (Hair, Howard, et al., 2020a).

To estimate the minimum number of participants required for this study, a GPower analysis was conducted. The calculation initially referred to the school's overall student count of 685 learners listed in its administrative records. However, the actual population relevant to this research, restricted to the secondary and senior high school levels, consisted of 248 students. The final sample of 205 respondents not only met but exceeded the minimum threshold suggested by the GPower analysis, ensuring that the study achieved sufficient statistical power for subsequent model testing. This clarification helps reconcile the difference between the administrative population figure and the specific population used in the analysis. This ensured that the results were robust and generalizable within the defined research context. The questionnaire instrument used in the study was organized into five sections. The first section collected demographic data. The second section consisted of 22 items across four key constructs:

1. Family digital experience (5 items)
2. Attitude toward digital technology (5 items)
3. Perceived digital competence (5 items)
4. Student engagement (7 items)

These items were adapted from prior research, notably from Nurani (2023), and measured using a Likert scale ranging from "Strongly Disagree" to "Strongly Agree." The questionnaire used in this study consisted of five sections and was developed by adapting items from previously validated instruments relevant to digital learning research.

The first section gathered students' demographic information, including age, gender, and level of study. The second section measured the four main constructs of the study, comprising a total of 22 items. Family Digital Experience was assessed using five items adapted from Nurani (2023), which explore the extent of students' exposure to technology at home, parental guidance, and the frequency of digital interactions within the family. Attitude toward Digital Technology was measured with five items that capture students' perceptions of the usefulness, enjoyment, and acceptance of digital tools for learning. The third, Perceived Digital Competence included five items that asked students to evaluate their confidence and self-assessed ability in using digital platforms, navigating online resources, and completing technology-based tasks. The last, Student Engagement was measured using seven items that represent behavioural, emotional, and cognitive engagement in digital learning activities, such as persistence, interest, participation, and willingness to explore digital materials.

All items were presented using a five-point Likert scale ranging from 1 = Strongly Disagree to 5 = Strongly Agree. Before distribution, the questionnaire underwent content validation by two experts in educational technology and research methodology to ensure clarity, relevance, and alignment with the constructs. Minor adjustments in wording were made to improve readability for secondary and senior high school students. A pilot test with a small group of students (n = 30) was also conducted to check item reliability and clarity prior to full data collection.

To ensure the content validity and construct reliability, the questionnaire was designed based on previously validated instruments. The final survey scale and item distribution are provided below.

Table 1. Demographics description of the participants

Variable	Demographic	Frequency	Percentage
Age	15-16	50	24.4
Age	17-18	80	39.0
Age	19-20	75	36.6
Gender	Male (1)	85	41.5
Gender	Female (2)	120	58.5

The demographic data of the participants reveals a balanced distribution across age and gender groups. In terms of age, the participants are divided into three categories: 15-16 years, 17-18 years, and 19-20 years. The 15-16 age group includes 50 participants, accounting for 24.4% of the total sample. The 17-18 age group, representing the largest proportion, consists of 80 participants, making up 39.0% of the total. Meanwhile, the 19-20 age group comprises 75 participants, contributing 36.6% to the overall sample. Regarding gender, 85 participants are male, constituting 41.5% of the sample, while 120 participants are female, representing the majority at 58.5%. Overall, the study's total sample size of 205 participants reflects a diverse range of secondary and senior high school students, with the largest representation coming from the 17-18 age group and a slightly higher proportion of females. This demographic information is included to provide a clear picture of the sample's composition and to ensure that the methodological analysis appropriately reflects the characteristics of the students involved in the study.

RESULTS AND DISCUSSION

Result

Measurement Model

This study used the Partial Least Squares–Structural Equation Modelling (PLS-SEM) technique for data analysis. PLS-SEM is a type of structural equation modelling used to statistically analyse and measure latent variables with multiple observed variables, it involves regression-based methods, instead of the maximum likelihood estimation used in structural equation modelling. PLS is effective when used for theory development with fewer data assumptions, such as multivariate normality assumptions, smaller sample sizes than structural equation modelling, and measurement scales. For this study, SmartPLS 3.0 was used to assess the measurement and structural models. SPSS 23.0 was applied to examine descriptive statistics of the data. We used a two-step approach commonly used in SEM to evaluate model fit. This approach involves the assessment of the measurement model (outer model) and the assessment of the structural model (inner model). To assess model structures, we adapted Chin's recommendations of criteria.

To evaluate the model fit, the construct validity of the measurement model was tested by assessing discriminant validity and reliability. In the study, the measurement model was evaluated in terms of the factor loadings of each item, plus internal consistency reliability, including Cronbach's alpha, composite reliability, convergent validity, and discriminant validity. Convergent validity, which assesses whether each item measures what it was theoretically supposed to measure, is established when T-values are greater than 1.96. In this study, convergent validity was assessed using average variance extracted (AVE) and standardized factor loadings. The presence of multicollinearity among constructs was tested with the variance inflation factor. Discriminant validity was examined using square root average variance extracted (AVE) values that were larger than the inter-construct correlations, suggesting that each measurement item was better explained by its intended construct than by other constructs. The results of comparing the square root of AVE to construct correlations mean that each construct is more associated with its own measures than with other constructs. According to one study, the AVE and cross-loading can be used to assess validity. The result should be at least 0.70 (i.e., AVE > 0.50), and greater than the construct's correlation with other constructs.

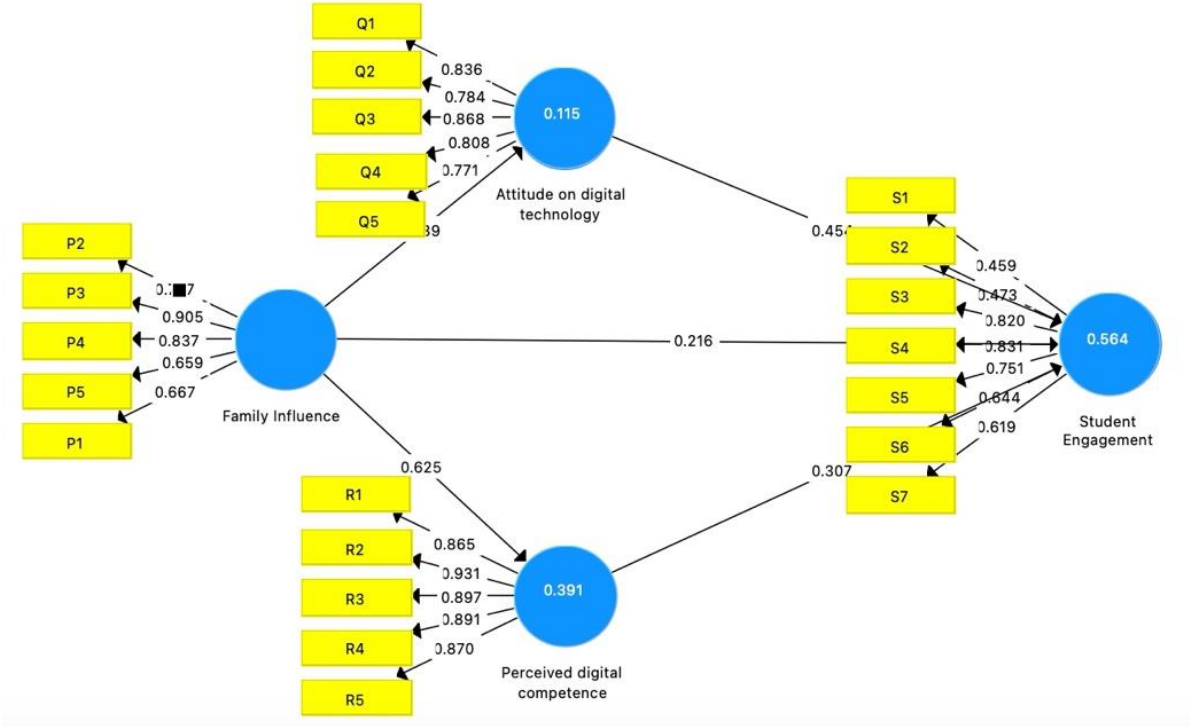

Figure 2. The Fit Model of Family Influence Shapes Students' Perceived Digital Competence and Attitudes toward Digital Technology

Path significances were determined by running the model through a bootstrap resampling routine to estimate the precision of the PLS estimates and assess the significance level of the estimates. The number of resamples used for this study was equal to 5000 (no sign changes option). In the research model, the path significance of each hypothesis was included, and we explained the variance (the R2) by each path. The T-test in the significance level (0.05) required a T-value > 1.96, and the significance level (0.01) required a T-value > 2.58.

Table 2. Outer loading

	Attitude on Digital Technology	Family Influence	Perceived Digital Competence	Student Engagement
P2		0.767		
P3		0.905		
P4		0.837		
P5		0.659		

	Attitude on Digital Technology	Family Influence	Perceived Digital Competence	Student Engagement
Q1	0.836			
Q2	0.784			
Q3	0.868			
Q4	0.808			
Q5	0.771			
R1			0.865	
R2			0.931	
R3			0.897	
R4			0.891	
R5			0.870	
S1				0.459
S2				0.473
S3				0.820
S4				0.831
S5				0.751
S6				0.644
S7				0.619
P1		0.667		

The outer loadings indicate the strength of the relationship between each indicator and its latent construct. For the Family Influence construct, indicators P2, P3, and P4 show strong loadings (0.767, 0.905, and 0.837), while P1 and P5 fall slightly below the recommended threshold with values of 0.667 and 0.659. In exploratory studies, such indicators may still be retained when their removal does not substantially improve the construct's reliability. All indicators for Attitude on Digital Technology (Q1–Q5) meet the loading criteria, ranging from 0.771 to 0.868. The Perceived Digital Competence construct also demonstrates strong measurement quality, with all indicators (R1–R5) loading between 0.865 and 0.931.

For Student Engagement, three indicators (S3, S4, S5) meet acceptable loading standards (0.820, 0.831, 0.751). However, four items, S1 (0.459), S2 (0.473), S6 (0.644), and S7 (0.619), fall below the ideal threshold. Loadings below 0.50 are typically discarded in PLS-SEM, but in this case, removing the lower-loading items did not improve the composite reliability or AVE of the construct. In addition, these items capture aspects of engagement that are theoretically relevant in the school's digital learning context. For this reason, they were retained, although their lower loadings suggest that these indicators may need refinement in future research. While their inclusion introduces some limitations, the overall reliability and validity measures for the Student Engagement construct remain within acceptable ranges.

Table 3. R square

	R Square	R Square Adjusted
Attitude on digital technology	0.115	0.100
Perceived digital competence	0.391	0.380
Student Engagement	0.564	0.541

The R-Square values indicate the proportion of variance in the dependent variables explained by the independent variables. For Attitude on Digital Technology, an R^2 of 0.115 suggests that 11.5% of its variance is explained by family influence, indicating a weak effect. In contrast, the Perceived Digital Competence construct has an R^2 of 0.391, showing that 39.1% of its variance is explained by family influence, representing a moderate effect. The strongest relationship is observed for Student

Engagement, with an R^2 of 0.564, indicating that 56.4% of its variance is explained by family influence, perceived digital competence, and attitudes toward technology, demonstrating a strong overall effect.

Table 4. Construct Reliability and Validity

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Attitude on digital technology	0.874	0.890	0.908	0.663
Family Influence	0.832	0.878	0.880	0.597
Perceived digital competence	0.935	0.937	0.950	0.794
Student Engagement	0.806	0.869	0.846	0.694

The constructs' reliability and validity were assessed using Cronbach's Alpha. Composite Reliability (CR), and Average Variance Extracted (AVE). For Attitude on Digital Technology, the Cronbach's Alpha of 0.874. Composite Reliability of 0.908. and AVE of 0.663 confirm strong internal consistency and convergent validity. The Family Influence construct also shows good reliability, with a Cronbach's Alpha of 0.832. Composite Reliability of 0.880, and AVE of 0.597. The Perceived Digital Competence construct exhibits excellent reliability and validity, with a Cronbach's Alpha of 0.935. Composite Reliability of 0.950, and AVE of 0.794. Lastly, the Student Engagement construct has a Cronbach's Alpha of 0.806. Composite Reliability of 0.846, and AVE of 0.694, indicating good reliability and convergent validity across all construct.

Table 5. The Variance Inflation Factor (VIF)

	VIF	R3	5.436
P2	1.611	R4	3.335
P3	2.900	R5	2.771
P4	2.369	S1	1.684
P5	1.529	S2	1.348
Q1	2.423	S3	2.052
Q2	2.330	S4	2.191
Q3	3.479	S5	1.954
Q4	2.176	S6	1.577
Q5	2.186	S7	1.711
R1	3.153	P1	1.408
R2	6.359	R3	5.436

The Variance Inflation Factor (VIF) values were examined to assess multicollinearity. Most indicators exhibit acceptable VIF values below 5, ensuring that multicollinearity is not a significant issue. However, two indicators, R2 (6.359) and R3 (5.436), exceed the threshold, suggesting potential multicollinearity concerns. These items may require further investigation or modifications to improve the model's stability and predictive accuracy.

Structural Model Assessment

Step 1: Evaluation of Structural Model Results

The structural model was evaluated for multicollinearity using Variance Inflation Factor (VIF) values. A VIF below 3.0 indicates no multicollinearity issues. Most indicators in this study, such as P2 (1.611) and Q1 (2.423), showed acceptable VIF values. However, R2 (6.359) and R3 (5.436) exceeded the threshold of 5, suggesting potential multicollinearity concerns. Overall, multicollinearity is not a significant issue for the majority of the variables, ensuring the reliability of the structural model.

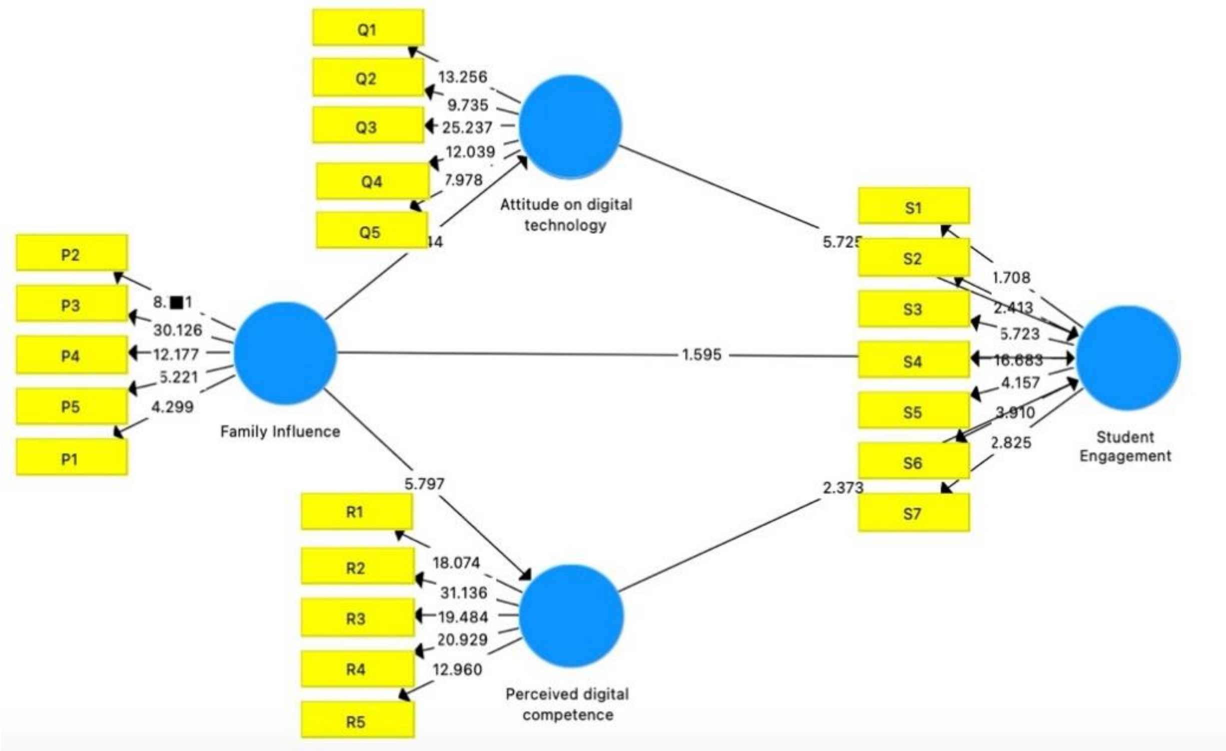

Figure 3. Evaluation of Structure Model

Step 2: Evaluation of Path Coefficients

After confirming that multicollinearity was not an issue, the structural model was examined to identify the strength of the relationships among the constructs. The path coefficients show varying levels of influence, with values closer to ±1 indicating stronger predictive relationships. Among the five tested paths, the relationship between Attitude on Digital Technology and Student Engagement ($\beta = 0.454$, $p < 0.001$) emerged as the strongest. This suggests that students' attitudes play a more direct and substantial role in shaping their engagement compared to the other predictors.

In the context of Sinar Bijaksana Guang Ming School, digital tools are frequently used in daily learning activities, making students' willingness, interest, and openness toward technology particularly influential. When students perceive technology as useful, enjoyable, and supportive of their learning, they are more likely to participate actively and sustain their engagement over time. This explains why the Attitude → Engagement path carries the strongest coefficient in the model. The other significant paths, Family Influence → Attitude, Family Influence → Perceived Competence, and Perceived Competence → Engagement, also contribute to engagement, but their effects are more indirect, making attitude the most immediate driver of engagement in this learning environment.

Table 6. Summary of hypothesis testing result

Hypothesis	Path	Coefficient	T-Statistic	P-Value	Conclusion
H1:	Family Influence → Attitude on Digital Technology	0.339	2.544	0.011	Supported
H2:	Family Influence → Perceived Digital Competence	0.625	5.797	0.0	Supported
H3:	Family Influence → Student Engagement	0.216	1.595	0.111	Not Supported
H4:	Perceived Digital Competence → Student Engagement	0.307	2.373	0.018	Supported
H5:	Attitude on Digital Technology → Student Engagement	0.454	5.725	0.0	Supported

In structural equation modelling, the R^2 value, also known as the coefficient of determination, is a critical metric used to evaluate the predictive ability of the model for endogenous (dependent) constructs. It measures how well the independent variables explain the variance in the dependent variables within the dataset analysed. However, R^2 values only reflect the predictive ability of the data sample used and should not be generalized to the broader population (Rigdon, 2016). The R^2 value ranges from 0 to 1, with higher values indicating greater predictive power. For interpretation, R^2 values of 0.67, 0.33, and 0.19 are typically categorized as strong, medium, and weak levels of predictive strength, respectively (Hair et al., 2014).

In this study, the R^2 values were calculated for the endogenous constructs: Attitude on Digital Technology, Perceived Digital Competence, and Student Engagement. The results show that the R^2 value for Attitude on Digital Technology is 0.115, indicating a weak level of predictive power, with family influence explaining only 11.5% of the variability in attitudes toward digital technology. For Perceived Digital Competence, the R^2 value is 0.391, representing a moderate level of predictive power, meaning family influence explains 39.1% of the variability in perceived digital competence. Finally, Student Engagement has an R^2 value of 0.564, reflecting a moderate to strong predictive power, with family influence, perceived digital competence, and attitudes toward digital technology collectively explaining 56.4% of the variability in student engagement.

The adjusted R^2 values, which account for the sample size and the number of predictor constructs, support these findings and validate the model's predictive power. In conclusion, the results indicate that while Attitude on Digital Technology has a weak predictive relationship, both Perceived Digital Competence and Student Engagement demonstrate moderate to strong levels of predictive strength. These findings highlight the significant role of family influence, digital competence, and attitudes in shaping student engagement within a digital learning environment.

Table 7. Table F square

F^2 Square	Attitude on Digital Technology	Family Influence	Perceived Digital Competence	Student Engagement
Attitude on digital technology				0.417
Family Influence	0.130		0.641	0.061
Perceived digital competence				0.132
Student Engagement				

The relationships between the constructs reveal that Attitude on Digital Technology has the strongest direct influence on Student Engagement with a path coefficient of 0.417, indicating a moderate positive relationship where students with positive attitudes toward digital technology are more likely to engage actively. Family Influence shows a strong positive effect on Perceived Digital Competence (0.641), highlighting the significant role of family in building students' confidence in using digital tools, although its direct effect on Student Engagement is minimal (0.061), suggesting an indirect impact. Additionally, Perceived Digital Competence demonstrates a weak positive relationship with Student Engagement (0.132), indicating that while competence contributes, its role is less direct compared to attitudes. These findings emphasize the importance of fostering positive attitudes toward digital technology and leveraging family support to enhance digital competence, which collectively drive student engagement in digital learning environments.

Discussion

The results of the PLS-SEM analysis showed different levels of significance across the proposed relationships. Family Influence significantly predicted Attitude on Digital Technology and Perceived Digital Competence. Perceived Digital Competence and Attitude on Digital Technology both significantly predicted Student Engagement. However, Family Influence did not have a significant direct effect on Student Engagement ($p = 0.111$). These findings indicate that family support contributes indirectly to engagement through its influence on competence and attitudes, rather than acting as a direct determinant.

Family Influence and Attitude on Digital Technology (H1)

The results show a significant positive relationship between Family Influence and Attitude on Digital Technology ($\beta = 0.339$, $T = 2.544$, $p = 0.011$). This suggests that students who receive greater exposure, encouragement, or guidance from their families in using digital tools tend to develop more positive attitudes toward technology. The direction of this relationship can be seen in Figure 4, which illustrates the path from Family Influence to Attitude on Digital Technology within the structural model.

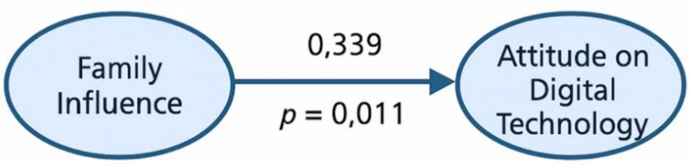

Figure 4. Path Coefficient from Family Influence to Attitude on Digital Technology.

This finding is in line with earlier studies showing that parental involvement, whether through mediation, modelling, or routine digital activities, shapes how students view technology as part of their learning experience (Lin et al., 2023; Yusuf et al., 2011). When technology is naturally embedded in family life, students often feel more familiar and confident when using digital tools in school contexts (Aisyah, 2022; Lee et al., 2023).

The current study also reinforces the role of constructive digital parenting. Practices such as supervising online activities, providing reasonable limits, and offering guidance have been shown to support the development of positive attitudes toward digital technology (Kim et al., 2018; Bong & Chen, 2021). Within the broader framework of this research, such attitudes appear to be an important foundation for sustaining engagement, which becomes more evident in the subsequent hypotheses.

Family Influence and Perceived Digital Competence (H2)

A significant and strong relationship was found between Family Influence and Perceived Digital Competence ($\beta = 0.625$, $T = 5.797$, $p < 0.001$). This aligns with existing literature that highlights family as a primary source of early exposure to digital tools, fostering skills and confidence in navigating digital environments (Razali et al., 2021; Huseinović, 2023; Livingstone et al., 2017; Pons-Salvador et al., 2022). Parents who actively engage with their children's digital activities provide critical opportunities for skill-building and literacy development (Wolf et al., 2022; Widayanto et al., 2023). Moreover, the presence of positive parent-child interactions in digital contexts has been shown to enhance students' resilience and adaptability to educational technology (Nur'Aini, 2022; Rahayu, 2020).

Parents who actively engage with their children's digital activities provide critical opportunities for skill-building and literacy development (Kumpulainen et al., 2020). Studies indicate that parental mediation practices are significantly influenced by parents' own digital literacy levels, which in turn enhance mediation strategies and support children's digital development (Adigwe et al., 2024). Young children have varying degrees of opportunity to engage with and learn from digital technologies in their homes, depending on how parents frame media use and family interactions with and around media (Kumpulainen et al., 2020). Parents should encourage their children to engage in various digital practices, such as coding, multimodal communication, and composing, to prepare them for future formal learning (Soyoof et al., 2023).

Moreover, the presence of positive parent-child interactions in digital contexts has been shown to enhance students' resilience and adaptability to educational technology (Schriever, 2021). Early childhood teachers recognize the importance of working in partnership with parents and articulating the positive role digital technologies play in educational settings, as a positive home-school connection is beneficial to young children (Schriever, 2021). Additionally, family-related aspects, such as parental education level, parental occupation, and family income, significantly impact students' digital competence, with financial factors contributing to observed variations in students' digital competence levels.

Family Influence and Student Engagement (H3)

The path from Family Influence to Student Engagement was positive but not statistically significant ($\beta = 0.216$, $p = 0.111$). This means that, although family support contributes to shaping students' digital experiences, it does not directly translate into sustained engagement. This result is consistent with the abstract and supports the notion that family influence operates mainly through internal variables, such as attitudes and digital competence, rather than having a direct impact. Given that the participants are older adolescents (15–20 years), school experiences, peer interactions, and personal motivation tend to play a more dominant role in influencing engagement than parental involvement. These contextual factors likely explain why the direct effect of family influence was not supported.

Perceived Digital Competence and Student Engagement (H4)

The significant positive relationship between perceived digital competence and student engagement ($\beta = 0.307$, $T = 2.373$, $p = 0.018$) highlights the critical role of digital skills in fostering active participation in learning activities. Students with higher perceived competence are better equipped to leverage digital tools for collaboration, problem-solving, and accessing information, which enhances their engagement (Bong & Chen, 2021; Suadad, 2023). This finding aligns with prior studies that demonstrate a strong link between digital literacy and academic achievement, as well as the importance of integrating technology into curricula to build these competencies (Sarva, 2023; Akram, 2022).

Attitude on Digital Technology and Student Engagement (H5)

The analysis shows that the strongest path in the model is the relationship between Attitude on Digital Technology and Student Engagement ($\beta = 0.454$, $p < 0.001$). This suggests that students' attitudes, such as whether they find technology useful, enjoyable, or supportive of their learning, play a more immediate role in shaping engagement than their perceived level of competence. Even when students possess adequate digital skills, their willingness to remain involved in technology-based learning depends largely on how positively they view the use of digital tools. The pattern of results also indicates that students who feel more capable with digital tools often develop more positive attitudes, and these attitudes can encourage greater engagement. This interpretation aligns with the significant findings in H1 and H4, which show that both family influence and digital competence shape the attitudes that students bring into their learning activities.

The school environment further reinforces this relationship. At Sinar Bijaksana Guang Ming School, digital tools are used frequently across subjects, and teachers integrate technology into daily lessons. This consistent exposure allows students to become comfortable with digital platforms and helps build favourable attitudes toward their use. In such a digital-rich environment, positive attitudes become a key factor that sustains student engagement. Students who view technology as helpful and relevant are more motivated to explore, participate, and persist in their learning. This finding is also consistent with the Technology Acceptance Model, which highlights the role of perceived usefulness and ease of use in shaping attitudes and, ultimately, learning behaviour.

CONCLUSION

This study identifies several key findings regarding the factors that shape students' sustained engagement in digital learning. First, family influence significantly contributes to students' attitudes toward digital technology and their perceived digital competence. However, the structural model shows that Family Influence → Student Engagement is not statistically significant ($p = 0.111$), indicating that family support does not directly predict engagement in this context. Instead, its role appears to be indirect, operating through attitudes and competence rather than influencing engagement on its own.

Second, perceived digital competence demonstrates a meaningful and significant effect on Student Engagement, suggesting that students who feel confident using digital tools are more likely to participate actively in digital learning activities. The most important finding, however, is that attitudes toward digital technology emerge as the strongest predictor of engagement ($\beta = 0.454$). This highlights that students' willingness, interest, and positive perceptions of technology have a more immediate influence on engagement than either competence or family background.

Taken together, the results emphasize that fostering sustained engagement requires more than increasing digital skills; it also involves shaping students' attitudes through supportive learning experiences and consistent exposure to technology within the school environment. Future studies may examine potential mediating pathways and explore additional factors, such as peer influence, classroom practices, and school digital culture, to provide a more comprehensive understanding of what drives student engagement in technology-rich learning settings.

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