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TECHNOLOGY ACCEPTANCE MODEL ON PEDAGOGICAL SKILLS: THE MODERATING ROLE OF ANDROID GAME ADDICTION

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ABSTRACT

This study was to determine the direct effect of the technology acceptance model on the pedagogical skills of prospective teachers and the moderating role of android game addiction on the relationship between technology acceptance model and pedagogical skills in teacher-candidate students. This study used Structural Equation Model (SEM) – by the Partial Least Square (PLS) analysis method, where the analysis is conducted by using the Smart-PLS 3.0. Respondents in this study were teacher-candidate students with the main criteria of having an addiction to playing android-based games. The findings indicate that, first, perceived ease of use of technology in learning can increase students' pedagogical skills, where students can use technology effectively then they can reflect the knowledge to teaching skill of prospective teacher. Second, perceived usefulness does not affect pedagogical skills directly because there is more important role that affect students' pedagogical skills, such as: students' motivation to learn and teach. Third, attitude toward using of technology in learning can increase pedagogical skills. The higher attention in using technology, the more increasing pedagogical skills. Fourth, android game addiction does not have mediating effect between perceived ease of use, perceived usefulness, and attitude toward using and pedagogical skills. This finding also shows that students' level of android games addiction has no significant relationship to academic performance, in the context of pedagogical skills. The findings also highlight the importance of social and emotional support in enhancing pedagogical skills, and suggesting that internal motivation play an important role.

Keywords: *Pedagogical Skills, Technology Acceptance Model (TAM), Android Game Addiction, Teacher Candidate Students*

1. INTRODUCTION

The internet has become one of life's basic necessities today. The rapid acceleration of digitization, which surged during the COVID-19 pandemic, has pushed society to adapt to technology [1]. Now, human needs are increasingly met by technological advancements, creating a profound dependence on them [2]. The education sector has undergone significant changes, with technology and the internet transforming the learning process [3]. Teachers play a critical role as facilitators: they must deliver quality information to students [4], explain the core principles of their subjects, and instill the positive values outlined in learning objectives [5]. To achieve this, teachers need strong pedagogical skills [5]. To achieve this, teachers need strong pedagogical skills [6].

This competency serves as a framework for teachers to create varied learning approaches in the classroom and effectively guide students toward achieving learning objectives. Students pursuing Education as their field of study are training to become future educators. They are expected to act as facilitators, helping learners develop cognitive, affective, and practical skills all of which contribute to national progress [7]. Today's learning systems have evolved, offering diverse models and formats supported by technology [8]. However, students' engagement in classroom learning can be influenced by the convenience of technological tools [9]. The digital interfaces of hardware devices also provide opportunities for students to explore virtual environments [10].

Games are a popular form of entertainment, and mobile-based Android games are designed for easy operation—requiring only a network or Wi-Fi

connection [11]. However, this accessibility often leads to addiction, characterized by compulsive engagement with the same activity [12]. Such behavior can reduce learning effectiveness and hinder optimal knowledge retention during study sessions [13]. Addiction involves repeated, excessive involvement in an activity despite its negative consequences [14]. In the context of Android game addiction, this can impair the development of pedagogical skills a core competency that future teachers must cultivate for effective classroom instruction [15]. While technology integration is crucial for creating innovative learning experiences, research indicates that educators often favor its continued use due to the perceived comfort and convenience it provides [16] [17]. However, this reliance can have detrimental effects when applied to contexts like mobile gaming. Therefore, this study examines the relationship between technology acceptance among Education majors and their pedagogical abilities, with Android game addiction as a moderating factor.

2. METHOD

This study employs a quantitative research design using a Structural Equation Modeling (SEM) approach with Partial Least Squares (PLS) analysis [18]. This method enables researchers to examine relationships between variables in the conceptual model through quantitative data analysis. We utilize the SmartPLS software to validate the proposed relationships between constructs and their explained variance [19]. The study investigates the moderating role of Android game addiction in the relationship between the Technology Acceptance Model and pedagogical skills among Education majors across Indonesian universities, specifically focusing on students with gaming addiction tendencies. The conceptual framework for this study is presented in the following figure.

This study employs a quantitative research methodology using Structural Equation Modeling (SEM) with Partial Least Squares (PLS) analysis. PLS-SEM enables researchers to examine relationships between variables within the conceptual framework using quantitative data. We utilized SmartPLS software to analyze the relationships between constructs and assess their explained variance [13]. The research investigates how Android game addiction moderates the effect of Technology Acceptance Model factors on pedagogical skills among Education majors at Surabaya State University, specifically focusing on students demonstrating game addiction behaviors. The conceptual framework in this study can be seen in the following figure.

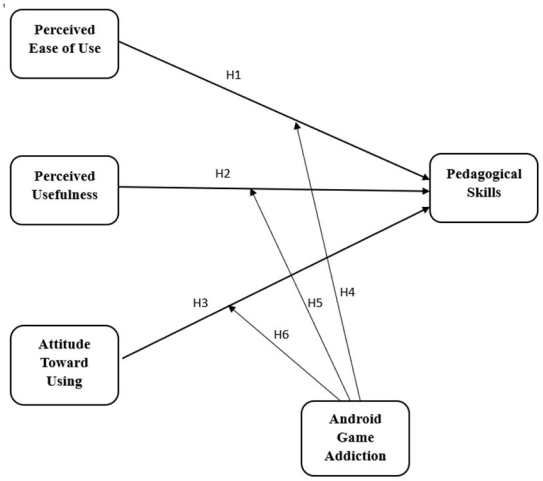

Figure 1. Conceptual Framework

Based on this conceptual framework, the hypotheses proposed in this study are:

H1: Perceived Ease of Use has a positive effect on Pedagogical Skills

H2: Perceived Usefulness has a positive effect on Pedagogical Skills

H3: Attitude Toward Using has a positive effect on Pedagogical Skills

H4: Perceived Ease of Use has a positive and significant effect indirectly reinforced by Android Game Addiction on Pedagogical Skills

H5: Perceived Usefulness has a positive and significant effect indirectly reinforced by Android Game Addiction on Pedagogical Skills

H6: Attitude Toward Using has a positive and significant effect indirectly reinforced by Android Game Addiction on Pedagogical Skills

2.1 Data Collection Methods

Data were collected through survey questionnaires distributed to study participants. The questionnaire comprised carefully designed Likert-scale items for data collection [20]. The answer options in the questionnaire are using a Likert scale with a range of five alternative answers. Each alternative answer has a score or scale value with predetermined criteria as follows.

Table 1. Likert Scale

Criteria	Assessment Score
Strongly Disagree	1
Disagree	2
Moderately Agree	3
Agree	4

Strongly Agree	5

2.2 Data Analysis Technique

This study employs Partial Least Squares (PLS) analysis within a Structural Equation Modeling (SEM) framework. PLS analysis consists of two components: the outer (measurement) model and the inner (structural) model [21,22]. The outer model evaluation focuses on reliability and validity assessments [23]. For validity, we examine the Average Variance Extracted (AVE), where values ≥ 0.5 indicate that a latent variable explains more than half of its indicators' variance. Validity testing determines whether the measurement instrument (in this case, the questionnaire items) accurately measures the intended constructs [24]. Reliability is assessed through Cronbach's Alpha or Composite Reliability (CR), with acceptable thresholds of 0.7 (minimum) and ideal values of 0.8-0.9. Each latent variable should demonstrate absolute correlations > 0.7 with its indicators, ensuring at least 50% variance explanation. Reliability testing evaluates measurement consistency, where a reliable instrument produces stable results across repeated administrations [25]. The complete testing criteria are presented in Table 2.

Table 2. Rule of Thumb Validity Test and Reliability Test

Validity and Reliability	Parameters	Rule of Thumb
Convergent Validity	Loading Factor	>0,70
	AVE	>0,50
	Communality	>0,50
	Cross Loading	>0,70
Discriminant Validity	Root AVE and Correlation between Latent Constructs	Root AVE > latent construct correlation
Reliability	Cronbach's Alpha	>0,70
	Composite Reliability	>0,70

The inner model was evaluated using R-squared (R^2) to assess the explanatory power of exogenous constructs on endogenous constructs. The R^2 values were interpreted as follows: 0.75 indicates strong predictive power, 0.50 indicates moderate predictive power, and 0.25 indicates weak predictive power. Additionally, we examined Q-squared (Q^2) predictive relevance, where values greater than zero ($Q^2 > 0$) indicate the model's ability to predict observed values. Model evaluation included assessing the statistical significance of path coefficients through bootstrapping (two-tailed test). A t-value exceeding 1.96 ($t > 1.96$) was considered statistically significant at the 5% level, which served as the basis for hypothesis testing.

2.3 Subjects, Time and Place of Research

The study population consisted of 310 undergraduate (S1) Education students exhibiting Android gaming addiction. Given this specific focus on prospective teachers with demonstrated gaming addiction, we employed a random sampling technique with the following inclusion criteria: all participants must meet the predefined requirements for Android game addiction.

Table 3. Participants' Characteristics

Characteristics		Participants
Gender	Female	242
	Male	68
Region of University	Surabaya	164
	Malang	30
	Tulungagung	20
	Jakarta	25
	Yogyakarta	20
	Pontianak	2
	Semarang	4
	Jember	4
	Bengkulu	6
	Lampung	5
	Padang	3

	Medan	2
	Pasuruan	25
Bachelor Programs	Accounting Education	26
	Digital Business Education	13
	Drama, Dance and Music Education	5
	Office Administration Education	166
	Indonesian Language and Literature Education	2
	Javanese Language and Literature Education	2
	English Language Education	5
	Japanese Language Education	2
	Economics Education	38
	Early Childhood Education	8
	Elementary School Teacher Education	17
	Social Studies Education	3
	Science Education	8
	Historical Education	2
	Culinary Education	2
	Cosmetology Education	2
	Mechanical Engineering Education	2
	Information Technology Education	7
Academic Standing	1st-year student	22
	2nd-year student	155
	3rd-year student	66
	4th-year student	67

Total Participants (N = 310)

3. RESULTS

The data analysis technique in the study used the SEM (Structural Equation Modeling) method and through the PLS (Partial Least Square) approach. To process data using SmartPLS 3.0 software.

3.1. Evaluation of the Measurement Model (Outer Model)

The Outer Model defines how each indicator relates to its variable.

3.1.1. Convergent Validity

Convergent Validity measuring the validity of statement items from each indicator as a construct measure, can be seen from the outer loading presented in table 4.

Table 4. Loading Factor

Variables	Indicators	Outer Loading	Description
Perceived Ease of Use	X1.1	0.805	Valid
	X1.2	0.722	Valid
	X1.3	0.824	Valid
	X1.4	0.815	Valid
	X1.5	0.780	Valid
	X1.6	0.805	Valid
Perceived Usefulness	X2.1	0.784	Valid
	X2.2	0.729	Valid
	X2.3	0.751	Valid
	X2.4	0.747	Valid
	X2.5	0.832	Valid
	X2.6	0.768	Valid

Attention Toward Using	X3.1	0.826	Valid
	X3.2	0.808	Valid
	X3.3	0.825	Valid
	X3.4	0.776	Valid
Android Game Addiction	Z1.1	0.813	Valid
	Z1.2	0.811	Valid
	Z1.3	0.867	Valid
	Z1.4	0.800	Valid
	Z1.5	0.807	Valid
	Z1.6	0.846	Valid
	Z1.7	0.862	Valid
	Z1.8	0.802	Valid
	Z1.9	0.881	Valid
	Z1.10	0.708	Valid
	Z1.11	0.729	Valid
	Z1.12	0.821	Valid
	Z1.13	0.850	Valid
	Z1.14	0.779	Valid
	Z1.15	0.862	Valid
	Z1.16	0.800	Valid
	Z1.17	0.807	Valid
	Z1.18	0.780	Valid
	Z1.19	0.805	Valid
	Z1.20	0.854	Valid
Pedagogical Skills	Y1.1	0.810	Valid
	Y1.2	0.784	Valid
	Y1.3	0.807	Valid
	Y1.4	0.820	Valid
	Y1.6	0.804	Valid
	Y1.7	0.780	Valid

The outer loading test results in Table 1 show that all indicators for the three independent variables (Perceived Ease of Use, Perceived Usefulness, and Attention Toward Using) exceeded the 0.7 threshold, confirming their validity as measurement instruments. However, two independent variables - Intention to Use and Actual System Usage - contained indicators that failed to meet validity requirements and were consequently excluded from further analysis. For the Android Game Addiction variable, 20 indicators demonstrated valid outer loading values. Invalid indicators from this moderation variable were likewise excluded from subsequent testing. Similarly, among the dependent variable indicators (Pedagogical Skills), six met the validity with scores above 0.7, while one indicator was eliminated for failing to reach this threshold.

3.1.2. Discriminant Validity

Discriminant validity testing in research using cross loading and square root of average (AVE) values which aims to test whether indicators are valid in reflecting latent variables. Discriminant validity uses the square root of average extracted (√AVE). So, the indicator can be said to have good discriminant validity if the AVE root value of each latent variable is greater than the correlation with other variables. The results of this study are presented in table 5.

Table 5. Discriminant Validity

Variables	Average Variance Extracted (AVE)	AGA.Z	ATU.X3	PEOU.X1	PS.Y	PU.X2
AGA (Z)	0.665	0.815				
ATU (X3)	0.654	0.098	0.809			
PEOU (X1)	0.624	0.302	0.565	0.790		
PS (Y)	0.641	0.345	0.479	0.633	0.801	
PU (X2)	0.592	0.075	0.746	0.490	0.376	0.769

For a variable to demonstrate adequate discriminant validity, two conditions must be satisfied: (1) its Average Variance Extracted (AVE) must exceed 0.5, and (2) the square root of its AVE must be greater than its correlation coefficients with other variables. The results presented in the table indicate that all independent, dependent, and moderating variables achieved AVE values between 0.5 and 0.66, thereby meeting the first validity criterion. Furthermore, each variable's AVE square root exceeded its inter-construct correlations, providing additional evidence of robust discriminant validity.

3.1.3. Reliability Test

Reliability testing assesses the precision, consistency, and accuracy of measurement instruments in evaluating constructs [26,27]. We evaluated each construct's reliability using two measures: composite reliability and Cronbach's alpha. Composite reliability examines the internal consistency among indicators within each construct, while Cronbach's alpha provides additional verification of measurement consistency. For both measures, values exceeding 0.70 indicate acceptable reliability, with higher values representing stronger internal consistency.

Table 6. Reliability Test

Variables	Cronbach 's Alpha	Composite Reliability	Description
PEOU (X1)	0.849	0.892	Reliable
PU (X2)	0.862	0.897	Reliable
ATU (X3)	0.824	0.883	Reliable
AGA (Z)	0.973	0.975	Reliable
PS (Y)	0.888	0.915	Reliable

Table 6 displays the results of testing composite reliability and Cronbach's alpha. Based on the reliability test above, it shows that the Cronbach Alpha and Composite Reliability values for each variable have reliable values. This can be seen through the reliability test results that have met the requirements, which are above 0.7.

3.1.4. Structural Model Evaluation (Inner Model)

The Inner Model aims to define how the relationship between one construct and another construct [28,29]. This test is used to review the relationship between constructs that have been hypothesized in the study. Inner model testing is also seen through the R-Square value. The R-Square test is used to measure how much the composition of the dependent variable value can be explained by the independent variable. A value of 0.75 in the R-Square test indicates a substantial (strong) category, a value of 0.50 is interpreted into the moderate category, and a value of 0.25 is included in the small category.

Tabel 7. R-Square

	R Square	R Square Adjusted
PS (Y)	0.455	0.442

The R^2 value of 0.455 indicates that the combined explanatory power of Perceived Ease of Use, Perceived Usefulness, and Attention Toward Using accounts for 45.5% of the variance in Pedagogical Skills, falling within the moderate effect size range. The remaining 54.5% of the variance is attributed to unmeasured variables outside this study's scope.

3.2. Hypothesis Test

The research hypothesis can be answered through the results of the t-statistic or p value of the Measurement Bootstrapping test model used to see the relationship between constructs and the significance value in the path coefficients table. The test results are presented in table 8.

Table 8. Path Coefficient

Variables	Coefficient	T Statistics	P Values
Direct Effect			
PEOU (X1) → PS (Y)	0.473	7.134	0.000
PU (X2) → PS (Y)	-0.024	0.337	0.736
ATU (X3) → PS (Y)	0.213	3.115	0.002
Indirect Effect			
PEOU (X1) * AGA (Z) → PS (Y)	0.028	0.339	0.735
PU (X2) * AGA (Z) → PS (Y)	0.042	0.433	0.665
ATU (X3) * AGA (Z) → PS (Y)	-0.034	0.390	0.697

Statistical significance is established when *p*-values are < 0.05, while results with *p*-values > 0.05 are considered non-significant. Based on Table 5, the results of hypothesis testing are in the form of coefficient values, t-statistics on each direct and indirect coefficient path, along with P-values.

Perceived Ease of Use has an influence with a significance value of 0.000 which is greater than 0.05. Then it has a positive coefficient value with a value of 0.473 and a t-count of 7.134> (1.96). The positive coefficient value states that if the Perceived Ease of Use variable increases, then Pedagogical Skills will also increase. Therefore, it can be concluded that H1 is accepted.

Perceived Usefulness showed no statistically significant direct effect on Pedagogical Skills (p = 0.736 > 0.05). The analysis yielded a coefficient of -0.024 with a t-statistic of 0.337 (below the critical value of 1.96), indicating a negative but non-significant relationship with Pedagogical Skills improvement. Consequently, hypothesis H2 is rejected.

Attention Toward Using demonstrates a statistically significant positive effect on Pedagogical Skills (p = 0.002 < 0.05). The analysis reveals a substantial positive relationship, evidenced by a coefficient of 0.213 and a t-statistic of 3.115 (exceeding the critical value of 1.96). These results support the acceptance of hypothesis H3.

The effect of Perceived Ease of Use moderated by Android Game Addiction on Pedagogical Skills has no significant effect on the indirect path. In table 4, the P-values are 0.735 (>0.05), the coefficient value is 0.028 and the t-count is 0.339> (1.96). Thus hypothesis 5 states that Perceived Ease of Use has a positive and significant indirect effect reinforced by Android Game Addiction on Pedagogical Skills, or H5 is rejected.

The indirect effect of Perceived Usefulness on Pedagogical Skills was found to be non-significant (*p* = 0.665 > 0.05), leading to the rejection of this hypothesis. Although the analysis yielded a positive coefficient (0.042) and a t-statistic of 0.433 (below the critical value of 1.96), these results indicate that Android Game Addiction does not significantly moderate the relationship between Perceived Usefulness and Pedagogical Skills. Thus, hypothesis H6 is rejected.

The moderating role of Android Game Addiction between the relationship of Attitude Toward Using and Pedagogical Skills with P-values of 0.697 (>0.05), a coefficient value of -0.034, and a t-count value of 0.390 > (1.96). This states that Android Game Addiction does not moderate the relationship between Attitude Toward Using and Pedagogical Skills positively and significantly indirectly, so H7 is rejected.

4. DISCUSSION

The results indicate that Perceived Ease of Use (PEOU) has a statistically significant positive effect on pedagogical skills. Specifically, improvements in PEOU correlate with enhanced teaching abilities, suggesting that when educators find a technology or system more intuitive and user-friendly, they become better at integrating it into their teaching practices [30]. This finding aligns with [31] which identifies PEOU as a key factor in technology acceptance. In an educational context, if educators perceive teaching tools or methods as easy to use [32], they are more likely to adopt and implement them effectively, thereby improving their pedagogical skills. A higher PEOU encourages educators to explore and integrate diverse technological tools into their teaching strategies. This not only boosts their confidence in using these tools but also promotes a proactive approach to instruction, allowing them to adapt their methods to better engage students. As a result, adopting user-friendly technologies fosters continuous professional development. Educators refine their pedagogical skills through hands-on application and collaboration with peers, ultimately enhancing teaching effectiveness and student learning outcomes. These findings underscore the importance of institutions prioritizing usability in educational technologies [33].

Second, Perceived Usefulness does not significantly influence Pedagogical Skills. The data indicates that students' perception of technology's benefits has little measurable impact on their teaching abilities [34]**.** Although students may feel the technology has benefits, it does not automatically contribute to the development of pedagogical skills. This suggests that there is other factors, such as [35] students' motivation to learn and teach also plays an important role in the development of pedagogical skills. This study shows that students who are highly motivated to develop their teaching skills tend to be more successful in applying effective pedagogical techniques. In addition, there are supporting findings from teachers' perspectives from the research [36] which reveals a similar disconnect. Although educators widely acknowledge technology's potential to improve learning outcomes, this belief rarely translates into improved teaching practices. For instance, many teachers report strong digital literacy and a positive attitude toward technology, yet they frequently fail to integrate it effectively due to inadequate training and institutional support.

These results underscore a critical gap between recognized benefits and actual pedagogical application. The research suggests that external factors including insufficient training, lack of institutional support, and gaps in pedagogical knowledge play a more decisive role in technology integration than mere perceptions of usefulness.

Third, the study reveals that Attitude Toward Using (ATU) technology positively and significantly influences Pedagogical Skills (PS). This indicates that when student teachers demonstrate greater engagement and focus in utilizing educational technology, their teaching abilities show measurable improvement [37]. These findings align with research by [38], which established that user attention to educational technology significantly impacts learning outcomes. Enhanced focus on technological tools leads to better educational results, including the development of critical pedagogical competencies. Moreover, the results [39] demonstrate a direct correlation: as student teachers increase their active engagement with technology (ATU), their pedagogical skills (PS) improve proportionally. This relationship highlights the value of creating supportive technological environments where frequent use not only builds comfort with digital tools but also encourages innovative teaching approaches. The findings suggest that when educators prioritize the integration of technology in their teaching, they not only enrich their instructional strategies but also cultivate a deeper understanding of pedagogical principles, thereby enhancing overall teaching effectiveness.

Fourth, the study finds that Android Game Addiction does not mediate the relationships between Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Attitude Toward Using (ATU), and Pedagogical Skills (PS). This indicates that students' level of mobile game addiction does not influence how technology acceptance factors (PEOU, PU, ATU) affect their teaching abilities. These results align with [40], which found no significant relationship between mobile game addiction and either academic performance or pedagogical skills. However, contrasting research [41] suggests that digital media addiction can negatively impact certain skill development areas, including academic and pedagogical growth [42]. The present study's findings may be explained by students' internal motivation, which appears to significantly enhance pedagogical skills regardless of game addiction levels. From a theoretical perspective, constructivist learning theory (Piaget & Vygotsky) supports these results. The theory emphasizes that meaningful learning occurs through active environmental interaction. Since game addiction typically represents passive engagement rather than constructive learning activity, it logically would not mediate the relationship between technology acceptance factors and pedagogical skill development.

5. CONCLUSION

This study demonstrates that the perceived ease of using educational technology enhances pedagogical skills among preservice teachers. This improvement occurs as students who effectively utilize technological tools are able to translate their technical competence into teaching proficiency. When preservice teachers become comfortable with educational technology, they naturally incorporate these tools to support and enhance their instructional practices.

Then, a positive attitude toward using educational technology enhances pedagogical skills. The study reveals a direct correlation: the more focused users are when utilizing technology, the greater their improvement in teaching competencies. This indicates that attentive engagement with educational tools significantly impacts learning outcomes, particularly in developing pedagogical abilities. As users devote more concentrated effort to technology integration, they demonstrate measurable progress in cultivating effective teaching skills.

On the other hand, perceived usefulness does not directly impact pedagogical skills because other factors such as students' motivation to learn and teach play a more critical role. This study demonstrates that students who are highly motivated to improve their teaching skills are more successful at applying effective pedagogical techniques than those who focus primarily on the perceived usefulness of technology. Additionally, Android game addiction does not mediate the relationship between perceived ease of use, perceived usefulness, attitudes toward technology, and pedagogical skills. The findings also indicate that the level of Android game addiction has no significant effect on academic performance, particularly in terms of pedagogical skills. Finally, the study highlights the importance of social and emotional support in developing pedagogical skills, suggesting that internal motivation is a key factor.

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