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ORIGINAL ARTICLE

Investigating the Role of Academic Engagement: A Mediation Model of Technology Attitudes and Academic Performance Among Pharmacy Students

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ABSTRACT
In the context of increasing technology integration in higher education, understanding how students' attitudes toward technology relate to learning outcomes has become an essential line of inquiry. This cross-sectional study tests a structural mediation model (H1-H5) examining how four technology attitudes - Positive Attitude, Anxiety, Negative Attitude, and Task Switching - affect Academic Performance through Academic Engagement. Data were collected from 679 pharmacy students in Vietnam using a validated self-report questionnaire. Measurement models were examined through Exploratory and Confirmatory Factor Analyses (EFA/CFA), and hypotheses were tested using Structural Equation Modeling (SEM). The Confirmatory Factor Analysis confirmed the 15-item Media and Technology Usage and Attitude Scale (MTUAS) (RMSEA = 0.067) but indicated poor fit for the 3-factor Utrecht Work Engagement Scale for Students (UWES-9S) (RMSEA = 0.110), justifying the use of a composite engagement score. Structural model results suggested that the path from Academic Engagement to Academic Performance (H5) was not statistically significant (p = 0.073), leading to the rejection of all four indirect-mediation hypotheses (H1-H4). These findings do not support the proposed mediation framework and provide empirical evidence for the "engagement-achievement paradox," suggesting that, in this Vietnamese pharmacy cohort, technology attitudes and self-reported engagement may not directly translate into measurable academic performance outcomes.

1. INTRODUCTION

The integration of digital technology into higher education has become both pervasive and transformative, particularly in specialized, resource-intensive disciplines such as pharmacy education. Learning Management Systems (LMS), virtual simulations, and discipline-specific mobile applications are now indispensable components of the contemporary learning environment. However, the effectiveness of these technological innovations is not inherently assured; rather, it largely depends on students' psychological dispositions and how they engage with digital tools throughout their learning. Understanding the psychological mechanisms underlying this interaction - and how they influence academic outcomes - has therefore emerged as a critical focus of educational research.

Previous studies on technology use in education have primarily adopted a descriptive approach, frequently employing linear regression analyses to identify predictors of students' Academic Performance, operationalized as Grade Point Average (GPA). While these studies offer valuable insights, they often neglect the deeper psychological and motivational mechanisms that explain why and how technology-related attitudes shape learning outcomes. To address this theoretical gap, the present study applies an integrated conceptual framework that extends the

foundational Technology Acceptance Model (TAM) proposed by Davis (1989) by incorporating contemporary adaptations specifically contextualized for educational settings (Hidayat, 2024).

Within this framework, students' technology-related attitudes are not assumed to influence GPA directly. Instead, these attitudes are hypothesized to affect a mediating construct - Academic Engagement - defined as a positive and fulfilling psychological state characterized by Vigor, Dedication, and Absorption (Schaufeli et al., 2002). Empirical evidence supports this perspective, showing that factors such as technology acceptance, digital self-efficacy, and adaptability significantly predict students' engagement in academic contexts (Agnestiara et al., 2025; An et al., 2022; Zhao et al., 2022).

Nevertheless, most prior research has examined these constructs in isolation, leaving a conceptual gap in understanding how both positive (e.g., enthusiasm, perceived usefulness) and negative (e.g., anxiety, task switching) technology attitudes operate together within a unified structural model. This issue is particularly relevant in Vietnam's rapidly digitalizing higher education landscape, where pharmacy programs face unique challenges in integrating complex virtual laboratories, scientific software, and digital learning systems into curricula.

Against this backdrop, the present study seeks to clarify the psychological pathways through which students' technology attitudes influence learning outcomes. Specifically, it aims to develop and empirically test a mediation model examining how four dimensions of technology attitudes - Positive Attitude, Anxiety, Negative Attitude, and Task Switching - affect Academic Performance (GPA) through Academic Engagement.

2. LITERATURE REVIEW

2.1. Historical Trajectory of Educational Technology Research: From Adoption to Psychological Engagement

Over the past three decades, academic literature regarding technology in higher education has witnessed a significant conceptual evolution, moving from a purely functionalist view toward a psychological perspective. Early investigations during the 1970s and 1980s were predominantly centered on Computer-Aided Instruction (CAI), prioritizing hardware capabilities and the logistical efficiency of delivering educational content (Suppes, 1966; Kulik et al., 1980). In this initial phase, the research approach was largely "technocentric", often positioning students as passive receivers of digital information rather than active participants in the learning journey.

A pivotal shift occurred with the advent of the Technology Acceptance Model (TAM) by Davis (1989), which redirected scholarly attention from technical utility to user perception. For more than twenty years, TAM and its subsequent iterations have been the dominant frameworks, identifying Perceived Usefulness and Perceived Ease of Use as the core drivers of technology adoption. However, while TAM effectively forecasts whether a student will utilize a system, it creates a blind spot regarding the quality of that interaction or the learner's psychological condition during usage (Hidayat, 2024).

More recently, particularly in the post-2010 landscape, the scope of inquiry has broadened beyond mere adoption to encompass Digital Well-being and Academic Engagement. As digital tools have become omnipresent, scholars now acknowledge the dichotomous nature of technology (Monge Roffarello & De Russis, 2019). While positive attitudes toward technology can foster deep learning, continuous connectivity simultaneously introduces specific stressors. These include technostress, anxiety, and cognitive fragmentation resulting from frequent task switching (Barton et al., 2021; Vallone et al., 2023).

Accordingly, the current study endeavors to synthesize these historical perspectives. By merging the foundational principles of TAM with the psychological framework of Academic Engagement (Schaufeli et al., 2002), this research addresses a critical gap. It aims to elucidate how students' multidimensional technology attitudes—spanning from enthusiasm to anxiety—collectively influence academic performance within the demanding context of pharmacy education.

2.2. The Pathway from Technology Attitudes to Academic Engagement (H1-H4)

TAM posits that individuals' positive perceptions of technology - such as perceived usefulness and perceived ease of use - enhance their willingness to engage in related behaviors (Davis, 1989; Hidayat, 2024). Extending this framework, the present study conceptualizes students' attitudes toward technology as direct antecedents of Academic Engagement, defined through the dimensions of Vigor, Dedication, and Absorption (Schaufeli et al., 2002).

Empirical evidence reinforces this theoretical linkage. The constructs that align with positive technology attitudes - such as Technological Self-Efficacy (Agnestiara et al., 2025), Technology Adaptation (Zhao et al., 2022), and Technology Acceptance (An et al., 2022) - have been consistently reported as significant positive predictors of student engagement. These findings suggest that favorable perceptions of technology can enhance students' motivation and emotional investment in learning activities.

H1: Positive Attitude is positively associated with Academic Engagement.

In contrast, negative technology attitudes and anxiety function as psychological inhibitors of engagement. Studies on technostress have demonstrated that heightened anxiety in digital learning environments can undermine motivation and focus, thereby reducing engagement levels. For example, a large-scale SEM study by Arbulú Pérez Vargas et al. (2024) involving 1,468 university students revealed that technology-related stress negatively predicted academic engagement ($\beta = -0.107$), a result corroborated by subsequent research across educational contexts.

H2: Technology-related Anxiety is negatively associated with Academic Engagement.

H3: Negative Attitude is negatively associated with Academic Engagement.

Additionally, the Preference for Multitasking represents a cognitive inclination toward divided attention, which is inherently detrimental to the sustained concentration required for deep learning. Barton et al. (2021) argue that multitasking disrupts working memory and diminishes cognitive absorption, directly opposing the psychological immersion that defines academic engagement.

H4: Multitasking Preference is negatively associated with Academic Engagement.

2.3. The Impact of Academic Engagement on Academic Performance (H5)

Academic engagement refers to the activities students participate in and the associated positive psychological state marked by vigor, dedication, and absorption (Schaufeli et al., 2002). This engagement is robustly established as a direct, proximate antecedent to achievement because it represents the active manifestation of successful Self-Regulated Learning. Students exhibiting high Vigor, Dedication, and Absorption are more likely to utilize deep learning strategies and persevere through academic challenges (Schaufeli et al., 2006; Schaufeli et al., 2002; Tomas & Poroto, 2023a).

H5: Academic engagement is positively associated with Academic performance (Grade Point Average - GPA).

Table 1. Summary of Recent Key Studies on Technology, Engagement, and Performance

Author(s) & Year	Context / Country	Methodology	Key Variables	Key Findings (Relevant to our model)
Hidayat et al. (2024)	165 Indonesian University Students	PLS-SEM	TAM, Student Performance (GPA)	Perceived Usefulness and Perceived Ease of Use (TAM variables) directly predicted Student Performance (GPA). (Supports H1 logic)
An et al. (2022)	1,023 Chinese Adolescents	SEM	Technology Acceptance, Learning Engagement	Technology Acceptance had a significant positive and direct effect on Learning Engagement. (Supports H1)
Zhao et al. (2022)	480 Chinese University Students	SEM	Technology Adaptation, Academic Engagement	Technology Adaptation (a concept related to positive attitude) was a significant positive predictor of Academic Engagement. (Supports H1)
Agnestiara et al. (2025) (Agnestiara et	100 Indonesian Vocational Students	SEM	Technological Self-Efficacy, Academic Engagement	Technological Self-Efficacy (a key component of positive attitude) had a significant

				positive effect on Academic Engagement. (Supports H1)
Vallone et al. (2023)	2,746 Italian University Students	SEM	Technostress, Academic Motivation, Psychological Health	Technostress had a significant negative impact on academic motivation factors, which are closely related to engagement. (Supports H2/H3)
Terry et al. (2016)	129 University Students	Experimental Design	Preference for Multitasking, Metacognition, Quiz Scores	Preference for Multitasking (our Task Switching variable) was negatively correlated with quiz scores (performance). (Supports H4)
Tomas & Poroto (2023b)	569 Filipino University Students	SEM	Self-Regulation, Learning Engagement (UWES), GPA	Learning Engagement (measured with UWES, our scale) was a significant direct predictor of GPA. (Supports H5)

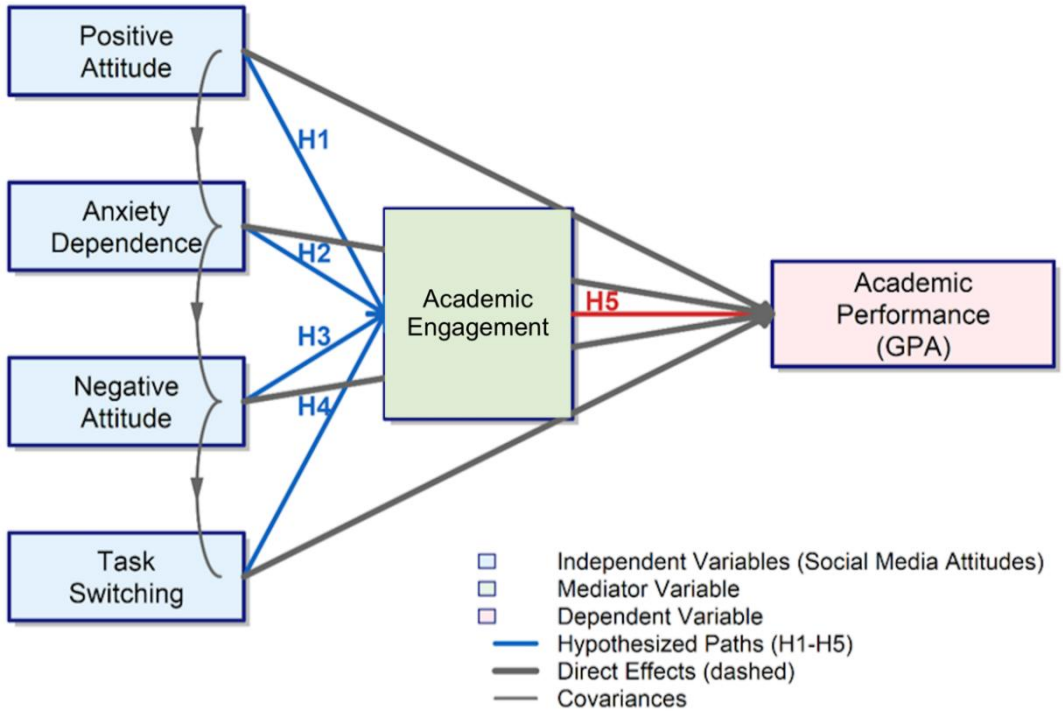

Figure 1. The Proposed Conceptual Model

3. MATERIALS AND METHODS

3.1. Study design and data collection

This study employs a cross-sectional quantitative design to explore the relationships among students' technology attitudes, academic engagement, and GPA. The research was conducted at Nguyen Tat Thanh University, a multidisciplinary applied institution in Ho Chi Minh City, Vietnam, which provides a representative context of higher education modernization in Southeast Asia. Data were collected over seven weeks, from July 1 to August 19, 2022,

targeting pharmacy undergraduates enrolled in a five-year bachelor's program. The sampling frame included students from the second, third, and fourth years, ensuring adequate representation across academic progression stages.

All participation was voluntary and anonymous. Before completing the survey, the students were informed of the research objectives, confidentiality assurances, and the voluntary nature of their involvement. Only students who provided informed consent were included in the study. To maintain data integrity, responses with incomplete sections or repetitive answer patterns were excluded through a preliminary quality check. Ethical approval for the study was obtained from the Scientific Committee of Nguyen Tat Thanh University, which confirmed that the research met the criteria for minimal-risk educational and behavioral research.

3.2. Measures

The research instrument was a 32-item self-report questionnaire developed in Vietnamese, comprising three major sections: (1) demographic background, (2) attitudes toward technology, and (3) academic engagement.

The first section contained seven items collecting information on gender, academic year, GPA, co-residence with parents, employment status (having a part-time job or not), engagement in physical activity, and current residence (urban, suburban, or rural). These variables were included to account for socio-demographic diversity and potential covariates in the structural analysis.

The second section adopted the Attitude component of the Media and Technology Usage and Attitude Scale (MTUAS) (Rosen et al., 2013), which has been widely applied in cross-cultural studies (Costa et al., 2016; Sabbah, 2019). The MTUAS evaluates four psychological dimensions of technology attitudes: Positive Attitude, Anxiety/Dependence, Negative Attitude, and Task Switching. Each item was rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree), allowing computation of mean scores for each subscale ranging from 1 to 5. A higher score represented a stronger endorsement of the respective dimension.

To verify construct validity, a Confirmatory Factor Analysis (CFA) was conducted using the original 16-item structure. One item (Item 15) demonstrated a low factor loading (< 0.40) and was removed from subsequent analyses. The resulting 15-item, with a four-factor solution (6-3-3-3), demonstrated acceptable model fit (Comparative Fit Index [CFI] = 0.889, Tucker–Lewis Index [TLI] = 0.862, Root Mean Square Error of Approximation [RMSEA] = 0.067, Standardized Root Mean Square Residual [SRMR] = 0.051). Internal reliability coefficients indicated satisfactory internal consistency: Positive Attitude ($\alpha = 0.794$), Anxiety/Dependence ($\alpha = 0.819$), Negative Attitude ($\alpha = 0.796$), and Task Switching ($\alpha = 0.649$). These indices collectively affirmed the psychometric adequacy of the Vietnamese version of the MTUAS for the present context.

The third section measured Academic Engagement using the Utrecht Work Engagement Scale for Students (UWES-9S) (Schaufeli et al., 2006), a globally validated tool employed in diverse higher education settings (Carmona-Halty et al., 2019; Loscalzo & Giannini, 2019; Meng & Jin, 2017; Tayama et al., 2019). The scale comprises three subdimensions - Vigor, Dedication, and Absorption - assessed through nine items on a 7-point Likert scale (0 = never to 6 = always). Higher mean scores indicate higher engagement levels.

A CFA was performed to validate the theoretical three-factor model of UWES-9S. Although the fit indices - CFI (0.951), TLI (0.917), and SRMR (0.048) - were acceptable, the RMSEA (0.110) exceeded the conventional threshold, indicating suboptimal model fit. However, the scale demonstrated excellent overall reliability ($\alpha = 0.930$). Based on both statistical evidence and recent methodological consensus treating engagement as a unified psychological construct, a composite mean score was computed to represent Academic Engagement as the mediator variable in the structural model.

3.3. Ethical Considerations

All study procedures adhered to the ethical standards of the Declaration of Helsinki and the national guidelines for educational research ethics. The Scientific Council of Nguyen Tat Thanh University reviewed the study protocol. It confirmed that it met the exemption criteria for institutional review due to its non-invasive, minimal-risk nature. Participants were fully informed about the objectives, procedures, potential benefits, and confidentiality measures before data collection. Written informed consent was obtained electronically before accessing the online survey. Data were stored on secure servers and analyzed in aggregate form to protect participant identity and privacy.

3.4. Data analysis

Data analysis was performed using R (version 4.3.1) within a multi-step analytical framework to ensure methodological rigor and replicability. Statistical significance was determined at $p \leq 0.05$.

In the first phase, the measurement models for the MTUAS and the UWES-9S were validated. This validation process began with an Exploratory Factor Analysis (EFA) and was followed by a Confirmatory CFA using the lavaan package. Before conducting these analyses, multivariate outliers were identified and removed based on Mahalanobis distance. Construct validity was assessed using fit indices, including Chi-square (χ^2/df), CFI, TLI, RMSEA, and SRMR. Internal reliability was confirmed through Cronbach's alpha and composite reliability coefficients.

In the second phase, a structural mediation model was defined and tested to investigate the hypothesized pathways (H1-H5) - composite mean scores derived from the validated factors served as manifest variables. A path analysis was conducted using the Maximum Likelihood Robust estimator to account for potential non-normality in the data. To ensure stable parameter estimates, 1,000 bootstrap resamples were generated, providing 95% confidence intervals and p-values for both direct and indirect effects. Model visualization and standardized coefficients were created to facilitate the interpretation of the mediation relationships among technology attitudes, academic engagement, and GPA.

4. RESULTS AND DISCUSSION

4.1. Sociodemographic Characteristics of Participants and Measurement Model Validation

After removing 71 multivariate outliers identified through Mahalanobis distance, the final analytical sample comprised 679 pharmacy students. Descriptive statistics for the sample are summarized in Table 2. The majority of respondents were female (80.9%), reflecting the typical gender distribution in pharmacy education programs. The participants were evenly represented across the three academic cohorts: Year 2 (31.7%), Year 3 (34.6%), and Year 4 (33.7%). The average self-reported GPA was 2.90 (SD = 0.39), indicating an overall satisfactory level of GPA.

Regarding living arrangements, 56.7% of the students lived with their parents, while 56.4% reported residing in rented accommodation during their studies. Approximately 38% of the respondents reported holding a part-time job, and only 20.5% met the recommended threshold of ≥150 minutes of physical activity per week. These background variables collectively provide a broad socio-academic profile of the pharmacy cohort under study, serving as contextual parameters for interpreting the structural model.

Table 2. Characteristics of participants

Participants' characteristics		**Overall(N=679)**	
		n	**%**
Gender	Female	549	80.9
	Male	119	17.5
	Other	11	1.6
Year of study	Year 2	215	31.7
	Year 3	235	34.6
	Year 4	229	33.7
Living with parents	Yes	385	56.7
Having a part-time job	Yes	258	38.0
Physical activity (≥150 min/week)	Yes	127	20.5
Residence during education	Home	261	38.4
	Rented accommodation	383	56.4
	Other	35	5.2
GPA	Mean (SD)	2.90 (0.39)	

The measurement model validation followed the analytical procedures described in Section 3.2. For the Media and MTUAS, the final 15-item, four-factor structure (6-3-3-3) achieved an acceptable fit with the data (CFI = 0.889, TLI = 0.862, RMSEA = 0.067, SRMR = 0.051). These fit indices confirm that the adapted MTUAS maintained robust factorial validity and internal consistency, supporting its suitability for assessing technology attitudes within the Vietnamese higher education context.

In contrast, the UWES-9S demonstrated mixed model fit. While the CFI (0.951), TLI (0.917), and SRMR (0.048) indicated adequate fit, the RMSEA value (0.110) exceeded the recommended threshold (< 0.08), signifying insufficient structural stability for the original three-factor configuration (Vigor, Dedication, and Absorption). This inconsistency suggests that the tripartite engagement model may not fully capture the engagement construct among Vietnamese pharmacy students, who experience a highly structured and content-intensive learning environment.

Based on this evidence, the analysis proceeded with a composite single-factor solution for Academic Engagement, supported by excellent reliability ($\alpha = 0.930$). This decision ensured both statistical validity and conceptual coherence, allowing the construct to serve as a unified mediating variable in subsequent structural modeling.

4.2. Correlation and Structural Model Analysis

Table 3. Descriptive Statistics and Pearson Correlations (N = 679)

Variable	M	SD	1	2	3	4	5	6
1. Positive Attitude	3.71	0.482	-					
2. Anxiety Dependence	3.50	0.734	0.418***	-				
3. Negative Attitude	3.44	0.700	0.150***	0.202***	-			
4. Task Switching	3.28	0.674	0.231***	0.208***	0.254***	-		
5. Academic Engagement	3.14	0.772	0.221***	**-0.008**	0.094*	0.141***	-	
6. GPA	2.90	0.390	0.026	0.058	0.055	0.007	**0.065**	-

Note. N = 679. M = Mean; SD = Standard Deviation. *p < 0.05, ***p < 0.001

Descriptive statistics and bivariate correlations among the six principal study variables are presented in Table 3. The mean scores indicate generally positive perceptions toward technology among participants (M_Positive Attitude = 3.71, SD = 0.48; M_Anxiety Dependence = 3.50, SD = 0.73; M_Negative Attitude = 3.44, SD = 0.70; M_Task Switching = 3.28, SD = 0.67). Academic Engagement recorded a moderate average level (M = 3.14, SD = 0.77), while the mean self-reported GPA remained consistent with institutional benchmarks (M = 2.90, SD = 0.39).

The correlation matrix reveals several noteworthy associations. A positive attitude toward technology demonstrated a small-to-moderate positive correlation with Academic Engagement ($r = 0.221$, $p < 0.001$), suggesting that favorable affective orientations toward technology may be accompanied by greater involvement and enthusiasm in academic tasks. Similarly, Task Switching (as a proxy for multitasking preference) exhibited a weak yet statistically significant positive correlation with engagement ($r = 0.141$, $p < 0.001$). In contrast, Anxiety Dependence showed no significant association with engagement ($r = -0.008$, $p > 0.05$), while Negative Attitude displayed only a minimal positive correlation ($r = 0.094$, $p < 0.05$). These mixed correlation patterns indicate that while certain attitudinal factors correspond with engagement, their magnitudes remain modest, underscoring the multidimensional nature of technology-learning relationships.

A central empirical observation concerns the relationship between Academic Engagement (Variable 5) and GPA (Variable 6). The correlation between these two constructs was non-significant ($r = 0.065$, $p = 0.092$). Although small and statistically inconclusive, this finding holds conceptual importance as it aligns with a long-standing and contested body of literature regarding the so-called "engagement-achievement paradox." Earlier foundational studies (Carini et al., 2006; Appleton et al., 2008) observed that, while engagement strongly predicts psychosocial and motivational outcomes, its association with GPA tends to be weak or inconsistent, often accounting for only limited variance in objective academic outcomes.

Recent research continues to substantiate this inconsistency. A systematic review by Amez and Baert (2020) characterized the association between student-level engagement and GPA as "heterogeneous," emphasizing its sensitivity to disciplinary and contextual factors. Likewise, Çali et al. (2024) reported that while behavioral engagement predicted performance outcomes, cognitive and emotional engagement - dimensions central to the UWES-9S - were not statistically significant predictors of GPA. Within the health sciences domain, similar complexities have been noted (Casuso-Holgado et al., 2013), where rigorous curricular structures and high-stakes assessments often dilute the predictive strength of psychological constructs such as engagement.

In light of these findings, the non-significant correlation observed in this study ($p = 0.092$) is not anomalous but rather contributes empirically to this ongoing debate. It reinforces the notion that while students' attitudinal and engagement factors are integral to their learning experiences, their measurable impact on Academic performance - as operationalized by GPA - remains limited, context-dependent, and influenced by unobserved mediating or moderating variables.

4.3. Hypothesis Testing (Structural Model)

Table 4. Results of Causal Mediation Analyses (N = 679)

Path	Hypothesis	Predictor (X) → Outcome (Y)	Estimate (β)	95% CI [Lower, Upper]	p-value	Result
Mediation Path (M → Y)	H5	Academic Engagement → GPA	0.034	[-0.004, 0.071]	0.073	Not Supported
Indirect Paths (X → M → Y)	H1	Pos. Attitude → Engagement → GPA	0.014	[-0.001, 0.032]	0.091	Not Supported
	H2	Anxiety → Engagement → GPA	-0.005	[-0.014, 0.001]	0.129	Not Supported
	H3	Neg. Attitude → Engagement → GPA	0.002	[-0.000, 0.009]	0.279	Not Supported
	H4	Task Switching → Engagement → GPA	0.004	[0.000, 0.012]	0.179	Not Supported
Direct Effects (X → Y)	(ADE)	Pos. Attitude → GPA	-0.013	[-0.079, 0.060]	0.724	Not Supported
	(ADE)	Anxiety → GPA	0.032	[-0.013, 0.076]	0.160	Not Supported
	(ADE)	Neg. Attitude → GPA	0.025	[-0.020, 0.073]	0.292	Not Supported
	(ADE)	Task Switching → GPA	-0.013	[-0.060, 0.031]	0.566	Not Supported

Note. N = 679; ADE = Average Direct Effect. Analyses conducted via lavaan package in R using 5,000 bias-corrected bootstrap samples. All coefficients are unstandardized estimates.

The hypothesized structural mediation model was examined using Structural Equation Modeling (SEM) to test all five proposed pathways simultaneously. The results are summarized in Table 4.

Consistent with the correlation findings reported in Section 4.2, the key direct path from the mediator, Academic Engagement, to the outcome variable, GPA, was not statistically significant (H5: $\beta = 0.034$, 95% CI [−0.004, 0.071], $p = 0.073$). Given this result, the essential condition for mediation - the presence of a significant relationship between the mediator and the dependent variable - was not satisfied. Consequently, none of the four indirect mediation hypotheses (H1-H4) received empirical support.

As shown in Table 4, the indirect effects of the four technology attitude dimensions - Positive Attitude, Anxiety, Negative Attitude, and Task Switching - on GPA through Academic Engagement were non-significant, with *p*-values ranging from 0.091 to 0.279. Similarly, the corresponding Average Direct Effects (ADE) between each predictor and GPA were statistically insignificant ($p > 0.10$ in all cases). Collectively, these results indicate that neither direct nor indirect effects were observed within the proposed mediation framework.

This non-significant outcome constitutes the study's central finding: the hypothesized mediation model was not supported by the empirical data. Specifically, although students' attitudes toward technology modestly correlated with engagement, these psychological and behavioral constructs did not translate into measurable differences in GPA. In this sample of Vietnamese pharmacy students, GPA appeared to be influenced more strongly by factors external to the model, such as curriculum structure, examination design, or prior academic achievement - variables beyond the scope of this analysis.

The absence of statistically significant pathways aligns with a growing body of research reporting similar inconsistencies in the predictive relationship between engagement-related constructs and academic outcomes (Amez & Baert, 2020; Çali et al., 2024). Rather than undermining the theoretical framework, this finding underscores the contextual nature of the engagement-achievement paradox, reaffirming that engagement may operate as a proximal motivational construct whose influence on performance is mediated through additional academic or environmental factors not captured in this model.

5. CONCLUSION

This study examines a structural mediation model in which four dimensions of students' technology attitudes - Positive Attitude, Anxiety, Negative Attitude, and Task Switching - were hypothesized to influence GPA through Academic Engagement. The model aims to clarify the psychological mechanisms connecting students' digital orientations with their learning outcomes in a Vietnamese higher education context.

The empirical results did not support the hypothesized mediation framework. Two findings stand out. First, the theoretical three-factor structure of the UWES-9S engagement scale showed a poor model fit (RMSEA = 0.110), validating the methodological decision to use a composite engagement score. Second, and most importantly, the structural model failed to demonstrate a significant direct relationship between Academic Engagement and academic outcomes ($p = 0.073$), thereby rendering all four indirect mediation paths (H1-H4) non-significant. Together, these results indicate that students' attitudes toward technology and their self-reported engagement did not have a measurable effect on academic achievement in this sample.

Rather than representing a statistical anomaly, this non-significant finding contributes empirical evidence to the ongoing debate surrounding the "engagement-achievement paradox." Consistent with previous studies (Carini et al., 2006; Amez & Baert, 2020; Çali et al., 2024), the present research reaffirms that while academic engagement is a crucial motivational construct, its predictive strength for GPA remains modest and context-dependent. In this Vietnamese pharmacy cohort, learning outcomes appear to be influenced by unmeasured institutional and pedagogical factors - such as assessment methods, prior academic preparation, or study workload - that were not captured in the current model.

These findings underscore the importance of contextualized interpretations of engagement research and highlight the need to go beyond attitudinal self-reports when examining student performance. Future research should employ longitudinal designs and integrate objective academic indicators (e.g., institutional GPA records) to capture temporal dynamics and reduce self-report bias. Moreover, expanding the analytical framework to include learning strategies, instructional design, and cognitive regulation may provide a more comprehensive understanding of how digital technology attitudes translate - or fail to translate - into measurable academic success.

Conflict of Interest: No potential conflict of interest relevant to this article was reported.

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