

Academic procrastination and achievement among university students under AI overreliance and contextual factors

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ABSTRACT

Academic procrastination remains a persistent challenge in higher education, particularly as artificial intelligence (AI) tools become increasingly integrated into students' learning activities. While AI can assist with academic tasks, excessive reliance on such technologies may influence students' learning behaviors and time management. This study employed a quantitative, cross-sectional design to examine the factors associated with academic procrastination and its relationship with academic achievement in higher education contexts where AI tools are widely used. Data were collected from 301 university students and analyzed using partial least squares structural equation modeling (PLS-SEM). The results indicate that the model explains a substantial proportion of variance in academic procrastination ($R^2=0.72$) and a moderate proportion in academic achievement ($R^2=0.30$). Academic procrastination shows a significant relationship with academic achievement ($\beta=0.551$, $p<0.001$). Among the predictors, self-regulated learning ($\beta=-0.800$) and school attachment ($\beta=-0.803$) exhibit the strongest negative associations with procrastination, while AI overreliance ($\beta=0.430$) increases academic procrastination. Digital competence ($\beta=-0.441$) also contributes to reducing procrastination. These findings suggest that academic procrastination functions as a key mechanism linking individual, contextual, and technological factors to academic outcomes in technology-supported higher education. The results highlight the importance of strengthening students' self-regulated learning and promoting cautious and responsible AI use in higher education.

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1. INTRODUCTION

Academic achievement is a key indicator of higher education effectiveness [1], increasingly linked to measurable outcomes aligned with sustainable development goal 4 and human capital development [2]. At the same time, digital transformation has expanded the use of artificial intelligence (AI) tools like ChatGPT in academic tasks [3]. While generative AI enhances learning efficiency, it also raises concerns about overreliance and its impact on students' self-regulation, engagement, and learning behaviors. Understanding these effects is essential for universities aiming to balance technological innovation with sustainable learning outcomes.

Academic procrastination is consistently linked to lower academic performance [4]. Key predictors include self-regulated learning, digital competence, and digital literacy [5], [6], while contextual factors such

as school attachment and family support also help reduce procrastination [7]. Self-regulated learning supports planning and monitoring, digital competence facilitates efficient technology use, and digital literacy enables critical engagement, while contextual support stabilizes motivation and engagement. However, these factors are often studied separately, with limited integrated models.

Recent studies suggest that AI overreliance may weaken metacognitive control and increase avoidance [8], [9], yet it is rarely included in procrastination frameworks. Existing research tends to examine technology use or self-regulation in isolation, limiting understanding of how AI-related behaviors interact with psychological and contextual factors. As AI becomes more prevalent in higher education, this gap constrains insight into its risks and unintended effects on student performance.

This study develops and tests an integrated model in which self-regulated learning, digital competence, digital literacy, family support, school attachment, and AI overreliance predict academic procrastination, which in turn affects academic achievement. Using partial least squares structural equation modeling (PLS-SEM), it examines the relationships among technological, individual, and contextual factors within a single framework. The study contributes by incorporating AI overreliance into the procrastination framework and positioning procrastination as the key mechanism linking multiple predictors to achievement. Compared to prior research that examines these factors separately, this model offers a more comprehensive view of student behavior in AI-integrated contexts. The findings provide practical implications for promoting responsible AI use and strengthening students' self-regulation and engagement.

2. LITERATURE REVIEW

2.1. Foundation theory

This study is grounded in self-regulation failure theory, which views academic procrastination as a breakdown in planning and behavioral control rather than a lack of ability [6]. In AI-integrated learning contexts, overreliance on AI can be viewed as a form of self-regulatory failure that reduces active engagement and increases academic procrastination. Social cognitive theory and rational emotive behavior theory further explain how contextual support and beliefs about effort shape procrastination behavior [10]. These perspectives guide the proposed model by positioning self-regulated learning, contextual factors such as school attachment and family support, and AI overreliance as predictors of academic procrastination, which in turn influences academic achievement.

2.2. Hypothesis development

Academic procrastination is the intentional delay of academic tasks despite knowing it may harm performance [11]. It fragments learning, delays effort until deadlines, and compresses study time, increasing cognitive load and limiting deeper processing. Since academic achievement depends on sustained effort [12], procrastination often leads to lower-quality work and higher stress, undermining outcomes. Although some students may benefit from pressure in specific cases [13], such effects are temporary. Repeated procrastination reinforces avoidance and stress, weakening performance over time [14]. From a rational emotive behavior theory perspective, it reflects avoidance-driven beliefs (e.g., fear of failure). In AI-supported environments, heavy reliance on AI may further encourage task delay by reducing the perceived cost of postponing effort. H1: academic procrastination negatively affects academic achievement.

Self-regulated learning refers to how students plan, manage, and adjust their learning [15] and is strongly associated with lower academic procrastination. Procrastination reflects a failure of self-regulatory control rather than simple poor time management [10], even when students recognize its negative consequences. Strategies such as metacognitive monitoring, time management, and effort regulation help reduce procrastination. Students who plan, track progress, and persist are less likely to delay tasks [16], whereas weak self-regulation leads to prioritizing short-term comfort. Evidence consistently shows that stronger self-regulation reduces procrastination and improves outcomes [15]. Based on this reasoning, this study proposed the following hypothesis (H2): self-regulated learning is negatively related to academic procrastination.

In digital and AI-supported learning environments, digital competence influences academic procrastination primarily through students' ability to initiate and manage academic tasks efficiently. Students with stronger digital competence experience fewer technical barriers and lower technology-related anxiety, which reduces avoidance and task delay [6]. When digital competence is limited, academic tasks may feel more demanding than they actually are, increasing uncertainty and the likelihood of postponement [17]. This mechanism becomes more salient in learning contexts where academic activities are closely tied to digital platforms. Accordingly, digital competence is expected to reduce academic procrastination. H3: digital competence is negatively related to academic procrastination.

Digital literacy affects academic procrastination through students' capacity to critically evaluate information and regulate attention in digital environments. Unlike operational digital skills, digital literacy helps students resist digital distractions and avoid passive reliance on automated support, which may reduce academic procrastination [18]. Students with limited digital literacy are more likely to engage with digital content uncritically, reinforcing avoidance-oriented learning behaviors [19]. In technology-mediated learning contexts, this regulatory function becomes increasingly important as students face constant exposure to AI-generated outputs. Therefore, higher digital literacy is expected to reduce academic procrastination. H4: digital literacy is negatively related to academic procrastination.

For university students, family support functions mainly as a background resource that shapes motivation and coping tendencies rather than directly regulating daily academic behavior. Emotional and instrumental support from family can stabilize students' learning conditions and reduce stress, which indirectly lowers avoidance and procrastination [20]. However, in highly autonomous learning environments, the influence of family support is likely to be weaker than that of institutional or individual factors. As a result, family support is expected to be negatively associated with academic procrastination, albeit with a modest effect. H5: family support is negatively related to academic procrastination.

School attachment refers to students' sense of connection to their school and learning environment [21], which influences how they handle academic demands. Strong attachment promotes engagement and persistence, while low attachment is associated with isolation, reduced motivation, and greater procrastination. A strong sense of belonging supports emotional stability and focus on long-term goals [22]. This factor is especially important in technology-rich and AI-supported environments [23]. Students who feel connected are more likely to use digital tools purposefully rather than for avoidance. Evidence shows that stronger school attachment is linked to greater academic responsibility, lower procrastination [7], and better psychological adjustment and learning persistence [24]. H6: school attachment is negatively related to academic procrastination.

AI overreliance refers to excessive dependence on AI tools for completing academic tasks, which may weaken self-regulation and proactive engagement. When students rely on AI for immediate solutions, they are more likely to postpone meaningful task engagement, assuming that AI support can compensate for delayed effort [25]. This reliance reduces metacognitive monitoring and encourages avoidance-oriented learning strategies [26]. In AI-supported learning environments, such dependence may legitimize task delay rather than reduce it. Therefore, higher levels of AI overreliance are expected to increase academic procrastination. H7: AI overreliance is positively related to academic procrastination. Building on this perspective, the proposed model integrates individual, contextual, and technological factors, with academic procrastination as the central mechanism linking them to academic achievement, as shown in Figure 1.

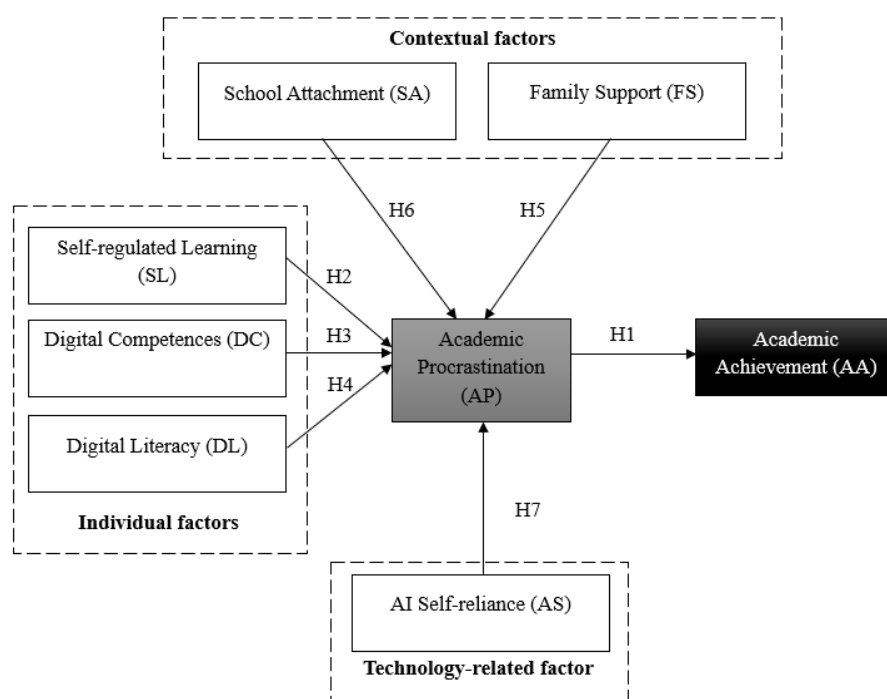


Figure 1. Proposed research model

3. METHOD

This study employed a quantitative, cross-sectional survey of students from private universities who regularly use digital technologies and AI tools in their academic work. This group was selected due to their higher learning autonomy, greater exposure to digital platforms, and more flexible instructional environments, making them suitable for examining self-regulation, technology use, and procrastination in AI-supported learning. All participants provided informed consent after being informed of the study's purpose, voluntary nature, and their right to withdraw at any time. Data were collected via an online questionnaire. After removing incomplete or invalid responses, 301 valid cases were retained. This sample size is adequate for PLS-SEM, enabling analysis of multiple latent variables and mediation effects. Participants came from various academic disciplines, capturing diversity in learning demands and technology use.

All constructs were measured using established scales adapted from prior studies and adjusted to the research context. Self-regulated learning was measured using items reflecting how students manage their learning activities, such as “setting clear academic learning goals” [15]. Digital competence was assessed through students' ability to use digital tools effectively for academic tasks, for example, “using advanced search functions to locate academic information” [27]. Digital literacy focused on critical and responsible use of digital technologies, including “awareness of ethical behavior in online academic environments” [18]. Family support was measured through perceived encouragement and assistance from family members, such as “encouragement to begin and sustain academic work” [28]. School attachment captured students' emotional connection to the institution, for instance, “feeling proud to be a student at the university” [21].

AI overreliance was assessed using indicators of excessive dependence on AI tools, such as “reduced independent management of academic tasks due to AI use” [25]. Although the AI overreliance construct was adapted from a general technology dependence scale, the items were revised to reflect excessive reliance on AI tools for academic tasks rather than social media use. Academic procrastination was measured through behaviors related to academic procrastination, such as “postponing the start of major assignments until just before the deadline” [11]. Academic achievement was assessed using self-reported indicators of learning outcomes, including “perceived improvement in academic skills through coursework” [29]. All items were rated on a seven-point Likert scale ranging from strongly disagree to strongly agree.

Data were analyzed using PLS-SEM, which is suitable for explaining and predicting academic procrastination in complex models with multiple antecedents and mediation, without requiring strict normality assumptions. The analysis involved two steps: evaluating the measurement model (reliability and validity) and testing the structural model (hypothesized relationships and mediation). Bootstrapping was applied to assess path significance. As data were self-reported and collected at a single time point, common method bias was also examined.

4. RESULTS AND DISCUSSION

The study sample comprised 301 university students. Female participants constituted a slightly larger proportion of the sample (58%), whereas male participants accounted for 42%. In terms of academic standing, the majority of respondents were in their second and third years of study, representing approximately two-thirds of the total sample. First-year students comprised about one-fifth of the participants, with the remainder being final-year students. Participants were drawn from diverse academic disciplines. Students majoring in social sciences and business-related fields represented the largest subgroup, followed by those in engineering and technology, and subsequently those in education and the humanities. Regarding technology engagement, most respondents reported regular use of digital tools and AI applications to support their academic tasks. This high level of technological engagement suggests that the sample was well positioned for examining learning behaviors within AI-supported educational contexts.

As reported in Table 1, the measurement results indicate that all constructs were measured with acceptable quality. All outer loadings exceed 0.70, indicating adequate indicator reliability. Cronbach's alpha and Rho_A values are above recommended thresholds, confirming internal consistency. Average variance extracted (AVE) values surpass 0.50, supporting convergent validity, while variance inflation factor (VIF) values below 3.0 indicate no collinearity issues. Additionally, the heterotrait-monotrait (HTMT) ratios are below 0.85, confirming discriminant validity. These results validate the measurement model and support proceeding to structural analysis. Academic procrastination significantly predicts academic achievement (H1: $\beta=0.551$, $p<0.001$), indicating a significant positive relationship between academic procrastination and academic achievement, consistent with prior research [14], [30]. Self-regulated learning (H2) is a strong negative predictor ($\beta=-0.800$, $p<0.001$), indicating that students who effectively plan and monitor their learning are less likely to procrastinate [16], as shown in Table 2.

Table 1. Measurement model results

Item	Outer loading	Cronbach's alpha	Rho A	AVE	VIF
DC1	0.804	0.874	0.887	0.635	1.045
DC2	0.801				1.524
DC3	0.812				1.719
DC4	0.832				2.363
DC5	0.733				2.764
AP1	0.782	0.907	0.908	0.645	2.050
AP2	0.862				2.818
AP3	0.861				2.108
AP4	0.756				2.003
AP5	0.804				2.233
AP6	0.778	0.858	0.882	0.644	2.245
AP7	0.770				2.058
AO1	0.916				2.290
AO2	0.898				2.244
AO3	0.936				2.660
AO4	0.898	0.759	0.804	0.669	1.011
AO5	0.964				2.922
AO6	0.847				2.410
AO7	0.808				1.312
AO8	0.742				2.372
AO9	0.721	0.874	0.877	0.636	2.564
DL1	0.794				1.512
DL2	0.786				1.556
DL3	0.872				1.524
SL1	0.876				1.666
SL2	0.817	0.808	0.809	0.631	2.939
SL3	0.844				2.187
SL4	0.771				2.450
SL5	0.786				2.325
SL6	0.826				2.391
SL7	0.861	0.802	0.803	0.650	1.723
SL8	0.885				2.392
SL9	0.890				2.145
SL10	0.895				2.833
SL11	0.888				2.052
SL12	0.892	0.736	0.761	0.651	2.360
SL13	0.860				1.309
SL14	0.878				1.243
SL15	0.887				2.665
FS1	0.844				2.503
FS2	0.879	0.736	0.761	0.651	2.916
FS3	0.795				2.547
FS4	0.908				2.713
FS5	0.845				2.076
SA1	0.876	0.736	0.761	0.651	2.168
SA2	0.878				1.871
SA3	0.887				2.368
SA4	0.845				2.142
SA5	0.845				2.901
AA1	0.734	0.736	0.761	0.651	1.413
AA2	0.855				1.591
AA3	0.826				1.427

Table 2. Structural model results

Hypothesis	Relationships	Original sample	t-value	p-value	Results
H1	Academic procrastination → academic achievement	0.551	12.920	0.000	Confirm
H2	Self-regulated learning → academic procrastination	-0.800	10.367	0.000	Confirm
H3	Digital competences → academic procrastination	-0.441	8.442	0.000	Confirm
H4	Digital literacy → academic procrastination	-0.047	2.105	0.035	Confirm
H5	Family support → academic procrastination	-0.085	2.138	0.033	Confirm
H6	School attachment → academic procrastination	-0.803	10.575	0.000	Confirm
H7	AI overreliance → academic procrastination	0.430	8.251	0.000	Confirm

Similarly, digital competence (H3) reduces procrastination ($\beta=-0.441$, $p<0.001$), likely by lowering technical barriers in technology-based learning [17]. Digital literacy (H4) shows a smaller but significant negative effect ($\beta=-0.047$, $p<0.05$), suggesting that critical digital skills help students manage information and maintain focus [18]. Family support (H5) shows a small but significant negative effect on procrastination ($\beta=-0.085$, $p<0.05$), suggesting that supportive home environments help reduce avoidance, though less

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strongly than individual and institutional factors [10]. School attachment (H6) is a strong negative predictor ($\beta=-0.803$, $p<0.001$), indicating that students who feel connected to their university are more engaged and less likely to procrastinate [7]. In contrast, AI overreliance (H7) increases procrastination ($\beta=0.430$, $p<0.001$), as heavy dependence on AI may encourage task delay and reduce engagement [9]. Importantly, this study is among the first to integrate AI overreliance into academic procrastination models.

The findings indicate that self-regulated learning and school attachment are the most influential factors in reducing academic procrastination, followed by digital competence and AI overreliance. These results suggest that technological support does not replace the need for self-regulation; rather, weak regulation becomes more problematic in AI-integrated learning environments. Several limitations should be acknowledged. The study relies on self-reported data, which may introduce response bias. In addition, the sample consists of students from private universities, which may limit the generalizability of the findings. The cross-sectional design also restricts causal interpretation. Future research should employ longitudinal designs and broader institutional samples to further examine how AI-related learning behaviors develop over time.

5. THEORETICAL CONTRIBUTIONS

This study contributes to academic procrastination research by positioning procrastination as a key process linking individual abilities, contextual factors, and AI-related influences to academic achievement. The findings show that, in AI-integrated learning environments, self-regulation failures remain critical rather than becoming less relevant. The strong effect of school attachment suggests that institutional connection continues to motivate students even in flexible, technology-rich settings, challenging assumptions about reduced contextual influence. In addition, AI overreliance is identified as a technological risk that may encourage delayed effort, helping explain why AI-supported learning leads to different outcomes across students.

6. MANAGERIAL IMPLICATIONS

The results suggest that efforts to reduce academic procrastination in AI-supported learning environments should begin with strengthening students' self-regulated learning. Training initiatives should go beyond generic time-management advice and focus more directly on goal setting, planning, and effort regulation. The strong effect of school attachment points to the importance of institutional connection. Universities should not assume that flexible or technology-rich learning environments naturally sustain student engagement. Instead, fostering regular interaction with faculty, building supportive academic communities, and creating spaces where students feel recognized and connected may help reduce disengagement and task delay. This is especially relevant in private universities, where autonomy is high and external structure is often limited.

The findings also indicate that operational digital competence plays a more immediate role in reducing procrastination than higher-level digital literacy alone. Institutions should ensure that students can use learning technologies efficiently and confidently. Reducing technical friction in everyday academic tasks may lower avoidance and make it easier for students to start work on time. AI overreliance emerges as a practical concern rather than a purely theoretical issue. Universities should not only promote AI adoption but also set clear expectations about appropriate use. Guidelines that clarify when AI tools are acceptable, combined with assessment designs that require active engagement and original thinking, may help prevent AI from becoming a shortcut that encourages task delay.

Although family support showed a weaker direct effect, it should not be ignored. Family expectations and support may still shape students' motivation and coping patterns in indirect ways. Clear communication about academic demands and encouragement of student autonomy may complement institutional efforts to address procrastination. The findings imply that managing academic procrastination requires coordinated action. Improving individual learning skills, strengthening institutional connections, and setting clear boundaries for AI use appear more effective than isolated interventions focused on technology alone.

7. CONCLUSION

This study examined academic procrastination as a key mechanism linking self-regulated learning, digital competence, digital literacy, family support, school attachment, and AI overreliance to academic achievement in AI-integrated higher education. The results show that self-regulated learning and school attachment reduce procrastination, while AI overreliance increases it. In turn, procrastination significantly

affects academic achievement. The study contributes by integrating AI overreliance with individual and contextual factors in a unified model, offering a more comprehensive explanation of procrastination in AI-supported learning. Findings indicate that advanced technologies do not replace self-regulation; instead, weak self-regulation becomes more problematic with heavy AI reliance. Practically, universities should strengthen students' self-regulated learning and promote responsible AI use through training and clear guidelines. However, the cross-sectional design limits causal conclusions, and AI overreliance was measured broadly. Future research should use longitudinal or experimental designs, include diverse contexts, and apply more detailed measures of AI use to better understand its impact on procrastination and achievement.

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During the preparation of this work, the authors used ChatGPT to improve grammar, punctuation, and language fluency in this manuscript. After using this tool, the authors reviewed and edited the content as needed and takes full responsibility for the content of the publication.

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AUTHOR CONTRIBUTIONS STATEMENT

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Le Quoc Thang	✓	✓		✓	✓		✓			✓		✓	✓	✓

C : Conceptualization

M : Methodology

So : Software

Va : Validation

Fo : Formal analysis

I : Investigation

R : Resources

D : Data Curation

O : Writing - Original Draft

E : Writing - Review & Editing

Vi : Visualization

Su : Supervision

P : Project administration

Fu : Funding acquisition

CONFLICT OF INTEREST STATEMENT

The authors report there are no competing interests.

ETHICAL APPROVAL

The study protocol was reviewed and approved by Ho Chi Minh University of Banking Review Board or Ethics Committee, ensuring compliance with ethical standards for research involving human participants.

DATA AVAILABILITY

The data that support the findings of this study are available on request from the corresponding author, [LQT]. The data, which contain information that could compromise the privacy of research participants, are not publicly available due to certain restrictions.

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