

Digital intervention on academic procrastination: a systematic review

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ABSTRACT

Academic procrastination is a widespread problem in higher education and is associated with poorer academic performance, reduced well-being, and difficulties in self-regulation. With the increasing use of digital technologies in education and psychological support, digital interventions have emerged as a potentially scalable approach to addressing academic procrastination. However, systematic evidence regarding how such interventions is defined, how effective they are, and what factors shape their outcomes remains limited. This systematic review aimed to clarify the concept of digital interventions in the context of academic procrastination, evaluate their effectiveness, and identify factors influencing intervention success. Following preferred reporting items for systematic reviews and meta-analyses (PRISMA) 2020, a systematic search was conducted across Web of Science, ScienceDirect, SpringerLink, and ProQuest, supplemented by citation tracking and reference screening. Finally, 17 empirical studies were included. The findings showed that digital interventions could be grouped into three broad categories and generally produced beneficial, though varied, effects on academic procrastination. More structured and theory-driven interventions tended to show more consistent benefits, whereas lower-intensity interventions yielded mixed or context-dependent results. Overall, digital interventions appear promising, but their effectiveness depends on intervention design, user engagement, and contextual support.

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1. INTRODUCTION

Academic procrastination, defined as the voluntary delay of intended academic tasks despite expecting to be worse off for the delay, is a pervasive issue among students worldwide [1]. It is associated with a range of negative outcomes, including poorer academic performance, elevated levels of stress and anxiety, and reduced psychological well-being [2], [3]. Recent evidence further suggests that procrastination may predict later depression and anxiety symptoms over time, underscoring its relevance not only to academic functioning but also to student mental health [4]. With the increasing academic pressure on students in higher education, more flexible learning methods, and the popularity of online learning environments, the ability to initiate and maintain task participation has become more important. Recent studies also show that procrastination tends to increase as the academic term progresses in both face-to-face and online learning

environments, highlighting the importance of monitoring delay behavior in digitally mediated study contexts [5]. At the same time, ubiquitous digital interference and loose deadlines may exacerbate academic procrastination, thereby increasing the risks to students' academic achievement and mental health. These trends highlight the urgency of implementing targeted and scalable interventions and provide a clear basis for systematic evaluation of digital methods to alleviate academic procrastination.

Traditional interventions for academic procrastination mainly include cognitive-behavioral therapy, time management training, and self-regulation strategies [6], but these methods often rely on longer cycles, professional support, and higher investment, resulting in limited operability [7]. In contrast, digital interventions implemented through online platforms, mobile applications, or digital communication tools have advantages such as flexibility, automation, and personalization, and are becoming a promising alternative solution [8]. Meanwhile, research has shown that academic procrastination is not only influenced by individual characteristics, but also by factors like technological availability, task value, emotional cost, and digital learning environment [9]. Recent evidence further shows that guided online interventions can effectively reduce procrastination among college students at a lower intensity and maintain a certain effect during follow-up [10].

Despite the increasing attention to technical support methods, existing literature still lacks a systematic review of digital interventions for academic procrastination. While previous reviews have explored procrastination or digital mental health interventions separately, none have synthesized empirical findings specific to digital solutions targeting academic procrastination. As a result, several key issues remain unresolved: how should such intervention measures be conceptualized and understood? What digital interventions can demonstrate the most stable results? Under which individual characteristics, design schemes, or situational conditions are the most effective? The research gap not only limits the clarity of theoretical interpretation, but also restricts the practical guidance for the development of scalable student support systems. This review fills the literature gap by clarifying the conceptual basis of digital interventions for academic procrastination, integrating empirical effects of different intervention types, and identifying key factors that affect intervention effectiveness in academic contexts. To achieve the above goals, the following research questions are proposed: i) RQ1: how are digital interventions defined and categorized in the context of academic procrastination? ii) RQ2: how effective is digital intervention in reducing academic procrastination, and what are the advantages of different types of digital interventions in reducing academic procrastination? and RQ3: what key factors influence the efficacy of digital interventions in academic settings?

2. METHOD

This systematic review follows the preferred reporting items for systematic reviews and meta-analyses (PRISMA) 2020 guidelines [11], which provide standardized reporting procedures for systematic reviews to improve transparency, completeness, and reproducibility. The review process includes four stages: literature search, screening, inclusion criteria evaluation, and final inclusion. Use PRISMA flowchart to record the research screening process, including identification, screening, exclusion, and the final number of included literatures, and provide a detailed explanation of the exclusion criteria at the full-text stage. Each article was independently reviewed by two researchers, and disagreements were resolved through discussion.

In the first stage, we conducted a comprehensive search of four major databases-Web of Science, ScienceDirect, SpringerLink, and ProQuest-to obtain peer-reviewed research in related fields. The search focuses on publications from the past decade to reflect the rapid development of digital technology in the field of education. We applied the following query to the title, abstract, and keywords using Boolean operators: ("academic promotion") AND ("digital intervention" OR "online program" OR "internet-based intervention" OR "mobile app" OR "web-based") [12]. A total of 1540 records were obtained through preliminary search; After limiting the results to English publications, there are 994 remaining. After screening abstracts and excluding irrelevant, non educational, and non empirical publications (such as reviews and book chapters), 15 empirical studies designed using quantitative or mixed methods were ultimately included. In the second stage, two additional articles that met the criteria were identified through reverse citation tracing by screening the list of retained research references. Finally, a total of 17 studies were included in this review. The research screening process is shown in the PRISMA flowchart in Figure 1, and the included studies can be found in the reference list [13]–[29].

The Cochrane Handbook notes that clearly defined and well-articulated inclusion criteria are a fundamental prerequisite for conducting a systematic review, and that these criteria should directly address the research question and be consistent with the subsequent search, screening, and synthesis processes [30]. The included research should be on academic procrastination occurring in educational environments (such as schools, universities, or other formal learning environments), involving digital or technology mediated interventions aimed at reducing academic procrastination, designed using quantitative or mixed methods, and published in English on peer-reviewed academic sources.

Given the heterogeneity of the included studies, this review used the mixed methods assessment tool (MMAT) to conduct a brief assessment of the methodological quality of the studies. The MMAT is suitable for evaluating various types of empirical studies and was therefore deemed appropriate for this review [31]. Since this review aims to provide an overall synthesis of the existing evidence rather than a detailed methodological comparison, the assessment was conducted using a descriptive approach. Particular attention was paid to the appropriateness of study design, sampling, and measurement methods; the completeness of outcome data; and the reporting of intervention implementation. A brief MMAT assessment indicates that the included studies generally exhibited moderate to relatively high methodological quality. Most studies maintained a reasonable alignment between their research questions and study designs, and the outcome measures used were generally appropriate for the study objectives. However, some studies had limitations, including small sample sizes, reliance on self-report scales, short follow-up periods, and insufficient reporting on the implementation of interventions or the handling of missing data.

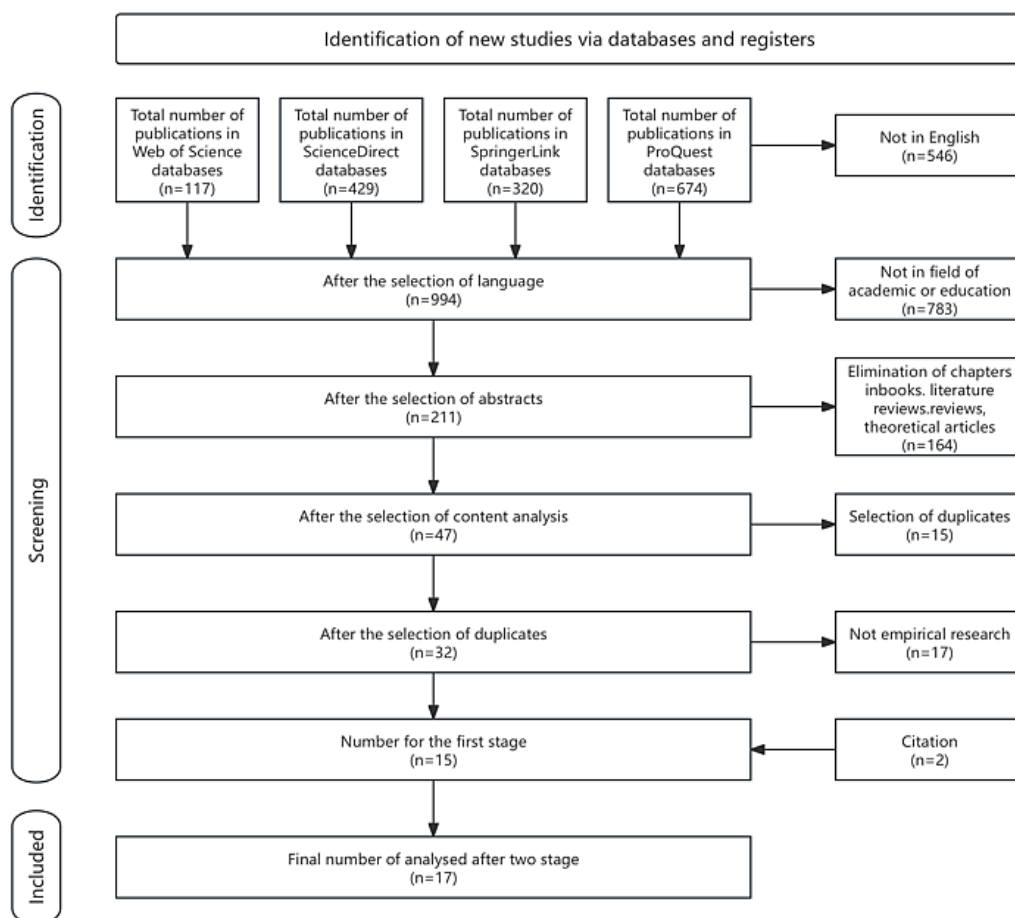


Figure 1. The procedure of search approach

3. RESULTS AND DISCUSSION

3.1. Definition of digital interventions

The concept of digital interventions in the context of academic procrastination is relatively recent and still evolving. Across the reviewed studies, definitions and categorizations of digital interventions vary significantly, reflecting differences in theoretical underpinnings, technological formats, and intervention goals. Generally, digital interventions refer to programs delivered via technological platforms—such as mobile applications, web-based tools, browser extensions, or automated messaging systems—designed to promote behavioral change without direct human facilitation [32]. In the context of academic procrastination, these interventions typically aim to improve time management, enhance self-regulation, and reduce delay in academic task initiation. However, a standard definition across studies is lacking. Among the 17 included articles, defined or categorized the digital intervention being implemented. These definitions can be grouped into three major typologies based on purpose and technological form:

3.1.1. Structured digital therapeutics

The definition of digital intervention in this type of article is mainly based on the network or mobile devices as the main carrier cognitive behavioral therapy (CBT)/acceptance and commitment therapy (ACT) Digitally deliver structured modules (psychological education, goal setting, implementation intention, exposure/acceptance, and recurrence prevention) with a clear focus on reducing procrastination; it can be self-service, guided by someone or a digital coach, and chatbot. Core behavior change technologies (BCTs) include planning and goal setting, self-monitoring and feedback, skill training, and recurrence prevention; (partial) human computer hybrid support [13]–[22]. The specific situation is shown in Table 1.

Table 1. Definition of digital intervention in structured digital therapy

Author	Item	Definition
[13]	Internet CBT	Deliver cognitive behavior therapy in the form of Internet self-help modular courses, with or without the support of remote therapists, and implement it through online platforms to systematically reduce delays.
[14]	Internet CBT	8-week self-help internet cognitive behavior therapy (iCBT): provide psychological education and practice of CBT through online platform modules, aiming to systematically reduce procrastination, and compare it with offline group CBT in a pragmatic randomized controlled trial.
[15]	Mobile CBT	A hybrid mobile therapy: using the smartphone application MT-PRO for 14 days of training (using cognitive bias correction, gamification, and operant conditioning to promote functional cues and avoid nonfunctional cues), combined with two brief group counseling sessions, systematically reducing procrastination through online means.
[16]	Web-ACT	Deliver ACT to college students in the form of a web-based self-service module, cultivating psychological flexibility and commitment actions through online exercises and materials, thereby reducing academic procrastination.
[17]	Digital coach	StudiCare procrastination, an internet and mobile cognitive behavior therapy (iCBT) project optimized by “persuasive system design (PSD)”, is provided with guidance and support by human e-coach or automated digital coaches to reduce college students’ procrastination behavior.
[18]	Chatbot	Deeply integrate a semi-mature chatbot (Moa) with a mobile to-do app, providing guidance on self-observation, strategy development, and reflection through situational dialogue for 30 consecutive days.
[19]	Guided/self-help Internet	StudiCare procrastination, a CBT based 5-week e-coach delivered via Internet/mobile terminals, is an IMI (internet and mobile based intervention) for college students to systematically reduce delays.
[20]	intervention	A guided Internet intervention called GetStarted, e-coach provides structured support online to reduce college students’ procrastination, and evaluates its effectiveness with two arm randomized controlled trial (RCT).
[21]		A guided web intervention aimed at college students, supported online by trained student digital coaches (e-coaches), primarily testing feasibility and acceptability.
[22]		An internet self-help intervention (without manual guidance) for undergraduate psychology students reduces delay through online modular content and is verified with RCT scheme.

3.1.2. Light-touch nudges and single-session programs

This type of article mainly defines digital intervention through low threshold methods such as short message service (SMS)/notifications/short-range modules, focusing on initiation and rhythm maintenance, commonly used in short-term/widespread scenarios, and can be used as an independent intervention or an “enhancement/consolidation” component of the main project. Core BCTs include timely reminders, implementation of intentions/plans, task simplification, and short-term skill exercises; Emphasize accessibility and scalability [23]–[26]. The specific situation is shown in Table 2.

Table 2. Definition of digital intervention in light-touch nudges and single-session programs

Author	Item	Definition
[23]	SMS assistance	A 2-week unsupervised internet training (ON. TOP) and compare whether it superimposes daily SMS support to systematically reduce students’ delay through online-only modules and SMS boost.
[24]	Single low-intensity universal network intervention	A single, low-threshold interactive web program (FOCUS): first screened with pure procrastination scale and then presented personalized feedback and behavior change suggestions in real time (while the control group only saw the total score) to evaluate its impact on college students’ procrastination behavior.
[25]	Single low-intensity universal network intervention plan	
[26]	Low burden digital channel	A 10-week, fully online, low-burden project that combines smartphone sports applications with theory-based social media (Facebook) health education to promote behavior and health outcomes for college students.

3.1.3. Embedded/platform-level designs

The third type is to embed interventions into courses/learning management system (LMS)/online systems or distracted situations, using learning analytics-driven planning, reflection, visual feedback, interval practice/task timing, and incentive mechanisms, attention governance, and situational control to change

learning rhythms and external environments to reduce procrastination. Core BCTs include self-monitoring and visual feedback, planning/reflection protocols, spaced practices, and commitment/stimulus control [27]–[29]. The specific situation is shown in Table 3.

Therefore, within the framework of this review, digital intervention can be defined as a replicable solution delivered through technology carriers such as Web/Mobile/LMS/SMS/Dialogue Agents, with the core goal of reducing academic procrastination, and embedded with identifiable behavior change technologies (such as planning, prompting, self-monitoring and feedback, skill training/CBT, and situational control); The implementation path is mainly divided into three categories: structured digital therapy/skill training, lightweight assistance and single universal intervention, and platform embedding and system layer design. All 17 literatures mentioned above can be classified into these three categories.

Table 3. Definition of digital intervention in embedded/platform-level designs

Author	Item	Definition
[27]	LMS embedded plan	Using a web-based “plan reflect” protocol in the course context and providing visual (graphical) feedback on medical students’ learning procrastination behavior to reduce procrastination and enhance self-regulated learning.
[28]	Interval practice/task timing motivation in online programming systems	The “incentivized spaced practice” mechanism embedded in the online programming question system shapes learning rhythms, suppresses delays near deadlines, and analyzes its dynamic correlation with test performance through platform design and self-selected/incentivized interval exercises presented in learning logs.
[29]	Attention governance/situational control (SNS)	Digital intervention is defined as the “D-Crastinate method”: first, guide users to identify their procrastination types in social networks and triggers triggered by platform functions, and then provide personalized strategies and implementation guidelines based on diagnostic results (such as environmental/functional adjustments, commitments, and prompts) to enhance awareness and self-control, and reduce procrastination in SNS contexts.

3.1.4. Three “axes of operation” across categories: key comparable elements in the definition

Regardless of which category it belongs to, the definition details of “digital intervention” mainly vary along three axes, as shown in Figure 2. Why these three axes? They determine the intensity, dosage, and scenario embedding of “digital interventions” in different studies, directly affecting their effectiveness: for example, for the same CBT, compliance and effects may differ under “guided/unguided/digital coaching”. As a reminder, the trajectory is different between two weeks/eight weeks and single/boost. Both are ‘feedback’, with different visibility and effects embedded in independent apps and LMS.

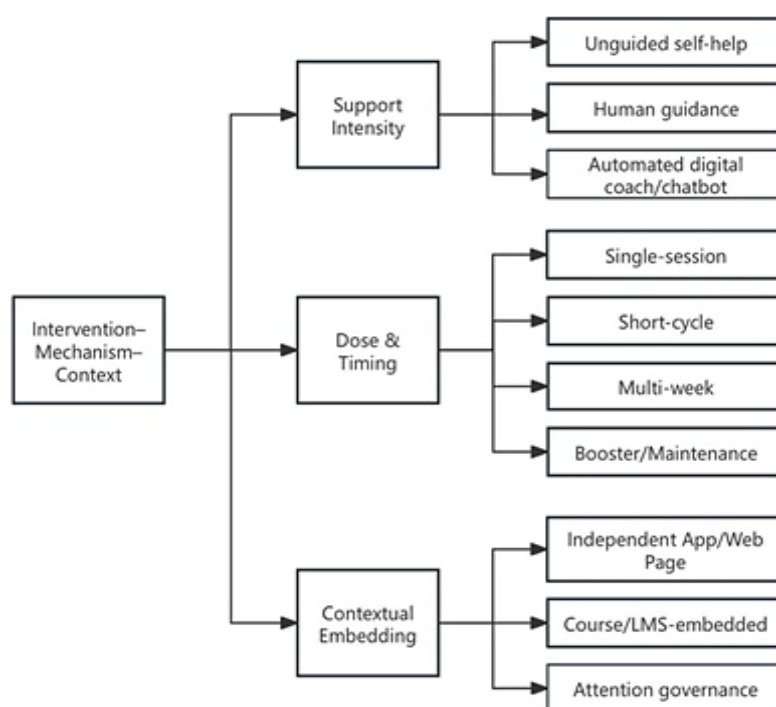


Figure 2. Three axes of operation

Furthermore, many studies use the term “digital intervention” interchangeably with “online program” or “e-intervention,” often without differentiating between guided (with therapist support) and unguided (fully automated) formats. This lack of conceptual clarity limits comparability and meta-analytic integration. To address this issue, future research should clearly define the delivery mechanism, user interaction level, and theoretical orientation of its intervention measures. Adopting digital intervention methods based on different types can improve the clarity and consistency of research on digital solutions for academic procrastination.

3.2. The effectiveness of digital interventions

Based on the 17 studies included, digital intervention has a positive effect on academic procrastination that is generally moderate to small but context dependent. Among them, structured multi-component networks or mobile interventions with CBT or ACT as the core have the most stable effects, and some studies can still maintain them in medium and long-term follow-up; Lightweight or single intervention may be effective in the short term, but its long-term effects and cross situational generalizability are relatively limited; the design of embedded or system level platforms has a significant inhibitory effect on procrastination near deadlines by adjusting learning pace and attention allocation, and may bring spillover benefits to learning performance. Overall, the 17 studies included in this article all showed that digital interventions have a certain effect on reducing academic procrastination, but there are differences in the intensity and applicability of different intervention types. Their specific advantages can be summarized into the following three aspects:

3.2.1. Structured digital therapy

Multiple randomized trials show that CBT delivered via the Internet can significantly reduce academic delay, has clear advantages over waiting or conventional control, and retains part/most of the benefits during the 6-12-month follow-up [14], [15]. The CBT pilot RCT on the smartphone side also reproduced significant improvements [16]. The webpage pilot of the ACT route showed a moderate improvement in the sample of college students before and after, and improved the process mechanisms such as commitment actions [17]. In terms of support intensity, iCBT with persuasive design and digital coaching has comparable efficacy to manual e-coach in a non-inferiority design, suggesting an expandable human-machine hybrid support path [18]. The pilot RCT of embedding a semi mature chatbot into a mobile to-do app showed that compared to the “app only” intervention group, the intervention group performed better in procrastination and time management in the short term, but was sensitive to user engagement [19].

3.2.2. Light-touch nudges and single-session programs

A three-arm randomized controlled trial with two weeks of online training showed that the condition of daily SMS not only significantly improved compliance, but also correlated with a decrease in procrastination; When there is a lack of SMS enhancement, the effect is weak or unstable, indicating the crucial role of “prompts/clues” in short-term interventions [24]. Single, low-threshold web projects (FOCUS) did not detect stable intergroup advantages in the main self-reported indicators in a real large sample. The author attributed the reasons to factors such as evaluation reactivity, follow-up loss, and natural use intensity, suggesting the boundary conditions for such interventions [25], [26].

3.2.3. Embedded/platform-level designs

Embedding plan reflection protocols and visual feedback into courses or LMS can significantly reduce procrastination and enhance self-regulation [28]. Longitudinal studies in online programming platforms have also shown that interval practice is associated with lower procrastination and higher grades, indicating that platform rhythm design helps reshape learning behavior [27], while diagnostic grouping push based on learning analysis provides an operational pathway for timely intervention [33]. Overall, compared to pure self-help forms, manual guidance or digital tutoring usually has higher compliance and more lasting effects, and multi week structured interventions are also more conducive to the formation and maintenance of self-regulation skills; The effectiveness of single or lightweight interventions relies more on high-quality personalized feedback and timely reminders. However, existing research still faces issues such as high intervention heterogeneity, inconsistent measurement and follow-up, insufficient objective behavioral indicators, sample concentration mainly in Europe and North America, and limited robustness of lightweight projects in natural contexts. Therefore, future research should report intervention doses, behavioral change technology combinations, and support intensity more clearly, incorporating log level objective behavioral indicators and multi time point follow-up, and strengthening randomized or quasi experimental designs and cross-cultural and scalability validation in the context of curriculum platforms.

3.3. Influencing factors of digital interventions

Among the 17 studies included, 10 provided more in-depth evidence on the factors influencing the effectiveness of digital interventions on academic procrastination. Overall, the effectiveness of intervention measures depends not only on the intervention content itself, but also on the interaction between internal and external factors. Internal factors mainly involve individual characteristics and psychological mechanisms. Evidence suggests that students with more severe procrastination tendencies and weaker self-regulation abilities may benefit more from intervention [14]–[16], while psychological flexibility [17], [18] and emotional regulation abilities [24] can also affect the effectiveness of intervention. External factors are mainly related to intervention design, guidance mode, and situational conditions. Research has shown that technical and persuasive design features, such as interactive functionality, feedback, and personalized support, can affect user engagement and intervention effectiveness [19], [21], while guided or semi guided models typically bring better compliance and outcomes than purely self-help methods [14], [22]. In addition, the fit between intervention measures and academic environment, including their integration with learning platforms and contextual conditions, is also an important determinant of their effectiveness [27], [28]. In summary, these research findings indicate that digital interventions for academic procrastination are most effective when factors such as learner characteristics, design features, support intensity, and environmental adaptability are met.

3.3.1. Internal factors: individual characteristics and psychological mechanisms

Individual differences are important factors affecting the effectiveness of digital interventions. Research has shown that baseline procrastination level, self-regulation ability, motivational orientation, and emotional regulation ability all affect intervention response. Students with higher levels of procrastination and weaker self-regulation usually benefit more from structured CBT programs, while those with higher levels of self-discipline have relatively limited improvement and may have a ceiling effect [14]–[16]. Meanwhile, emotional factors such as anxiety, fear of failure, and low self-compassion can also affect the effectiveness of interventions; Interventions that combine emotion regulation training or enhance psychological flexibility are more effective in reducing avoidance behavior and promoting task initiation [17], [24]. Overall, the cognitive, emotional, and self-regulation mechanisms related to procrastination are not only the basis for problem formation, but also determine the effectiveness of digital interventions. Therefore, personalized design based on individual psychological characteristics is more conducive to improving intervention effectiveness.

3.3.2. External factors

In addition to internal psychological mechanisms, the effectiveness of digital interventions is also influenced by external factors related to the design, guidance, and implementation context. These factors dynamically interact with each other, affecting participation, persistence, and sustainability of outcomes. Firstly, technical and design features are crucial. Compared with static self-service modules, intervention measures that include persuasive elements such as target visualization, feedback, gamification, and reminders often improve engagement and behavior maintenance rates. The research by Mutter *et al.* [18] and Lee *et al.* [19] further suggests that digital coaches or chatbots can enhance personalization and real-time feedback, although being too complex may reduce usability. Secondly, the intensity and pattern of guidance can also affect the intervention outcomes. The evidence from Rozental *et al.* [14], [15] and Amarnath *et al.* [21] suggests that guided or semi guided interventions typically achieve higher completion rates and longer lasting effects compared to non-guided interventions. Similarly, Mutter *et al.* [18], demonstrated that AI assisted hybrid support provides a scalable and effective model for student intervention. Finally, context embedding is essential. Integrating intervention tools into academic platforms or learning management systems can better align with students' learning habits and reduce barriers to participation [27]. In contrast, independent interventions that are disconnected from students' academic environment may limit participation. Cultural and situational factors, including educational norms, workload, and technical familiarity, may also affect responsiveness. Overall, the success of digital interventions for academic procrastination depends not only on the intervention content itself, but also on how the intervention content is provided, supported, and embedded in the learning environment.

4. CONCLUSION

This systematic review indicates that digital intervention provides a potential, moderately effective, and scalable solution for reducing academic procrastination. Among the 17 studies included interventions such as structured CBT and ACT showed the most stable and lasting effects; lightweight, single dose, or platform embedded interventions exhibit short-term effects that vary depending on the context. The intervention effect is not only influenced by internal factors such as individual self-regulation, emotional coping, and motivation, but also depends on external factors such as persuasive design, guidance intensity, and situational fit. Although existing research still has limitations in terms of methods, long-term tracking, and cultural applicability, the overall evidence suggests that well-designed, adaptable, and user-centered digital tools can effectively promote

students’ self-regulated learning and time management. Future research should further strengthen personalized mechanisms, introduce objective behavioral indicators, and focus on cultural and ethical inclusiveness to enhance the sustainability and universality of digital interventions in academic procrastination management.

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C : Conceptualization	I : Investigation	Vi : Visualization
M : Methodology	R : Resources	Su : Supervision
So : Software	D : Data Curation	P : Project administration
Va : Validation	O : Writing - Original Draft	Fu : Funding acquisition
Fo : Formal analysis	E : Writing - Review & Editing	

CONFLICT OF INTEREST STATEMENT

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest. The author declares that he/she has no conflict of interest.

DATA AVAILABILITY

Data availability is not applicable to this paper as no new data were created or analyzed in this study.

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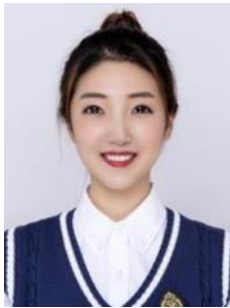
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