Investigating Gamification to Reduce Procrastination - Systematic Literature Review

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Abstract: *Introduction:* Procrastination significantly impacts in the lives of young people and adults, both in academic and professional contexts, reducing interest, performance and productivity. The prevalence rates in the general adult population highlight the frequency of this phenomenon. Procrastination, defined as the voluntary postponement of tasks despite awareness of its negative consequences, undermines academic performance, workplace productivity, and mental and physical health. Gamification, as a strategy within interactive systems, has been recognized for its potential to enhance motivation and, consequently, to reduce procrastination. *Methods:* This study explores how integrating gamification elements (such as points, badges, challenges, leaderboards, and progress bars) into interactive systems can improve user engagement, motivation, and task management, and consequently, help to reduce procrastination. The research methodology followed a systematic literature review, guided by SEGRESS guidelines. *Results:* The review included 24 studies, carefully selected from 781 identified through reputable databases. The findings highlight both the potential benefits and the challenges of employing gamification to combat procrastination. *Discussion:* This research emphasizes the importance of personalization in gamification strategies to address procrastination effectively. It further contributes to interactive systems design by exploring how organizational processes/behaviors and productivity can be enhanced through gamification systems (technology), tailored to assist users (students, workers, and procrastinators in general) in overcoming procrastination-related challenges.

Keywords: Procrastination, Postpone, Gamification, Gamify, Task Management, Interactive Systems.

1 Introduction

Procrastination is the act of voluntarily delaying an action despite the awareness of its negative consequences [Alblwi *et al*., 2019b]. It has severe impacts on individuals' lives across various contexts, as evidenced by rates of procrastination ranging between 15% and 20% in the general adult population, highlighting its prevalence [Lukas and Berking, 2018]. Procrastination is particularly high in educational settings, where approximately 40% of university students engage in significant procrastinatory behavior, and nearly 50% procrastinate consistently [Pereira and Díaz, 2021]. In the workplace, it is a major source of work-related stress [Alblwi *et al*., 2019b] and consequently affects society as a whole [Andreae *et al*., 2019].

Cognitive Behavioral Therapy (CBT) is widely recognized as one of the most effective treatments to reduce procrastination in both the short and long term [Pereira and Díaz, 2021]. However, psychological treatments are often seen as inaccessible due to financial constraints, the challenge of finding a compatible therapist, or the time required to see noticeable results. In this context, digital interventions, such as internet-based and mobile-based interventions (IMIs), have gained attention for their potential to promote behavioral change [Lukas and Berking, 2018]. While these interventions cannot replace the expertise of mental health professionals, they can serve as complementary tools, increasing accessibility and providing additional support for individuals struggling with procrastination.

One way to enhance the effectiveness of these digital interventions is through Persuasive System Design (PSD), which applies Human-Computer Interaction (HCI) strategies to encourage positive behavioral changes. Prior studies highlight the potential of PSD in IMIs, demonstrating promising outcomes in reducing procrastination while also contributing to improvements in anxiety and depression symptoms [Mutter *et al*., 2023]. By integrating game mechanics, PSD-based systems can become even more engaging and effective.

Gamification technologies might enhance the effectiveness of PSD by improving motivation to keep using the intervention. By incorporating game elements like points, badges, leaderboards, and progress bars, gamification can help users develop better time and task management skills, ultimately reducing procrastination and improving their overall quality of life [Mutter *et al*., 2023]. However, the effectiveness of gamification in combating procrastination also depends on the interaction between

people, organizations, and technology [Andreae *et al.*, 2019]. While technology provides the platform for gamification, organizations create the necessary environment for its adoption, and individuals, with their unique traits, determine how these systems are perceived and utilized. The intersections among these domains (organizational behavior, human-computer interaction, and information technology) represent critical areas for the development of gamified solutions that are effective, accessible, and adaptable to diverse contexts [Singh, 2012; Smith and Abrams, 2019; Uppalike, 2022; Aziz *et al.*, 2017; Suh and Wagner, 2017], as illustrated in Figure1.

Figure 1. Related fields to effect Gamified Interactive Systems (GIS).
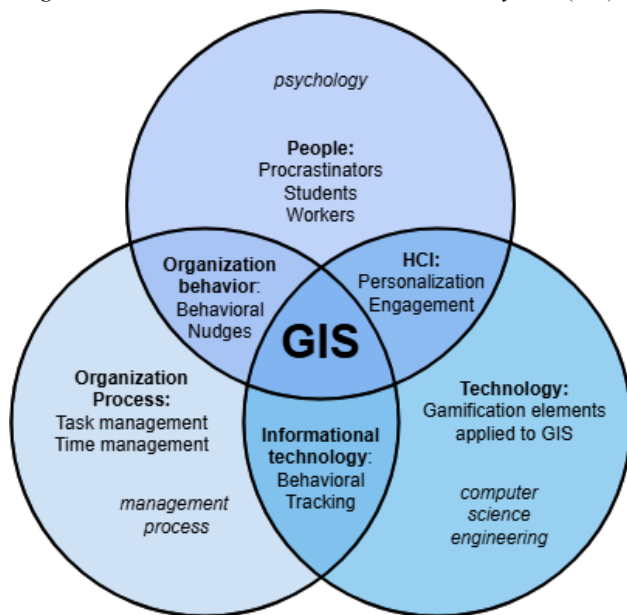
Therefore, this paper presents a systematic review of the literature (SRL) that aims to investigate **how gamification influences procrastination**. To develop a comprehensive understanding of this relationship, the study also examines individual differences, contextual factors that contribute to increased procrastination, and the impact of system design choices on intervention outcomes.

This article is organized as follows: Section 2 presented the theoretical background considering procrastination and gamification. Section 3 shows the related works that inspired us. Section 4 presents our SRL, its protocol, and execution steps, while Section 5 presents its results. Section 6 presents an analyze of the results and a discussion of the relations between them. At last, Section 7 presents the final remarks, limitations and future works.

2   Theoretical Background

The following section presents the theoretical background underlying this study, focusing on fundamental concepts related to the topic. It provides a structured overview of the key definitions of procrastination and gamification, establishing a foundation for understanding their interrelation. By examining the mechanisms through which game-inspired strategies influence behavior and their

potential as an intervention for delaying tendencies, this section aims to contextualize the research.

2.1   Procrastination

Procrastination is the consistent act of voluntarily postponing important tasks, despite knowing it may lead to negative future consequences [Kirchner-Krath *et al.*, 2024b]. It is a persistent behavior often integrated into an individual's lifestyle, that can leave the person overwhelmed by their inaction [Rodriguez *et al.*, 2019]. Due to a lack of self-regulation skills, procrastinators frequently engage in other activities to avoid the primary task, finding temporary relief from the discomfort associated with it [Lukas and Berking, 2018].

When managed carefully, procrastination can serve as a temporary stress-relief mechanism that improves mood, which can, in turn, positively impact productivity. Controlled procrastination allows individuals to maintain a healthy balance, managing their procrastination while minimizing negative effects. In contrast, those with poor time management skills who delay tasks until the last minute often experience heightened stress and lower work performance [Alblwi *et al.*, 2019a]. Therefore, procrastination can be classified as intentional or unintentional [Higashi *et al.*, 2024].

Unintentional procrastination is caused by a lack of emotional regulatory skills, ineffective time management, and poor motivation, and it is associated with several mental health issues, including heightened anxiety and stress, low self-esteem, and an increased likelihood of developing or exacerbating depression [Amit *et al.*, 2021; Kirchner-Krath *et al.*, 2024b; Lukas and Berking, 2018]. Recent studies have further linked procrastination to serious physical health conditions, such as cardiovascular disease, hypertension, sleep disturbances, and poorer overall well-being as reflected in increased susceptibility to physical illness [Gómez-Romero *et al.*, 2020].

A significant number of individuals experience negative impacts from uncontrolled procrastination, among them, university students are the most affected population, reporting the lack of time or procrastination as primary reasons for failing or dropping out of online courses [Madrid and de Jesus, 2021]. Inefficient time management, and consequently procrastination, can lead to poor academic performance, characterized by low-quality, rushed work, missed deadlines, and heightened stress while an effective time management has been shown to correlate strongly with better academic outcomes [Auvinen *et al.*, 2015].

2.2   Gamification

Gamification is the integration of game elements—such as mechanics, challenges, levels, rules, goals, and playfulness—into non-game contexts to foster motivation around real-world issues, such as encouraging positive behaviors or discouraging negative ones [Amit *et al.*, 2021]. By leveraging game characteristics, gamification exploits the inherent motivational power of games, aiming to make

tasks more engaging and enjoyable. This approach has gained significant popularity in the educational context, where points, leaderboards, and badges (achievements) are used to captivate students' attention, consequently enhancing the learning process [Rogers *et al*., 2021].

The fundamental distinction between gamification and games lies in the application of game elements for purposes beyond entertainment. While a game is typically designed as an end in itself, gamification serves as a means to an end, with objectives extending beyond pure enjoyment [Diefenbach and Müssig, 2019]. In this sense, the distinction between games and purposeful games (or serious games) becomes evident. However, what further distinguishes gamification from purposeful games is the underlying principle that gamification applies game elements to a non-playable context, whereas serious games are games by their own, designed with specific purposes in mind [Costa *et al*., 2023].

It is important to emphasize that a game, in isolation, does not constitute a gamification strategy. Instead, it is the strategic use of games or game-like elements in a specific context, aimed at achieving a defined goal, that indeed qualify as gamification [Oliveira and Petersen, 2014]. This distinction highlights the intentional and purposeful nature of gamification as a concept [Larson, 2019].

3   Related Works

To the best of our knowledge, we have not identified any systematic review specifically addressing the use of gamification to reduce procrastination. However, related fields provide insights into the connection between gamification and education, particularly in student motivation, as well as general analyses of various intervention strategies aimed at reducing procrastination, as can be seen in Figure 2.

As sources of inspiration and reference, we consulted the following systematic reviews, which have been categorized as related works (RW01 to RW05): RW01 - "Psychological Interventions of Virtual Gamification within Academic Intrinsic Motivation: A Systematic Review" [Xu *et al*., 2021], RW02 - "A Meta-Analysis on the Impact of Gamification on Students' Motivation" [Mamekova *et al*., 2021], RW03 - "The Rise of Motivational Information Systems: A Review of Gamification Research" [Koivisto and Hamari, 2019], RW04 "Combating Procrastination with Information Systems: A Systematic Review on Design Approaches and Effects" [Kirchner-Krath *et al*., 2024a] and RW05 - "Overcoming Procrastination? A Meta-Analysis of Intervention Studies" [van Eerde and Klingsieck, 2018]. The latter two focus on procrastination and strategies to mitigate it, while the first three explore the impact of gamification on motivation.

The first review, Psychological Interventions of Virtual Gamification within Academic Intrinsic Motivation: A Systematic Review [Xu *et al*., 2021], examines psychological interventions that use gamification to enhance students' intrinsic motivation in academic settings. This review indicates that gamification can be a valuable

Figure 2. Relation between the related works and the themes.
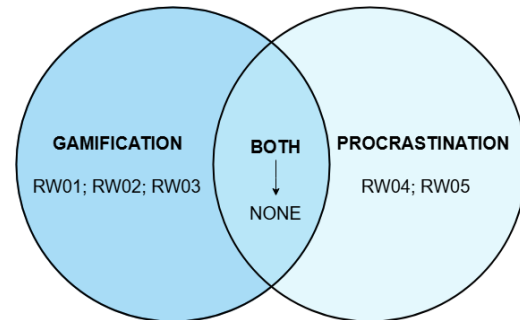
tool for engaging students and enhancing their intrinsic motivation. However, its effectiveness appears to depend on factors such as the game design, the context in which it is applied, and the individual characteristics of students. The study underscores the importance of tailoring gamified interventions to maximize their benefits.

The second review, A Meta-Analysis on the Impact of Gamification on Students' Motivation [Mamekova *et al*., 2021], synthesizes findings from various studies on gamification's effect on student motivation. This meta-analysis shows that gamification generally has a positive impact, particularly when it includes immediate feedback and tangible rewards, which bolster both intrinsic and extrinsic motivation. Nevertheless, the review also points out limitations and suggests further research on the long-term effects of gamification, particularly concerning the sustained impact of game elements on motivation, as many researches only focus on the short-term effects.

In the third review, The Rise of Motivational Information Systems: A Review of Gamification Research [Koivisto and Hamari, 2019], the authors explore motivational information systems that incorporate gamification across multiple fields, including education and personal productivity. This review identifies common gamification mechanics and the motivational theories underlying these systems. It concludes that gamification can improve user engagement and task efficiency but raises concerns about extrinsic rewards potentially undermining intrinsic motivation over time, suggesting a potential "saturation effect" where gamification's impact wanes with prolonged exposure.

The fourth related work, Combating Procrastination with Information Systems: A Systematic Review on Design Approaches and Effects [Kirchner-Krath *et al*., 2024a], provides a valuable analysis of IS-based strategies for addressing procrastination. It categorizes these strategies into three main approaches: Behavioral IS design, Cognitive IS design, and Social IS design, with an additional category for Other IS design approaches. This study reinforces the idea that procrastination is a well-established subject in psychological research—studied extensively since the early 1990s—while the application of IS to mitigate procrastination has gained momentum only in the past decade, and how information systems offer the potential for greater accessibility and scalability compared to traditional interventions.

Finally, Overcoming Procrastination? A Meta-Analysis of Intervention Studies [van Eerde and Klingsieck, 2018]

focuses on procrastination and evaluates various intervention strategies aimed at mitigating it. This meta-analysis finds that cognitive-behavioral and time management interventions are particularly effective. Techniques such as Cognitive Behavioral Therapy (CBT) and setting specific, measurable goals are highlighted as successful in reducing procrastination. Additionally, this review emphasizes that interventions tailored to individual characteristics tend to be more effective, providing insights into designing personalized gamified strategies to combat procrastination by reinforcing key psychological mechanisms.

What distinguishes this work from those related studies is the unique connection it establishes between the fields of procrastination and gamification. This research endeavors to understand how specific gamification elements can address particular characteristics of procrastination in users. It explores the effects of procrastination on individuals' lives, identifying the underlying causes, predisposition factors, and the potential positive and negative impacts of gamified interventions. By doing so, it sheds light on how gamification can contribute to better time management, task organization, and increased motivation to complete tasks. This integrative approach not only bridges two distinct domains but also provides a comprehensive diagram for understanding how it is important to design personalized, effective solutions to help mitigate procrastination.

4 Methodology

The main research objective of this study is to explore how gamification strategies can help reduce procrastination and identify what is needed to support procrastinators in regaining control over their routines and tasks, thereby improving quality of life. To achieve this, a systematic review was conducted, considering the material produced up to the present moment, to offer insights and contributions to the development of interactive systems with a people-centered focus.

4.1 Study Planning

We followed the SEGRESS (Software Engineering Guidelines for Reporting Secondary Studies) [Kitchenham *et al.*, 2023] guidelines to structure the protocol of our Systematic Literature Review (SLR). Based on the method proposed by Kitchenham and Charters, these guidelines enable a more comprehensive review of primary studies within a research topic. The process follows three main stages, as illustrated in Figure 3: planning[1], execution, and reporting or publication of results.

Figure 3. Stages of the Systematic Literature Review.

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[1]SLR Protocol: `https://doi.org/10.17605/OSF.IO/RV2EM`
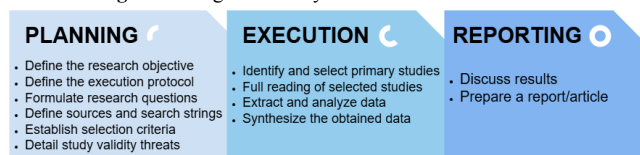
To satisfy the research objective, the main question generated was:

How can gamification influence efforts to reduce procrastination?

From this main point, were developed the following secondary research questions:

Q1: Which factors contribute to increased procrastination within the context outlined in the study?

Q2: What are the impacts of procrastination on an individual's life?

Q3: What are the main gamification strategies implemented to address procrastination?

Q4: How effective are the proposed gamified interventions in reducing procrastination?

To ensure that the search provided accurate responses, inclusion (IC) and exclusion criteria (EC) were established, as shown in Table 1, to filter and select studies from the results. All non-duplicated studies went through a pre-selection stage, which aimed to eliminate research that did not mention the search string in the title, abstract, or keywords. The selected studies then proceeded to the selection stage by abstract reading, and finally, those that passed moved to the acceptance stage, which included a full reading of the articles. Studies that met at least one exclusion criterion were disqualified from the selection.

Table 1. Inclusion and Exclusion criteria for the selection of studies

Criteria	Description
IC - 1	Studies that answer at least one research question.
EC - 1	Duplicated studies.
EC - 2	Studies that are prefaces, books, book chapters, abstracts, posters, panels, lectures, keynotes, tutorials, editorials, or demonstrations.
EC - 3	Studies with fewer than 5 pages.
EC - 4	Studies with unavailable full text access.
EC - 5	Studies not written in English, Spanish or Portuguese.
EC - 6	Studies where the search string is not mentioned in the title, abstract, or keywords.
EC - 7	Studies that are not primary (systematic reviews or mappings).
EC - 8	Studies that do not address at least one of the research questions.

The chosen search databases for the scientific studies were the virtual libraries: ACM Digital Library[2], IEEE Digital Library[3], EI Compendex[4], Science@Direct[5], Scopus[6] and SBC Open Library[7].

The PICOC strategy, which considers the elements of Population, Intervention, Comparison, Outcome, and Context, was used as a brainstorm tool to organize the ideas for the research as shown in Table 2. However, since it is a review of the existing literature, the comparison term was not used, because we wanted to explore what kind of studies about the theme existed.

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[2]`https://dl.acm.org/`
[3]`https://ieeexplore.ieee.org/Xplore/home.jsp`
[4]`https://www.elsevier.com/products/engineering-village/databases/compendex`
[5]`https://www.sciencedirect.com/`
[6]`https://www.elsevier.com/products/scopus`
[7]`https://sol.sbc.org.br/index.php/indice`

Table 2. Definition of search criteria through the PICOC strategy.

PICOC term	Word
Population	Procrastination
Intervention	Gamification
Comparison	-
Outcome	Overcome
Context	Task Management

For the construction of the search string, it was decided not to include the Outcome and Context terms. This decision was based on the nature of an SLR, which prioritizes understanding the research area rather than focusing on specific outcomes. Additionally, it was relevant for this study to identify the most researched contexts of gamification, and including these terms would have overly restricted the search. Preference was given to focusing solely on the population (the central problem of the research) and the intervention (the proposed solution). To enhance the search string, synonyms of the main terms were also incorporated, resulting in the following:

("procrastination" OR "postpone" OR "postponing" OR "postponement")
AND
("gamification" OR "gamificate*" OR "gamified")

Finally, to support the execution of the SLR protocol, we used the *Parsif.al* system for organizing references. We then used *Google Sheets* to support the selection process and data summarization and *Atlas.ti* to analyze and correlate information.

4.2   Study Execution

Following the study's planning, searches were conducted in the previously mentioned digital libraries in September 2024, returning a total of 781 studies (Table 4). After identifying and removing 40 duplicate studies, the remaining 741 studies proceeded to the pre-selection stage, which excluded 685 articles. From the 57 remaining studies, 30 were selected based on abstract reviews, and finally, after a full-text review, 24 articles were accepted. It indicates a precision rate of 3.2% for our search string.

Table 4 summarizes the results at each step for each digital library, showing the duplicates (Dupl.) and remaining studies (Rest) in Step 1, removed (Rem.) and included (Incl.) studies in Steps 2 and 3, and finally, rejected (Rej.) and accepted studies in Step 4.

The first author read all full articles during step 4, classifying them as to be "accepted" or "rejected". After the full reading of the included studies, if there was any remaining doubts regarding the acceptance of an article, the second author would be called to ascertain that divergence. This casting vote was not necessary as there was no divergence or doubts in the selection.

5   Results

Table 3 presents the list of the 24 primary studies accepted for the literature review, where the ID column shows the identification of the articles in this SLR, followed by the columns Year of publication and Study title.

5.1   Preliminary Analysis of the Studies

A preliminary analysis of the accepted studies reveals that they were all published between 2015 and 2024 (Figure 4), with a notable peak around 2019, which may be attributed to the significant growth around gamification during this period (S09). This peak in 2019 suggests a heightened interest in gamified solutions during that period and may be related to the consolidation of gamification as a common practice and also the expansion of digital technologies that facilitate the implementation of game elements in online platforms and mobile applications.

Following 2019, interest in the topic remained substantial, although the volume of publications stabilized or slightly decreased as the field matured and researchers began to investigate more specialized or innovative approaches within gamification (S16). These findings indicate a sustained interest in the exploration of gamified strategies to mitigate procrastination.

Figure 4. Distribution of accepted articles by publication year.
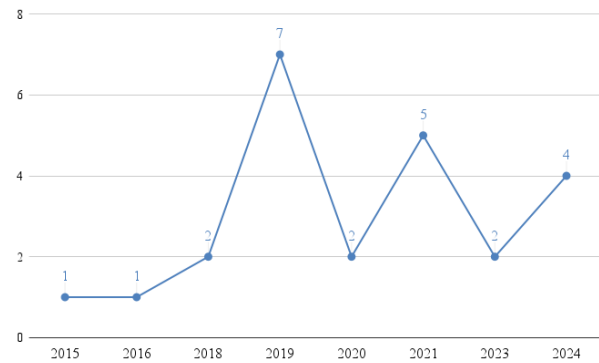
Observing the country of origin of the articles (Figure 5), it is evident that the majority of the studies originate from Germany, with 5 studies, representing 20.83% of the total. Ireland and Spain each contribute with 3 studies, accounting for 25% of the total. The United Kingdom, United States and New Zealand have 2 studies each (25%), while Jordan, Japan, Brazil, Finland, India, the Philippines, Belgium each have 1 study, collectively making up 29.16% of the total articles.

Figure 5. Map of distribution of articles by country of origin.
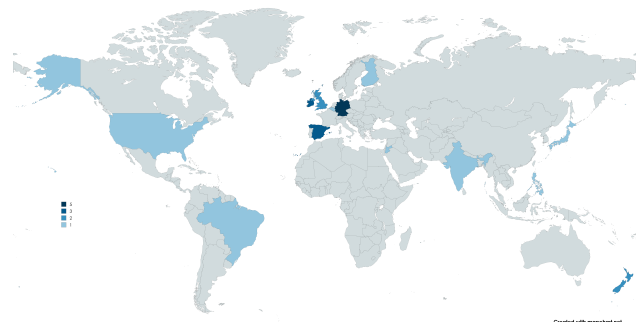
The contexts examined in the selected studies include Education, represented by 21 papers, Social Networking Sites (SNS), with 2 articles, and Work with a single study. This dominance of educational settings is expected, as education is a significant field for gamification research

Table 4. Studies by SLR steps.

Digital Library	Search	Step 1 Duplicated		Step 2 Pre-Selection		Step 3 Selection		Step 4 Acceptance	
		Dupl.	Rest	Rem.	Incl.	Rem.	Incl.	Rej.	Accepted
ACM Digital Library	176	4	172	162	10	5	5	0	5
EI Compendex	18	7	11	3	8	4	4	0	4
IEEE Digital Library	8	2	6	4	3	0	3	0	3
SBSI	1	0	1	0	1	0	1	0	1
Science@Direct	152	4	148	139	9	5	4	1	3
Scopus	426	23	413	377	26	13	13	5	8
Total	**781**	**40**	**741**	**685**	**57**	**27**	**30**	**6**	**24**

applications. As presented in Table 5, most studies center around university or academic contexts, though some also extend to digital education environments. This trend highlights the role of gamification in enhancing student engagement and motivation, particularly within structured academic environments, as well as its potential in online learning platforms where self-directed motivation is crucial.

Table 5. Context of studies

Education	University	S 01, S 03, S 04, S 05, S 06, S 09, S 10, S 11, S 12 S 13, S 16, S 17, S 18, S 19, S 20, S 21, S 22, S 23
	Digital education	S 02, S 08, S 24
Social Networking Sites		S 14, S 15
Work Environment		S 07

The purpose of this SLR is to analyze and understand how the selected studies address our research questions presented in Section 4. To achieve this, the studies were carefully examined for insights into the influence of gamification on procrastination, including details such as types of procrastination, its causes, the impacts on individual lives, specific game elements, and gamification strategies used to reduce procrastination and their effectiveness. The findings are described below.

5.2 Q1 - Which factors contribute to increased procrastination within the context outlined in the study?

Procrastination is a multifaceted issue influenced by various factors related to motivation and self-control (S04). Its primary causes are often attributed to a lack of emotional regulation skills, ineffective time management, and poor motivation (S06). External distractions, also known as 'time thieves,' such as notifications, frequently act as initial triggers for procrastination by easily diverting attention and increasing the likelihood of task postponement (S09). Additionally, procrastination is often motivated by a desire to avoid unpleasant tasks, providing temporary relief from the stress or discomfort associated with them, configuring the nature of the task an important factor in the prediction of procrastination behavior (S21). Furthermore, a mismatch between the perceived difficulty of a task and an individual's skill level can lead to fear of failure, which is reported as a primary driver of procrastination for over 70% of American university students, this fear of not being able to achieve the expected outcomes can be paralyzing for some students (S01, S04, S14). Since the factors are diverse, to address each one more specifically we divided the causes found in the selected studies in three categories: **General Causes, Task Triggers and Individual Susceptibility**.

5.2.1 General Causes

Procrastination arises from failures in the self-regulation of emotion, attention and motivation (S19). The procrastinator tend to avoid undesired feelings associated with the task, delaying it, despite expecting negative consequences from

Table 3. Accepted studies.

ID	Year	Title
S 01	2024	Effect of using gamification of "Kahoot!" as a learning method on stress symptoms, anxiety symptoms, self-efficacy, and academic achievement among university students [Alsswey and Malak, 2024]
S 02	2024	Engaging Minds - How Gamified Chatbots can Support and Motivate Learners in Digital Education [Benner *et al.*, 2024]
S 03	2024	Outplay Your Weaker Self: A Mixed-Methods Study on Gamification to Overcome Procrastination in Academia [Kirchner-Krath *et al.*, 2024b]
S 04	2024	Personalized Agent-Based Procrastination Suppression System [Higashi *et al.*, 2024]
S 05	2023	Utilização de Técnicas de Gamificação para Motivar a Realização de Atividades Complementares em Ambiente Universitário [Costa *et al.*, 2023]
S 06	2023	StudiCare procrastination - Randomized controlled non-inferiority trial of a persuasive design-optimized internet- and mobile-based intervention with digital coach targeting procrastination in college students [Mutter *et al.*, 2023]
S 07	2021	Framework For Preventing Procrastination And Increasing Productivity [Amit *et al.*, 2021]
S 08	2021	Towards the Design and Development of an Adaptive Gamified Task Management Web Application to Increase Student Engagement in Online Learning [Madrid and de Jesus, 2021]
S 09	2021	A gamified mobile-based APP to help university students to manage their tasks [Martín-García and Pérez Marín, 2021]
S 10	2021	Exploring Personalization of Gamification in an Introductory Programming Course [Rogers *et al.*, 2021]
S 11	2021	Struggling to Keep Tabs on Capstone Projects: A Chatbot to Tackle Student Procrastination [Pereira and Díaz, 2021]
S 12	2020	Academic procrastination and risk of suicidal behavior in university students: The role of emotional regulation; [Gómez-Romero *et al.*, 2020]
S 13	2020	A Proposal to Use Gamification Systematically to Nudge Students Toward Productive Behaviors [Edwards and Li, 2020]
S 14	2019	Procrastination on Social Networks: Types and Triggers [Alblwi *et al.*, 2019b]
S 15	2019	Procrastination on Social Networking Sites: Combating by Design [Alblwi *et al.*, 2019a]
S 16	2019	Counterproductive effects of gamification: An analysis on the example of the gamified task manager Habitica [Diefenbach and Müssig, 2019]
S 17	2019	Unravelling the ambivalent motivational power of gamification: A basic psychological needs perspective [van Roy and Zaman, 2019]
S 18	2019	Nudging the classroom: Designing a socio-technical artifact to reduce academic procrastination [Rodriguez *et al.*, 2019]
S 19	2019	Recommendations when Designing to Address Procrastination: A Psychological Perspective [Andreae *et al.*, 2019]
S 20	2019	The difference in intrinsic motivation when completing a prioritization task in a standard and gamified interface [Cassells and O'Broin, 2019]
S 21	2018	Reducing procrastination using a smartphone-based treatment program: A randomized controlled pilot study [Lukas and Berking, 2018]
S 22	2018	Gamification in education: Productivity and motivation through gamified time management software [Browne *et al.*, 2018]
S 23	2016	The effect of gamification on time-management in tertiary education [Cassells *et al.*, 2016]
S 24	2015	Increasing Students' Awareness of Their Behavior in Online Learning Environments with Visualizations and Achievement Badges [Auvinen *et al.*, 2015]

failing to complete it (S11, S21). This lack of emotional regulation skills results to low self control over their time and task management (S15).

Ineffective time management, a major concern for students (S23), frequently appears in studies as a source of stress and reduced work performance (S15). Poor time management skills are characterized by delaying tasks until the last minute (S04), misjudging how long tasks will take (S24), getting distracted by "time thieves" that steal away valuable time (S09) and spending unnecessary time polishing work (S11).

Time thieves are distractions that subtly divert focus, making it difficult to complete tasks on time, such as checking social network updates, responding to instant messages and emails in the middle of other task or just thinking of other topics instead of focusing about the immediate task (S09). Due to their approachable and engaging nature, it's easy to become distracted by social media, spend hours scrolling and procrastinate less motivating tasks.

Motivation, which describes the desires or needs that direct behavior toward a goal, drives individuals to act in ways that ensure their achievements. It is divided into two types: extrinsic and intrinsic motivation—respectively, external and internal reasons for completing an action. With extrinsic motivation, the outcome matters more than the action itself; individuals motivated extrinsically seek tangible rewards such as praise, money, gifts, or even points. Intrinsic motivation, on the other hand, is driven by the enjoyment of the activity itself, with internally motivated individuals seeking rewards like happiness, a sense of accomplishment, and personal satisfaction (S20).

Research indicates that prolonged work sessions may hinder motivation and productivity by limiting dopamine release, further diminishing the drive to complete tasks (S22). Low motivation, particularly the lack of intrinsic motivation, is strongly associated with procrastination. According to study S18, intrinsically motivated students tend to procrastinate less than those extrinsically motivated, suggesting that intrinsic motivation is more effective than the expectation of external rewards in combating procrastination (S18). It is important to note that motivation driven by guilt, rather than by enjoyment, does not foster positive emotional associations and, as a result, does not enhance intrinsic motivation (S19). Interestingly, the literature suggests that once individuals begin working on a task, the distractions and anxieties that previously fueled their procrastination become less prominent. They often find the task more enjoyable than anticipated and experience a sense of happiness as they progress. By the end of a work session, they are likely to feel a sense of accomplishment. This satisfaction can be further reinforced through positive feedback, fostering natural, intrinsic positive associations with task completion (S19).

5.2.2 Task Triggers

The nature of a task is a well-established catalyst for procrastination. Tasks that trigger procrastination are often those perceived as difficult, threatening, unenjoyable, stressful, or frustrating (S14). These tasks may be avoided due to factors such as fear of failure, perceived difficulty, task overload, or a lack of meaningful value attributed to the activity (S05). These factors diminish the task's ability to engage the brain's reward system, as they fail to stimulate a dopamine release. As a result, individuals are more likely to delay these tasks in favor of activities that offer immediate gratification and a more rewarding emotional response (S22).

In the study S19, the author, Helen Andreae categorizes these 'task triggers' into the three following types:

T1: Tasks that cause anxiety: People may feel uncertain about what the task involves, doubt their ability to complete it, or fear the consequences of failure. These factors generate anxiety, leading individuals to delay or avoid the task altogether.

T2: Tasks that are tedious: Although these tasks might not be particularly difficult, they require focus on activities that are not engaging or stimulating. Boredom is widely recognized as a key trigger of procrastination; many people report procrastinating to escape monotonous tasks and improve their mood.

T3: Tasks that are effortful for low perceived reward: Such tasks are often frustrating because they demand considerable effort yet yield minimal satisfaction or benefit in return. Without tasks that activate the brain's reward systems, such as dopamine release, individuals are more prone to procrastinate in favor of more gratifying alternatives. Once people begin the task, however, they often find it more manageable and enjoyable than anticipated, as distractions and initial fears fade.

Common academic tasks, including reading, exam preparation, and problem-solving exercises, frequently fall into these procrastination-prone categories (S05).

5.2.3 Individual Susceptibility

Studies highlight differences in self-efficacy and self-control as significant predictors of procrastination, both in terms of frequency and intensity (S03, S18). Self-efficacy refers to a person's belief in their capability to perform a task, while self-control pertains to their perceived ability to manage actions over time (S18, S23).

Procrastination is also linked to individual personality traits, such as impulsivity and perfectionism (S06, S11, S18) Cognitive, motivational, affective, and behavioral components play key roles in determining susceptibility to procrastination (S06, S21). Among behavioral factors, digital addiction stands out, as a problematic technology use that is strongly associated with procrastination (S14). Another group specially prone to procrastination are the perfectionists that risk to spend a lot of precious time rearranging and polishing their work as a subterfuge to focus on the other project's tasks (S11).

In terms of motivational factors, studies indicate that students with extrinsically motivation tend to procrastinate more than those who are intrinsic motivated (S18). Understanding how these characteristics influence

procrastination is essential for developing user-centric strategies tailored to individual needs, thereby providing personalized approaches to managing procrastination (S04).

5.3 Q2 - What are the impacts of procrastination on an individual's life?

When anticipating potential failure in tasks people perceive as challenging, many individuals tend to delay these tasks, which generates feelings of discomfort, such as inadequacy, guilt, and incompetence (S05). Procrastination is closely associated with significant mental health issues, including elevated stress levels and an increased risk of developing, maintaining, or exacerbating disorders such as anxiety and depression (S21). Generally, poor mental health in procrastinators leads to eroded self-esteem, a diminished perception of self-efficacy, high levels of self-sabotage, and, in some cases, neuroticism (S04, S21). One study even found a connection between procrastination and increased likelihood of suicidal tendencies due to a decreased mental health state (S12).

Beyond its mental health effects, procrastination is also linked to a range of physical health issues as can be seen in Figure 6, increasing the chances of serious conditions such as cardiovascular disease and hypertension (S03). Another negative impact on quality of life is the development of sleep disturbances (S12).

Figure 6. Procrastination effects in health.

In addition to health-related consequences, procrastination causes numerous problems in work and educational contexts, also presented in Figure 7. It is one of the main sources of work-related stress (S14), and extended periods of procrastination can lead to lack of motivation and job dissatisfaction, heightening stress and potentially even resulting in job loss (S07). In educational settings, particularly at universities where procrastination is most prevalent, it has significant effects on academic performance. Ineffective time management can lead to rushed work under time pressure, missed deadlines, low-quality outcomes, and consequently, lower grades and reduced retention rates, sometimes even delaying graduation (S23). Procrastination is frequently cited by

students as their primary reason for dropping out or failing online courses (S08).

Figure 7. Consequences of procrastination in the contexts.

The uncontrolled procrastination also leads to negative external evaluations compromising their social image to others, therefore driving higher levels of guilt due to breaking social norms. These effects impact not only procrastinators and their peers but also impose costs on society as a whole, as individuals make more mistakes, are less creative and effective, and tend to enjoy less the experiences in life (S19).

5.4 Q3 - What are the main gamification strategies implemented to address procrastination?

The goal of gamification is to increase motivation by exploiting the natural engaging power of video games (S07). For that there are various different gamification strategies to increase motivation, some of them targeting the user's intrinsic motivation, while many others focus in the extrinsic ones (S20). The main elements incorporated to interactive systems interventions are: Badges, Points, Leaderboard, commonly called as BPL in the literature, and Progress Bar, with at least 5 papers utilizing them as illustrated in Figure 8.

The following table 6 serves as a complement to the previous figure, offering a more in-depth analysis of the simultaneous use of game elements across the studies. While the figure provides a visual representation of the interconnection between the studies and the elements they reference, the table delves deeper into the specific relationships, highlighting which game elements are consistently employed together and by which studies. This dual perspective allows for a more comprehensive understanding of patterns, overlaps, and trends in the application of game elements, enabling a nuanced interpretation of their role within the research field.

Table 6. Game Elements presented in the studies

Game elements	S01	S02	S03	S04	S05	S06	S07	S08	S09	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20	S21	S22	S23	S24
Points	X				X		X	X		X			X		X		X					X		X
Badges	X	X			X		X	X		X							X					X		X
Leaderboard	X				X		X			X							X							
Progress Bar		X			X		X								X				X	X		X		
Challenges					X								X		X		X							
Avatar							X	X	X															
Narrative								X					X											
Friend Interaction								X																
Group Comp.																	X							
Mini games										X													X	
Leveling	X							X					X											
Phases																					X			
Visual Rep.																							X	X
Resource Mgmt.							X						X									X		
Chatbot		X									X									X				
Analyzed Only			X	X		X					X	X		X	X	X		X			X			

Figure 8. Prevalence of each gamification strategies
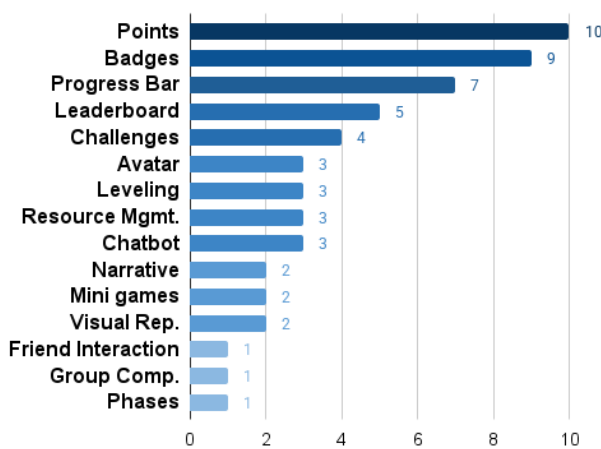
5.4.1 Extrinsic and Intrinsic motivators

The Octalysis Framework by Yu-Kai Chou [Chou, 2019] categorizes motivation into eight core drives, distinguishing between intrinsic and extrinsic factors that influence user engagement. Extrinsic motivators, which are driven by external rewards and task-oriented goals, include Epic Meaning & Calling (a sense of purpose), Development & Accomplishment (achievements such as points, badges, and leaderboards), Ownership & Possession (the accumulation of assets), and Scarcity & Impatience (the desire for limited-time rewards). In contrast, intrinsic motivators which emphasize emotional engagement, curiosity, and social connection, encompass Social Influence & Relatedness (team-based interactions and social validation), Unpredictability & Curiosity (narrative twists and mystery rewards), Loss & Avoidance (preventing negative outcomes), and Empowerment of Creativity & Feedback (opportunities for customization and exploration).

This framework provides a structured approach to understanding how gamification elements influence user behavior, offering a foundation for categorizing game mechanics based on their motivational impact. Accordingly, in our categorization of gamification elements into extrinsic (e.g., points, leaderboards, progress tracking) and intrinsic (e.g., narrative, creativity, social interactions), we applied the Octalysis Framework to establish a clear connection between gamification strategies and user motivation, particularly in the context of addressing procrastination.

5.4.2 Extrinsic gamification motivators

- **Points**: are generally a numerical representation of performance and achievement towards an established objective, providing the user with immediate feedback on their actions, promoting a sense of accomplishment and incentivizing consistent effort in order to complete tasks, reach goals or maintain a streak (S01, S05, S07, S08, S10, S17, S22, S24).
- **Badges**: are visual markers of achievement, often displayed as symbols or icons, that users earn for successfully completing a certain objective. They work as a tangible representation of progress aiming to foster a sense of pride and recognition over an activity, cultivating extrinsic motivation. Inside social networks, badges also promote interaction by showcasing achievements to peers, encouraging friendly competition or collaboration (S01, S02, S05, S07, S08, S10, S17, S22, S24).
- **Leaderboards** (Ranking): are ranked lists that display and compare the performance of users among themselves. Often based on the number of points or achievements collected, they serve as a motivational tool by creating a sense of competition while promoting engagement by setting clear goals and encouraging continuous effort to climb the ranks (S01, S05, S07, S10, S17).
- **Progress bar**: is a visual indicator that displays an user's advancement towards completing a task or reaching a goal. They work as a clear and intuitive representation of progress, providing real-time feedback and a sense of time control and achievement by encouraging users to continue their efforts to reach completion. A progress bar can be effective as a mean to increase intrinsic motivation, influencing users to raise their efforts as they see themselves nearing a goal (S02, S05, S07, S15, S19, S20, S22).
- **Group competition**: consists on setting teams of players against each other to achieve a shared goal or outperform opposing groups. This dynamic fosters collaboration within teams while tapping into the excitement of rivalry, motivating participants to contribute their best efforts. Group competitions serve to build a sense of community and shared purpose, promoting both social interaction and collective achievement (S17).

- **Minigames**: are smaller, self-contained activities within a larger game that offer players a break from the main objective. They serve as an engaging diversion, adding variety and enhancing the overall experience by providing opportunities to experiment with different mechanics. Minigames are designed to be quick, fun, accessible, and can also be used as a reward for the user's progress, promoting relaxation, creativity or strategic thinking depending on their content (S09, S23).
- **Leveling** (Evolution): refers to the process by which players increase their rank or status by accumulating points through completing tasks, challenges, or objectives. It serves as a structured progression system, providing users with a sense of growth and accomplishment as they unlock new contents or rewards with each level achieved. Leveling promotes sustained engagement by setting incremental goals, encouraging players to continue participating to advance further (S01, S08, S13).
- **Visual representation**: are the group of tools, such as points and progress bars, that convey progress, performance, or achievement in a clear and engaging way. They serve to make abstract concepts like goals or milestones more tangible, providing better feedback and understanding to users. By creating an intuitive and accessible experience, visual representations promote motivation, encourage effort and enhance user satisfaction (S23, S24).

5.4.3   Intrinsic gamification motivators

- **Challenges** (Quests, tasks or missions): are structured objectives that players undertake to achieve a specific goal. They serve as a way to guide users through meaningful activities, providing purpose and direction. By breaking larger goals into smaller, manageable steps, they help to sustain motivation and make tasks more engaging with defined rewards tied to its successful completion (S05, S13, S15, S17).
- **Avatar** (Customization): allow users to create and personalize a visual representation of themselves or their character within the game environment. This feature serves to enhance the sense of identity, agency and immersion by enabling the user to express their individuality and make their experience unique. It can be a source of extrinsic motivation by encouraging users to unlock new customization features as rewards for completing tasks, promoting interaction by a way of displaying your achievements (S07, S08, S09).
- **Narrative** (Storytelling): the use of a structured storyline or thematic context to engage players emotionally and immerse them in the experience. By creating compelling characters, settings, and plots, narratives give meaning to actions and objectives, fostering a deeper connection to the game and enhancing motivation to progress. Stories in games can also promote a sense of purpose and make tasks feel less monotonous by placing them within a larger, meaningful context (S08, S13).

- **Interaction** (Friend systems): are features that enable players to connect, collaborate or compete with others, creating a sense of community and engagement. These systems promote social interaction by allowing users to share achievements, exchange resources or team up to accomplish goals, which enhances the overall experience by adding a layer of human connection. They also encourage sustained participation through friendly competition or mutual support, creating a motivating environment where players feel valued and inspired to perform better (S08).
- **Reduction into phases** (Goal setting): is the process of breaking a task or challenge into smaller, manageable stages or levels, each with its own objective. This approach serves to reduce the sense of overwhelm by focusing the player's attention on immediate, achievable goals rather than the entirety of the task. It helps to maintain motivation and encourage sustained effort (S15).
- **Resource management** (Energy or time mgmt.): in games revolve around limiting the duration or frequency of actions a player can take, often through mechanics like energy systems or timed cooldowns. These mechanisms encourage players to prioritize tasks strategically, manage resources effectively, and return to the game regularly. They also promote balanced gameplay, preventing burnout from extended play sessions. When gamifying tasks, incorporating energy or time management can enhance productivity by aligning with psychological principles like the Pomodoro Technique, which involves short, focused work intervals followed by breaks. Research indicates that such structured sessions stimulate dopamine release, boosting motivation and productivity. Similarly, gamification mechanisms have been shown to sustain focus and drive during complex tasks, leveraging periodic rewards and clear limits to maintain engagement over time (S07, S13, S22).
- **Chatbots or NPCs** (Non-Player Characters): are interactive entities that simulate conversations or provide guidance to players, often serving as companions or mentors within the game environment. They are designed to enhance the user experience by offering context, instructions or storytelling elements increasing immersion and engagement. Chatbots and NPCs promote interactivity by creating a dynamic and personalized experience, adapting their responses to the player's actions or progress (S02, S11, S20).

The progress bar is predominantly used as an extrinsic motivator, offering a visual representation of progress and acting as a motivational reinforcement by highlighting how much remains to achieve a goal. This appeals to the externally driven need to "complete" tasks, a behavior rooted in extrinsic motivation. However, our findings suggest that it can also influence intrinsic motivation under certain circumstances. Studies have shown that visibly tracking progress or focused hours can foster a stronger sense of perceived control over time, contributing to a greater sense of autonomy and accomplishment, which are

key components of intrinsic motivation (S19, S20, S23). When aligned with a user's internal goals, the progress bar can make progress tangible, providing a sense of mastery and fulfillment.

This duality allows the progress bar to be classified as a hybrid element, bridging both extrinsic and intrinsic motivational aspects depending on the context in which it is applied. By visually connecting effort to outcome, it not only encourages task completion but also supports feelings of control and satisfaction, blending external reinforcement with internal motivation.

5.5 Q4 - How effective are the proposed gamified interventions in reducing procrastination?

In our findings, gamification has controversial outcomes, it can produce positive and negative effects in short and long-term. The effects can even be counterproductive, those effects that conflict with the originally intended goal (S16). The effects in this section are divided in Positive, Negative and Overall analysis as ilustrated on the following Figure 9.

Figure 9. Distribution Of Positive And Negative Effects
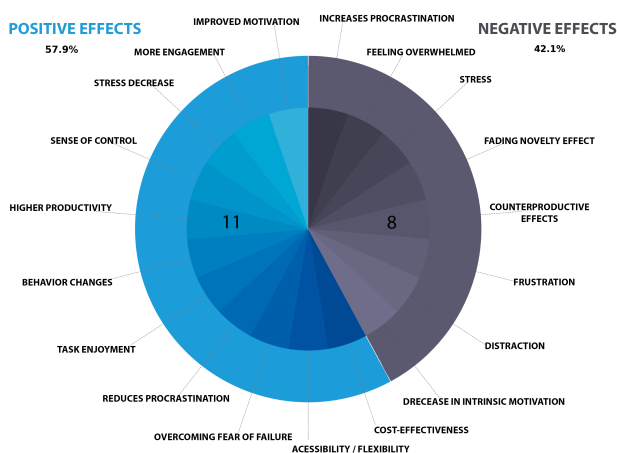
5.5.1 Positive Effects of Gamification

Gamification has shown potential in addressing various challenges, particularly in educational and motivational contexts. Studies highlight that the incorporation of game elements such as point systems, levels, and leaderboards could reduce the feeling of being overwhelmed or scared by the tasks by making them more fun and stimulating, thus enhance engagement, and improve academic performance by fostering a sense of control and accomplishment in students (S01, S07). Additionally, gamified applications can provide visual goal tracking and consistent rewards, which incentivize continuous engagement and planning tasks over time (S23). For instance, gamification has been employed effectively in courses to boost attendance, reduce procrastination, and enhance interaction with study materials (S10). By making tasks more intrinsically motivating, educators can address procrastination while encouraging autonomy among students (S20).

In IMIs, gamification offers unique advantages over traditional face-to-face treatments, including accessibility, flexibility, and cost-effectiveness (S11). Importantly, positive outcomes of gamified activities include enjoyment, pride, and a sense of achievement, which can foster more positive associations with work and learning processes (S19). When applied correctly, gamification can promote positive behavior, increase cognition in learning and strengthen connections between students and their education (S20).

5.5.2 Negative Effects of Gamification

Despite its benefits, gamification has its drawbacks, and poorly designed systems can undermine its potential. A heavy reliance on external rewards and points risks diminishing intrinsic motivation, as students may prioritize earning rewards over engaging with the actual task or learning process (S01, S15). When rewards are removed, the motivation to continue a task may decrease, leading to disengagement and procrastination (S19). Overloading users with excessive gamified elements can also lead to frustration, distraction, or feelings of being overwhelmed (S02, S03). Furthermore, competitive elements such as leaderboards can have adverse effects, including reduced motivation and impaired learning performance for some individuals that do not like to deal with peer pressure (S02). The general enthusiasm about gamification constitutes risks as well, given that an undifferentiated, naive use of gamification elements may result in the opposite to the intended behavior (S16).

Research indicates that gamification systems often fail to improve self-control in users, as they rely on external motivators rather than fostering autonomy (S04). In some cases, students in gamified environments reported lower motivation and satisfaction over time compared to non-gamified settings (S13). These issues are frequently attributed to poor design, with estimates suggesting that up to 80% of gamified systems fail due to inadequate planning and execution (S17, S23). Critics also point out the risks of the novelty effect, where initial enthusiasm for gamified systems fades over time, potentially reversing the intended benefits (S17). To mitigate these issues, careful consideration of context-specific design is essential, ensuring that rewards and game elements align with user needs and do not appear condescending or counterproductive (S16, S19).

5.5.3 Overall analysis

Certain game features can have both positive and negative effects on students' motivation and engagement, emphasizing the need for caution and deliberate consideration when applying game mechanics in educational contexts (S08). Research examining the interaction with game design elements in learning environments reveals both desirable and undesirable outcomes. These findings aid in understanding the workings of gamification and might help in explaining the mixed results about the effectiveness of gamification

reported in previous literature (S17).

Traditional systems for addressing procrastination often overlook individual differences in self-control and tend to offer only temporary solutions, failing to provide sustainable strategies for long-term behavior change (S04). The existing body of research on gamification is notably diverse, encompassing a wide array of game design elements and implementation contexts. This diversity, while valuable, has resulted in varied and often contradictory findings. As mentioned before, it has been observed that while some game elements may support specific psychological needs, they may simultaneously undermine others. This dynamic might partially explain the inconsistent effects reported in prior studies. Moreover, problems often arise when proposed interventions oversimplify complex gamification design processes. Merely replicating successful gamification elements from other domains without recreating the experiential value that makes them rewarding can lead to shallow implementations with limited impact (S16). A more profound exploration of the underlying psychological processes at play when users interact with gamified platforms could help elucidate how gamification works before evaluating its overall effectiveness (S17). For instance, it is expected that personalization will enhance the efficacy of systems by improving personal relevance, motivation, engagement, and self-efficacy (S11).

Not all studies progressed into testing the proposed interventions, with some remaining at the prototype development stage. Among those that conducted testing, a significant limitation was the duration of the testing period. Most studies tended to focus on short-term effects, collecting data over a period of approximately three weeks to one month. Long-term assessments were relatively scarce, with the longest follow-up period extending to seven months. However, no studies conducted follow-ups over the following years to determine whether the observed trends persisted in the long run (S03, S05). While extrinsic rewards have proven effective in the short term, they can negatively impact motivation over extended periods, this poses a particular challenge in areas such as time management, where long-term commitment is essential, and external rewards may ultimately undermine sustained engagement (S20).

To evaluate the results, a variety of structured self-reporting questionnaires were employed, targeting different variables. Stress and anxiety levels were measured using the Perceived Stress Scale (PSS) and the Hamilton Anxiety Rating Scale (HAM-A) (S01). Self-efficacy and self-control were assessed through tools such as the General Self-Efficacy Scale (GSE) tailored to academic settings, the New General Self-Efficacy Scale (NGSE), the Brief Self-Control Scale (SCS), and the Effortful Control Scale for Adults (S01, S02, S03). Procrastination behaviors were evaluated using several instruments, including the Tuckman Procrastination Scale (TPS) for general procrastination tendencies, the Pure Procrastination Scale (PPS) for habitual procrastination, the General Procrastination Questionnaire to assess procrastination severity at different stages (pre-treatment, post-treatment, and one-month

follow-up), and the Academic Procrastination State Inventory for academic-specific procrastination (S02, S03, S21). Motivational aspects were captured using the Intrinsic Motivation Inventory (IMI), which includes subscales such as Value/Usefulness, Effort/Importance, and Interest/Enjoyment (S20). Student motivation was also reported qualitatively using modified student engagement surveys (SEM) (S22). Emotional regulation was assessed using a modified version of the Emotion Regulation Skills Questionnaire (S21). Additionally, participant feedback on gamification systems was collected through focus groups, semi-structured interviews, and IMI questionnaires to evaluate subjective experiences (S23). Demographic data, including age, gender, and grade point average (GPA), were also gathered in some studies (S01).

6   Discussion

After a careful analysis of the literature on gamification as a tool to reduce procrastination, a grounded theory approach was used to systematically extract and organize data from the reviewed studies. This approach allowed for an evidence-based representation of the relationships between the key concepts observed in the literature as illustrated in Figure 10. This process maps the relationships between the current understanding of the primary causes of procrastination, individual factors that reinforce or increase susceptibility to this behavior, and the main negative consequences of procrastination on mental and physical health, as well as in different contextual settings. The figure also highlights gamification strategies that can be employed as interventions, and their potential positive and negative influences.

Procrastination is primarily caused by poor motivation, lack of emotional regulatory skills and ineffective time management (S04, S09, S23). It is further aggravated by factors such as time thieves, fear of failure, and the nature of the task. This article identifies a profile predisposed to procrastination, referred to as individual susceptibility, which includes personality traits (e.g., impulsivity, perfectionism), low levels of self-control, self-regulation, self-efficacy, and motivation (S06). Furthermore, procrastination has been linked to significant mental and physical health issues, including anxiety, depression, heightened stress, hypertension, cardiovascular disease, sleep problems, and, in severe cases, suicidal tendencies. Other adverse outcomes of procrastination include diminished performance in educational and professional contexts (S03, S07, S12).

The most effective treatment for procrastination is Cognitive Behavioral Therapy (CBT) (S11). However, due to accessibility challenges, whether related to time, availability of professionals, or financial constraints, more flexible and complementary solutions have been explored. While these digital interventions do not replace professional psychological treatment, Internet- and mobile-based interventions have emerged as promising support tools, particularly through the application of Persuasive Systems Design to facilitate behavioral change (S06). Gamification

Figure 10. Procrastination Related Concepts Diagram
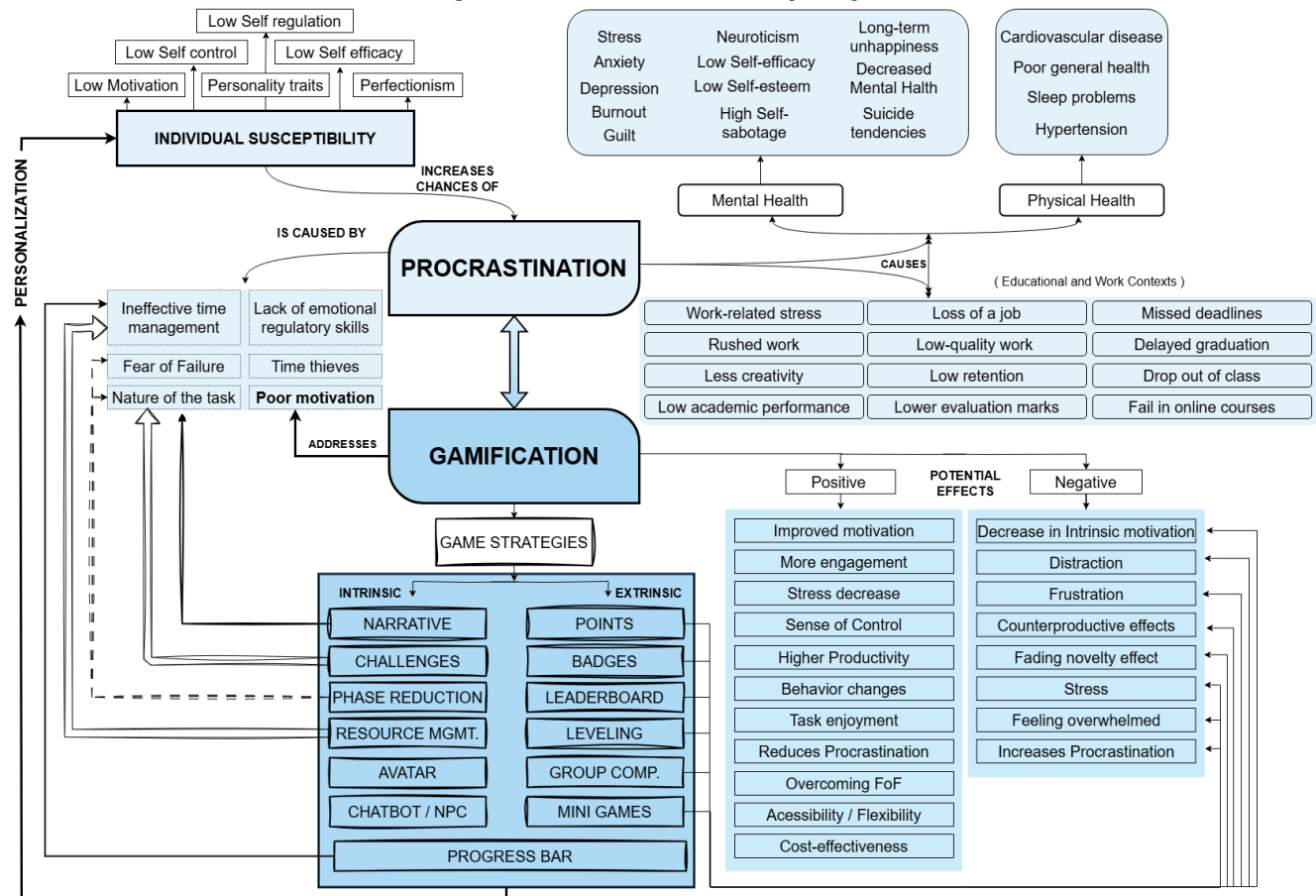
has been identified as a potential enhancement to these interactive systems, as it directly addresses the primary cause of procrastination: low motivation. Additionally, its mechanics and design elements can help mitigate secondary causes and aggravating factors, further reinforcing the effectiveness of digital interventions in supporting behavioral change.

Procrastinators require support to regain control over their lives and overcome inaction. Since this issue is strongly associated with low intrinsic motivation, gamification is expected to be a valuable tool. However, the field of gamification research is extensive and controversial, with contradictory findings. Critics argue that the observed benefits are merely temporary, driven by the novelty effect (S17). On the other hand, proponents highlight that potential counterproductive outcomes often result from poor gamification design, which relies primarily on elements that fail to activate users' intrinsic motivation.

As mentioned in question 1, individuals who are intrinsically motivated tend to procrastinate less than those driven primarily by extrinsic motivation (S18). It would therefore be expected that gamification strategies targeting this issue would focus on fostering intrinsic motivation. However, as observed in the response to question 3, the majority of interventions analyzed in the studies predominantly employed extrinsic motivational elements, such as points, badges, and leaderboards. A possible explanation for this trend is the relative ease of implementing extrinsic motivators within a system

compared to intrinsic motivators, such as narrative, which demand greater development time and resources. Consequently, one plausible reason for the underwhelming results reported in some studies could be the lack of strategic utilization of gamification's full potential. Instead of adopting a generalized approach, gamification elements should be designed to address specific causes of procrastination, informed by the positive and negative effects reported in the literature (S16).

The progress bar, for instance, has proven effective in addressing difficulties in time management and time thieves. By offering a visual representation of progress, it creates a stronger sense of control over time and fosters a feeling of autonomy and accomplishment, particularly when it tracks focused hours (S19, S20). This tangible representation of progress enhances the sense of mastery and fulfillment, thereby supporting task engagement.

To address each type of the "task triggers" identified in question 1, study S19 proposes tailored design interventions for different stages of task engagement. For example, interventions aimed at initiating tasks differ from those designed to sustain progress. Effortful tasks with limited immediate rewards often evoke frustration. In such cases, extrinsic rewards—such as achievement badges, point systems, or progress bars—can motivate individuals to begin and persist in task engagement. Similarly, tedious tasks can be made more stimulating and enjoyable through the use of storytelling, missions, challenges, visual representations, or mini-games, elements commonly found

in gamified environments.

Anxiety-inducing tasks present unique challenges due to their multifaceted nature. One effective approach to mitigate anxiety is the division of tasks into smaller, more manageable sub-tasks (i.e., phased reduction). This method reduces the perceived fear of failure, making tasks appear less overwhelming (S19). Gamification techniques that reward progress toward these smaller milestones further alleviate anxiety and encourage sustained engagement. Additionally, the integration of chatbots can provide real-time support, assisting individuals in managing anxiety during task completion (S20).

In addition to gamification interventions, other complementary approaches can directly address anxiety and be incorporated alongside gamified systems. For example, designs that include physiological interventions, such as guided breathing exercises to activate the parasympathetic nervous system, can promote relaxation and reduce anxiety. Similarly, encouraging physical exercise—a well-documented method for stress reduction—may indirectly support individuals in overcoming procrastination (S19).

Personalization has been reported to increase the chances of successful implementation of systems by enhancing personal relevance, motivation, engagement, and self-efficacy, thereby underscoring the importance of personalized, user-centric strategies in managing procrastination (S11). Customizing gamified experiences to resonate with cultural nuances and audience preferences is crucial, as cultural norms and values significantly influence how gamification is perceived, adopted, and ultimately its effectiveness and acceptance (S01). However, previous research has highlighted that the benefits of gamification may not be universal; individual differences can lead to variable outcomes. While some students experience increased motivation, others may see their motivation diminish, emphasizing the need for personalized approaches to maximize positive outcomes (S10, S24).

One prominent framework for personalization is the Hexad User Types survey, which categorizes users into six archetypes with distinct gamification preferences. The intent is to match game elements to user types, creating gamified experiences better suited to individual learners. For instance, research has explored whether the Hexad survey could guide personalization in an introductory programming course by predicting students' preferences for gamification elements on their learning platform. However, the findings suggest that this approach does not effectively enable automatic personalization in this specific context, indicating the limitations of such models (S10).

Another perspective focuses on the interaction between game design elements and psychological processes, as derived from Self-Determination Theory Deci and Ryan [1985]. This theoretical framework emphasizes the importance of satisfying three basic psychological needs (autonomy, competence, and relatedness) to foster intrinsic motivation. Research has shown that gamified systems in educational environments can have ambivalent effects: while some game elements enhance these feelings, others may undermine them. Situational factors, such as task

design and user context, play a significant role in this dynamic. These findings contribute to explaining the mixed results regarding gamification's effectiveness and highlight the importance of aligning game elements with users' psychological needs (S17). Improving individuals' self-determination can help address time-management issues and procrastination by making tasks more intrinsically motivating. For instance, the system can leverage game elements to enhance autonomy, provide meaningful feedback to foster competence, and facilitate peer interaction to improve relatedness. These strategies, rooted in SDT, may support users in developing better time-management habits and overcoming procrastination (S20).

Through this research, it was possible to establish cause-and-effect issues. Procrastination is a challenging issue to address due to the interconnected nature of its variables. What often causes procrastination can also be its consequence; for instance, procrastination leads to anxiety, yet anxiety, in turn, exacerbates procrastination, creating a self-reinforcing cycle. Consequently, effective treatment for procrastination should ideally address the individual's mental health as a whole (S19). Focusing on teaching strategies to develop emotional regulatory skills and self-control appears to be the most effective intervention, both in the short and long term—a process that could be significantly enhanced by gamification.

Unfortunately, there is a scarcity of studies proposing and testing approaches to tackle procrastination beyond the use of extrinsic game elements, which are also the most associated with counterproductive and negative effects reported in the literature. These include a decrease in intrinsic motivation, distraction, frustration, feelings of overwhelm, stress, and, in some cases, an increase in procrastination. However, the reviewed literature consistently highlights th potential positive outcomes of combining both intrinsic and extrinsic gamification elements. By overcoming this challenge, it is believed that the positive effects of gamified interventions can be fully exploited: improving motivation and engagement, reducing stress, increasing the sense of control and autonomy, fostering behavioral changes and task enjoyment, and ultimately achieving an overall reduction in procrastination.

6.1 Research Limitations

We carefully followed the SEGRESS protocol to ensure that this research was conducted rigorously. However, certain threats to the validity of this study must be acknowledged.

Firstly, the primary concern is the potential bias introduced by the fact that the selection process was conducted by a single researcher. While this could lead to subjective decisions, this threat was mitigated by adhering to a strict methodology for the literature review and data analysis. Secondly, search process was restricted to specific databases, which may have excluded relevant studies published in less accessible or non-indexed sources.

Additionally, the lack of snowballing techniques and manual exploration of references may have limited the identification of further relevant studies. Finally, the

interpretation of results is inherently subjective and dependent on the researchers' expertise, which, despite efforts to maintain objectivity through review, may still affect the findings.

7 Final Considerations and Future Work

Our findings highlight that gamification, while not a universal solution, can play a significant role in helping individuals manage their goals and responsibilities more effectively. One of the central discoveries of this study is the importance of combining intrinsic and extrinsic motivational elements to foster long-term behavioral change. Strategies that align with psychological needs—such as autonomy, competence, and relatedness—have demonstrated significant promise. However, over-reliance on extrinsic motivators, such as rewards, may inadvertently reduce intrinsic motivation, leading to disengagement over time. This highlights the need for a balanced approach in gamification design.

The identified game elements in the reviewed studies include: Points, Badges, Leaderboards, Progress Bars, Challenges, Avatars, Narrative, Friend Interaction, Group Competition, Mini-games, Leveling, Phases, Visual Representation, Resource Management, and Chatbots. Among these, Points (10), Badges (9), Leaderboards (5), and Progress Bars (7) were the most frequently used, reinforcing their dominance in gamified systems. Conversely, elements such as Friend Interaction (1), Group Competition (1), Phases (1), and Narrative (2) were the least employed, indicating a gap in strategies that leverage social engagement, structured storytelling, and phased progression.

The analysis revealed a strong prevalence of extrinsic motivators, particularly Badges, Points, Leaderboards (BPL), and Progress Bars, which appeared in at least five studies. These elements function as external reinforcers, driving engagement through tangible rewards, competition, and visible progress tracking. Among intrinsic motivators, Challenges, Avatars, and Narrative were the most commonly incorporated elements, albeit with significantly lower frequency. This discrepancy suggests that many gamification strategies still prioritize extrinsic over intrinsic motivation, potentially limiting long-term effectiveness.

While extrinsic motivators like BPL can successfully boost short-term engagement, their effectiveness may diminish once rewards are removed. Intrinsic motivators, on the other hand, are linked to deeper, sustained engagement but were underutilized in the analyzed studies. The imbalance between these two categories highlights the need for more personalized, well-structured gamification approaches that integrate both extrinsic and intrinsic motivators to foster sustainable behavior change in combating procrastination. Future research should explore a more balanced implementation of these elements to enhance both immediate motivation and long-term behavioral change in combating procrastination.

Gamification presents both benefits and challenges in addressing procrastination. When effectively designed, it enhances engagement, motivation, and academic performance by making tasks more stimulating and rewarding. Additionally, it provides accessible, flexible, and cost-effective alternatives that complement traditional interventions. However, poorly implemented gamification can undermine intrinsic motivation, foster dependency on external rewards, and, in some cases, exacerbate procrastination. Competitive elements and excessive game features may also cause distraction, frustration or disengagement, highlighting the need for careful and context-sensitive design.

The mixed outcomes observed in previous research reflect the complexity of gamification's impact, influenced by variations in game design elements and implementation strategies. Personalization and alignment with users' psychological needs are crucial for long-term effectiveness. Additionally, limitations in study duration and follow-up periods make it difficult to assess the sustainability of gamified interventions over time. Future research should focus on refining gamification strategies by considering individual differences, long-term behavior change, and deeper psychological mechanisms. A more nuanced approach, integrating personalization and comprehensive evaluation metrics, may enhance the effectiveness of gamified interventions in addressing procrastination sustainably.

The benefits of gamification extend beyond individual task completion to broader applications in interactive systems. When properly implemented, gamification can create user-centered systems that not only address procrastination but also enhance productivity and satisfaction in diverse contexts, such as education, workplaces, and digital platforms. Systems like IMIs and PSDs are pivotal in this regard, as they leverage user data to provide tailored interventions that promote positive behavior changes Klock *et al.* [2020].

Nevertheless, this research identified limitations, including the lack of long-term studies and the inherent biases of a single-author selection process. Additionally, many studies failed to offer comprehensive insights into the sustainability of gamification's impact over extended periods. Addressing these gaps through future research is crucial for advancing the field.

Looking forward, we propose the development of user-centered gamified interventions through collaborative design. This approach emphasizes cooperation over competition, fostering inclusivity, teamwork, and community-building. By enabling users of varying skill levels to contribute meaningfully, collaborative gamification can enhance engagement and satisfaction through shared achievements.

Personalized gamification strategies, tailored to individual differences and contextual factors, play a crucial role in addressing the complexities of procrastination Rodrigues *et al.* [2020]. Despite some conflicting results in the literature, the application of gamification in this domain shows potential when designed thoughtfully and adapted to users' specific needs. For the domain of interactive systems, this study underscores the need for solutions that integrate

personalized and adaptive gamified strategies. Future research should prioritize longitudinal studies to evaluate the sustained effectiveness of gamified interventions, while also exploring the interplay between game elements, psychological processes, and system usability. By addressing these challenges, researchers and practitioners can create innovative, sustainable, and effective interactive systems to tackle procrastination and support productivity in both individual and organizational settings.

Beyond its immediate benefits, addressing procrastination has profound implications for both individuals and society. On a personal level, overcoming procrastination can lead to significant improvements in mental health by reducing stress, anxiety, and the emotional burden of guilt and inadequacy. This, in turn, enhances overall well-being, self-efficacy, and life satisfaction. From a societal perspective, reducing procrastination contributes to increased productivity in workplaces and academic settings, improving job performance, innovation, and the quality of professional and academic outputs. Organizations benefit from more efficient workflows and better decision-making, while educational institutions see higher student success rates and reduced dropout rates. Ultimately, tackling procrastination through effective interventions—such as gamification—can lead to a more productive, creative, and mentally healthier society.

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Authors' Contributions

Considering the CRediT taxonomy, we declare that all authors contributed to the conception of this study: MBP: conducted the conceptualization, data curation, formal analysis, investigation, and writing – original draft. TMC: conducted the methodology, formal analysis, supervision, and Writing – review & editing. And, SWMS: conducted the methodology, supervision, and Writing – review & editing.

Competing interests

he authors declare that they have no known competing financialinterests or personal relationships that could have appeared to influ-ence the work reported in this paper.

Availability of data and materials

The datasets generated and/or analysed during the current study are available in `https://doi.org/10.5281/zenodo.15198503`.

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