Persuasive Software Features for a Behavior Change Support for Alleviating Academic Procrastination: A Scoping Review

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Abstract

Academic procrastination, the act of putting off academic tasks needlessly, is high in prevalence. The affected individuals experience harm in multiple facets of their lives and may perhaps cause harm to other people as well. Self-regulation predicts academic procrastination, and its improvement has been a target of many interventions to date. Behavior Change Support Systems have the capacity to alleviate academic procrastination through improvement of self-regulation. This paper analyzes the persuasive software features in previous research applications regarding academic procrastination by using the Persuasive Systems Design model.

Keywords

Behavior Change Support Systems, Persuasive Systems Design, Academic Procrastination

1. Introduction

Academic procrastination is defined as the self-reported tendency to always or nearly always put off academic tasks with the associated experience of problematic levels of anxiety (Rothblum, Beswick, & Mann, 1984, as cited in [1]). It should not be confused with the strategic delay of tasks, which is an informed choice without associated anxiety. Procrastination is a behavior that is often frowned upon and the individuals affected by it are commonly crowned lazy by character. However, a closer inspection suggests a lack of control and volition. It appears that today's busy and competitive environment has little sympathy toward those who, for one reason or another, fall short in efficiency.

Academic procrastination is a prevalent issue affecting especially student populations. The problem may be detrimental to one's academic success as various observed consequences also touch other aspects of life, both professional and private. Despite all the evidence, students at large aren't prepared to face the problem and sometimes even disregard its impact on their lives. Still, there is willingness for change. No doubt, there may be external reasons that contribute to and predict academic procrastination in students, and there are steps that educational institutes can take to support the success of their students. Committed and accessible environments of learning see less academic procrastination in students.

Motivational factors, such as self-regulation, drive planned behavior. Self-regulation is using both internal and external cues to determine when to initiate, maintain and terminate goal-directed actions [2]. An over overwhelming amount of research has been conducted to trace procrastinatory tendencies in students to various forms of self-regulation failures, and a correlation between subscales of self-regulation and executive functioning has been measured in different research settings. When we look at procrastination as a lack of skill in rigorously setting and working toward one's own goals, it seems evident that in most cases one cannot simply "pull oneself together". In other words, this detrimental behavior may be salvageable through practice of skills and attitudes supportive of working toward one's goals even through the dreaded tasks.

Even though self-regulation is not the sole correlate to academic procrastination, it is worthwhile to explore interventions directed at self-regulation improvement. Surely enough, research has inspected

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different approaches. Group counselling and workshops, time management systems, reminders, and various other strategies have been directed at the problem with variable results. The standing challenge is finding the interventions that are both effective and not resource intensive. Digital interventions, in comparison to traditional counselling and therapy-based solutions, offer better scalability and accessibility.

There exists an emerging field of research on Behavior Change Support Systems (BCSS). BCSSs are persuasive information systems often applied to promote healthier lifestyles such as reducing obesity [3, 4]. These information systems have the potential to offer relief from various problematic behaviors and attitudes complementing traditional interventions.

When you apply the search term "procrastination" to the search field in an Appstore, you get many hits: applications for habit building, improving focus, minimizing screentime, and task management, to name a few. It is a research effort in itself to evaluate the quality and strategies applied in these commercial applications. Research on digital interventions for academic procrastination through the lens of Persuasive Systems Design (PSD) [5] remains largely unexplored.

Combined prevalence and consequences of academic procrastination, and the lack of scalable and efficient solutions to mend it speak for themselves. It seems clear that the problem is highly prevalent and negatively affects students in multiple facets of their lives. Lowered academic success of the students additionally places a burden on the educational institutes, making effective interventions important for both parties. It would be desirable to achieve a system which, through principles of persuasion, would help students self-regulate their studies. For this reason, a BCSS designed for alleviation of academic procrastination is an attractive target of research, and a scoping review of previous research is one of the feasible approaches to proceed in specifying the persuasive software features to be implemented in such systems.

2. Background

2.1. Academic Procrastination

Studies have shown that over 40% of students procrastinate studying for exams always or nearly always [1] and that more than half of students procrastinate frequently, often, or always on academic tasks in general [6]. In their sample of language learners, Mardini and Arslan [7] found the prevalence of procrastination to be as high as 63%. Shaked and Altarac [8] captured students' own attitudes and thoughts on academic procrastination and found that, while majority of students reported to be academic procrastinators, half of them submitted assigned papers on time.

Studies have shed light on the external reasons that contribute to problematic procrastination. The nature of the task at hand can cause procrastination [9, 1, 8]. Students have stated multiple reasons for task aversiveness: assumed unimportance, assumed burden [9], scope, complexity, insufficient instructions [8], and assumed difficulty [9, 1, 8]. When procrastinating, students engage in less aversive and more enjoyable activities and choose instantly gratifying tasks in place of long-term rewarding tasks [10]. Other predictors of academic procrastination include: time demands due to day-to-day tasks at home, family obligations, and jobs besides study [8], as well as excessive amounts of study assignments [11]. There is also some evidence that the state of the school culture contributes to the level of procrastination in its attending students [9]. Building a healthy school culture nurturing teachers' commitment to students, and accessible teaching and learning facilities and infrastructure can curb academic procrastination [9].

Multiple studies have shown that academic procrastination leads to low academic achievement [9, 12, 1]. More specifically, late submissions [8, 13], lower quality of assignments [13], delays in receiving one's degree [8], and diminishing productivity [14]. Despite the evidence, as much as 77% of students do not see the connection between academic procrastination and grades [8]. On top of low academic achievement, academic procrastination has been found to cause harm to individuals' subjective wellbeing [15], poor quality of life [12], lower wages, and obstacles to professional advancement [8]. Other reported consequences of academic procrastination related to one's mental state include increased

stress [12, 8, 14, 16], damage to self-image and feelings of frustration [8], guilt [10], self-blame, and social disapproval [14]. Majority of students (64%) wish to act differently to avoid academic procrastination [8].

2.2. The Role of Self-Regulation

A lot of research has tried to identify predictors and causes of academic procrastination. Many variables have been studied, and the negative correlation between academic procrastination and self-regulation is a recurring finding. According to the self-determination theory (cf. [17] self-regulation can be described as a continuum of autonomy for behaviors a person might carry out, ranging from amotivated behaviors to intrinsic motivation). Amotivated behaviors are least autonomous for they lack purpose, carry no expectation of reward or perceived opportunity for change. Intrinsic motivation as the most autonomous form of self-regulation refers to behaviors that are engaged in for their own sake because of the pleasure and satisfaction associated with them. In education, self-regulation includes ability to plan time, precision and focus when teaching and using social resources (cf. [18]).

There are many different measures of self-regulation, some of which relate to academic procrastination. Rabin et al. [12] found that all clinical subscales of executive functioning, referring to self-regulation and other related processes, are correlated with academic procrastination. Zarrin et al. [19] found a negative correlation between all subscales of educational self-regulation and academic procrastination. Senécal et al. [2] found that all other less-autonomous forms of self-regulation than intrinsic motivation predict procrastination due to lesser persistence, negative emotions, and inconsistency of attitudes and behaviors.

There has been an effort to determine the effects of the more specific competencies that the umbrella term of self-regulation encompasses on academic procrastination. Limone et al. [20] observed that low capability of planning studies and low regulation of cognitive learning strategies were strongly associated with academic procrastination, which means that the failure in knowing how to manage time, or the failure to regulate oneself to manage their time may both lead to procrastination. Rebetez et al. [21] view the self-regulatory failure from the standpoint of controlling one's own thoughts, and their findings suggest that the issue of procrastination should be targeted through interventions to decrease impulsivity and thought control problems specifically.

Some competencies are closely linked or supportive of self-regulatory behavior. Low achievement motivation for self-regulation (the desire or effort to achieve a goal or mastery of objects, things, people, or ideas, and to achieve a higher standard; cf. [6], and self-efficacy (an individual's belief that they are capable of achieving desired results; cf. [22] predict academic procrastination [6]). Shaked and Altarac [8] observed this in students' rate of late submissions when they did not begin working immediately upon receiving instructions due to time management problems combined with low self-efficacy. Tripathi et al. [23] determined that self-efficacy for self-regulation explains 34% of variance for academic procrastination, suggesting that self-efficacy and self-regulation alone do not determine the level of academic procrastination. Furthermore, hope as a combination of goal-directed behavior and planning to accomplish the set goals is deemed beneficial in decreasing procrastination [23] Zarrin et al. [19] found that it is important to educate students on self-regulated learning, but also reduce their fear of failure [2, 1, 19].

2.3. Persuasive Systems Design

Persuasive Systems Design (PSD) is a systems development process model developed by Oinas-Kukkonen and Harjumaa [5]. The PSD model describes the underlying design assumptions, a three-step development process, and categorized software principles for building information systems that are deliberately designed with the intent of altering attitudes and behaviors of its users [5].

Because information technology is "always on" and influencing people's attitudes and behaviors, even unintentionally, it is important to be aware of the various ways information systems persuade people [24]. For this reason, Oinas-Kukkonen [24] introduced the research field of behavior change

support systems (BCSS) which he defined as follows: “Behavior change support systems (BCSS) are information systems designed to form, alter, or reinforce attitudes or behaviors or both without using coercion or deception”. Research on BCSS is an emerging field with great potential to improve people’s lives notable examples being various Health Behavior Change Support Systems (HBCSS) designed to improve health outcomes.

With regard to HBCSS, Ekpezu et al. [25] investigated the compliance intention of prospective users of such systems. Their study demonstrated that users’ perceptions on all four cornerstone software feature categories of the PSD model (credibility, social support, primary task support, dialogue support) play a significant role to comply with the system. Karppinen et al. [26] inspected the PSD framework through the lens of habit formation in health intervention. According to their finding different stages of habit formation can be supported by a range of tools provided by the model. For example, implementations of self-monitoring and reminders combined with tunneling can be particularly helpful in habit formation.

Mutter et al. [27] used the PSD framework to optimize a digital intervention applying cognitive behavioral therapy at academic procrastination. They concluded that the design was effective in reducing academic procrastination and correlated symptoms, such as depression, regardless of whether the guidance was provided by a digital coach or a human. Another persuasive application aimed at tackling academic procrastination was described in the work of Jha et al. [28]. In their study, perceptions of students on the application design were collected after a short experiment. The evaluation results suggest that use of self-monitoring and personalization would be most effective strategies for the problem at hand.

3. Study Setting

In this scoping review, majority of the source literature was gathered via two separate sub-searches. Firstly, works discussing academic procrastination, self-regulation, and the relationship between the two were acquired from the EBSCO database filtering for full-text availability, peer-reviewed, and English language. The EBSCO database was used for its relevance in the field of psychology. The search terms used were “academic procrastination” and “self-regulation”. This yielded 33 papers at the time of search out of which irrelevant and duplicate works were excluded. Secondly, to gain an understanding of the state-of-the-art solutions to the problem of academic procrastination, another search in EBSCO and ACM databases was conducted. On EBSCO, filters for full-text availability and peer-reviews were used and on ACM the search terms were sought from abstract. The search terms used were “self-regulation”, “intervention”, and “procrastination” and this yielded 24 articles from EBSCO and 42 articles from ACM. The selection criteria here were works discussing interventions and strategies to alleviate procrastination, which were demonstrated in some form rather than being fully theoretical. ACM database was included to reach sources discussing especially information systems. Additional literature on BCSS implementations was gathered from Google Scholar using a variety of search terms due to the scarcity of works related to academic procrastination.

4. Findings

The prior interventions for procrastination were investigated through the lens of the PSD model [5]. Software features of these interventions were analyzed through the model and annotated based on the intended effect on the participant. Tables 1-4 collect the results of this feature mapping divided by feature categories according to the model.

4.1. Primary Task Support

Primary task support features of are presented in Table 1.

Regarding **Reduction**, Shaffer and Kazerouni [29] found that being able to set milestones curbed procrastination and improved project outcomes in junior level programming students. For another

instance, an intervention program consisting of multiple guided workshops was carried out by Itach et al. [30]. The workshops included elements of problem awareness, a supportive peer environment, goal orientation, self-regulation training, cognitive reframing, and perseverance training. They found a decrease in procrastination across sessions. **Tunneling** could be found with tutorials.

Tailoring was found in terms of users being able to customize the application with selection of the digital coach gender, intervention modules and optional modules, and visual background [27]. Recommended procrastination management strategy may also be tailored [28]. Strong, true **Personalization** (cf. [31]) was not found from the investigated studies.

Self-monitoring was the most common persuasive software feature found in the primary task support category with dashboards, progress bars and periodic reports. The significance of goal-orientation in alleviating academic procrastination is a topic of great interest, and in most cases Self-monitoring relates to goal-setting. Tripathi et al. [23] argue that improving one's self-regulation alone is not sufficient to ensure academic achievement and performance and emphasize the role of goal-directed thinking and determined planning. Also, Irwin and Edwards [32] sought to decrease late assignment submissions by implementing a mechanism for automatic time management control called "submission energy" designed to encourage early work in a larger number of work periods.

Simulation included reflective writing seeking to analyze one's own thoughts and behavior and via this identify cause-effects. Admittedly, reflective writing is related to Self-monitoring as well. Kann and Högfeldt [33] investigated students' ability to develop metacognition skills, motivation, and habits to handle procrastination.

Table 1
Primary Task Support Features

Feature	Example Implementation
Reduction	project milestones [29]
	stepped intervention program with themes [30]
	smart goals [30]
	schedule sheets [13]
	project milestones [29]
Tunneling	launch tutorial [28]
Tailoring	choices on digital coach gender, intervention modules, and optional modules [27]
	opportunity to choose visual background of program [27]
	recommended procrastination management strategy [28]
Personalization	N/A
Self-monitoring	dashboard with metrics [28]
	module progress bars and daily diaries [27]
	weekly performance reports [34]
	timesheets [30]
	submission energy [32]
Simulation	procrastination cause-identification [28]
	reflective writing assignments [13, 33]
	rocking chair & miracle question exercises [30]
Rehearsal	cognitive reframing [30]

Rehearsal included a technical term of "cognitive reframing", which refers to an activity where a person views a phenomenon from a new angle attempting to change their attitude towards it. For example, one could replace "I bought sweets during my diet because I can't control myself." with "I bought sweets during my diet because I walked along the sweets aisle in the grocery store and the display invokes temptation that is hard for me to resist". The former statement is a defeating attitude which makes the individual feel like they are unable to stop buying sweets. The latter focuses on factors which can be controlled: walking through the sweets' aisle. This cognitive reframing is an example of Rehearsal, guiding towards concrete behaviors that promote reaching one's own goal.

4.2. Computer-Human Dialogue Support

It was apparent that **Reminders** were the most commonly implemented feature of this category. Ye et al. [35] observed how Reminders increased homework completion rate and midterm scores regardless of the message formatting. Edwards et al. [36] found that automatically generated periodic messages providing feedback on how the student is doing compared to classroom expectations reduced late submissions by 23% and increased early completions by 31%.

In implementations for **Suggestion**, if-then clauses may play the role of action plans to support behavior change. For instance, a dieting individual might state: "If I begin to crave sugar then I will have a healthier snack of fresh fruits.". When if-then clauses are computed by the system, they are Suggestions. If formulating if-then clauses is performed by the persuadee, they are Virtual Rehearsals under the primary task support category.

With regards to **Praise**, an automatic feedback system was utilized to encourage students to submit programming assignments early; this was found highly motivating by half of the participants [37]. Also, positive reinforcement via digital coach and confetti illustrations was found [27].

With regard to **Rewards**, Pychyl et al. [10] suggest that when individuals are subjected to repeated trials, i.e., resisting the temptation of instant gratification, it will teach them to prefer larger delayed 'rewards'. Inie and Lungu [38] piloted a browser extension designed to increase time on productive sites by making the user exchange time on microlearning tasks to afford for time on sites marked as 'time wasters', thus gaining Virtual Rewards.

The utilization of **Similarity**, **Liking** and **Social role** were found to be rare. For an overall view regarding dialogue support features see Table 2.

Table 2
Dialogue Support Features

Feature	Example Implementation
Praise	automatic feedback system to encourage students to submit programming assignments early [37]
	positive reinforcement via digital coach and confetti illustrations [27]
Rewards	earn pieces of a motivational image for task completion [27]
	earn entry to "timewaster" websites through microlearning tasks [38]
Reminders	homework reminders via email [35]
	email reminders on module completion [27]
	buddy-based diary completion reminders [27]
Suggestion	situational email alerts [13]
	if-then clauses [39]
Similarity	case stories [27]
Liking	presentation of content visually attractive to target group [27]
Social Role	digital coach responds to user's actions [27]

4.3. Credibility Support

System credibility features were the most under-identified feature category. See Table 3. However, **Expertise** was well utilized. For instance, expert statements were cited in each of the application's modules studied by Mutter et al. [27]. Furthermore, descriptions of empirically supported intervention content and data security measures were disclosed as well [27]. **Authority** was present in interventions, e.g. user groups being led by easily recognizable psychologists [30] or class mentors [33]. The investigated interventions delivered some level of **Real-world feel**, for instance, via introducing the application's development team [27]. Quite surprisingly, signaling **Trustworthiness** received much less emphasis in this problem domain, and similarly, there were no clear instances and examples about **Verifiability**, **Surface credibility**, and **Third-party endorsements**.

Table 3
Credibility Support Features

Feature	Implementation
Trustworthiness	N/A
Expertise	expert statements in each module [27]
	description of empirically supported intervention content and information on data security [27]
Authority	groups are led by a psychologist [30]
	groups are led by the class mentor [33]
Real-World Feel	introduction of the application's development team [27]
Verifiability	N/A
Surface Credibility	N/A
Third-Party Endorsements	N/A

4.4. Social Support

As shown in Table 4, with regards to **Social Learning**, sharing goals [30] and reflections within a peer group [33], and sharing updates on progress within the community [28] provide examples. The abovementioned examples apply to **Social Facilitation** as well. Social Facilitation was utilized also with providing information about diary completion of a 'buddy' [27], and requesting weekly presentations within a peer group [34]. Notably, no clear examples of **Normative Influence** and **Social Comparison** were found in the interventions.

Competition was utilized via leaderboards. An interesting implementation of **Cooperation** was collaborative question generation described by YeckehZaare et al. [34]. In their study, an environment of collaborative learning with question generation, mapping, and group evaluation, as well as optional student presentations, was introduced. This same activity was found also to persuade via **Recognition**.

Table 4
Social Support Features Implemented in prior Interventions

Feature	Implementation
Social Learning	sharing goals within a peer group [30]
	sharing reflections within a peer group [33]
	sharing updates on progress in challenges within the community [28]
Social Facilitation	information about diary completion of buddy [27]
	weekly presentations within a peer group [34]
	sharing goals within a peer group [30]
	sharing reflections within a peer group [33]
	sharing updates on progress in challenges within the community [28]
Social Comparison	N/A
Normative Influence	N/A
Competition	leaderboards [28]
Cooperation	collaborative question generation and group evaluation [34]
	buddy pairs remind and support one another about diary completions anonymously [27]
	group challenges [28]
Recognition	collaborative question generation and group evaluation [34]
	leaderboards [28]

5. Discussion

This paper has sought to map disparate academic interventions to the standardized PSD framework, providing a common language for HCI researchers. By synthesizing literature from both psychology

(self-regulation) and computer science (BCSS/PSD), the paper bridges the gap between behavioral theory and system design.

However, the paper also has weaknesses. Since this is not a systematic literature review, there is a risk of selection bias, and the search process may not have captured all relevant literature. Moreover, while the paper lists the features used, it provides only a limited comparative analysis of which features are most effective for specific procrastination triggers.

Future work could include research questions such as: How do systems detect procrastination behaviors in real-time to trigger appropriate interventions? How can systems collect necessary behavioral data while protecting student privacy? How do these systems integrate with existing educational technology infrastructure?

6. Conclusion

Alleviating academic procrastination among students is an important topic both in research and in society. Procrastination may lead to, for instance, lower academic achievements, late submissions, or lower quality of student assignments accomplished, and perhaps even a delay in receiving one's degree and diminishing productivity. Furthermore, it may touch other aspects of professional and private life, including individuals' subjective wellbeing, quality of life, wages, perceived stress, self-image and feelings of frustration, guilt, self-blame, and social approval.

Yet, many are willing to seek help for a change, and digital tools possess persuasive powers to support self-regulation improvement. Behavior Change Support Systems can help improve, for instance, self-efficacy and the adoption of more goal-directed behavioral targets.

This paper sought out to analyze previous research applications and recognize persuasive software features that can attack academic procrastination. Basic features recognized for the Primary Task Support include Reduction, Tunneling, and Tailoring on par with Self-monitoring, which directly relates to goal-setting. More advanced features, such as Simulation, via reflective writing and metacognition, and Rehearsal, through cognitive reframing, for instance, may be effective in alleviating procrastination. Virtual Rewards could be utilized in many ways, too. In a similar manner, Social Support, especially via Social Learning, Social Facilitation, and Cooperation, provides very interesting opportunities, as sharing goals, challenges, and reflections within a peer group, as well as collaborative problem solving, seem to be effective means to fight against academic procrastination.

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Declaration on Generative AI

The author(s) have not employed any Generative AI tools.

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