Psychology Research and Behavior Management

Dovepress

open access to scientific and medical research

Open Access Full Text Article

ORIGINAL RESEARCH

Do Smartphone Addiction and Self-Regulation Failures Affect Students' Academic Life Satisfaction? The Role of Students' Mind Wandering and Cognitive Failures

Mohammed Hasan Ali Al-Abyadh[1,2], Marwan Atallah Alatawi[3], Eslam Abdelhafiz Mohamed Emara[4], Sahar Abdulaziz Almasoud[5], Omar Alsetoohy[6], Ahmed Ramadan Mohammed Ali[7]

[1]Department of Special Education, College of Education in Al-Kharj, Prince Sattam bin Abdulaziz University, Al-Kharj, 11942, Kingdom of Saudi Arabia; [2]College of Education, Thamar University, Dhamar, Yemen; [3]Department of Special Education, College of Education and Art, University of Tabuk, Tabuk, Kingdom of Saudi Arabia; [4]Department of Educational and Psychological Sciences, Faculty of Special Education, Damietta University, New Damietta, Egypt; [5]Department of Teaching and Learning, College of Education and Human Development, Princess Nourah Bint Abdulrahman University, Riyadh, Kingdom of Saudi Arabia; [6]Department of Hotel Management, Faculty of Tourism and Hotels, University of Sadat City, Sadat City, Egypt; [7]Department of Psychology, Faculty of Education, The New Valley University, Kharga, Egypt

Correspondence: Omar Alsetoohy; Mohammed Hasan Ali Al-Abyadh, Email Omar.alsetoohy@fth.usc.edu.eg; m.alabyadh@psau.edu.sa

Purpose: The purpose of this study is to investigate how smartphone addiction and self-regulation failure influence students' academic life satisfaction considering the impacts of students' mind wandering and cognitive failures. It also sought to look at how students' minds wander, and cognitive failures are affected by smartphone addiction and self-regulation failure among university students.

Methods: The WarpPLS-SEM software was used to analyze the research data retrieved from a sample of 950 undergraduate students from universities in Egypt and the Kingdom of Saudi Arabia (KSA).

Results: In both countries, the findings revealed that students' smartphone addiction and self-regulation failures negatively affect students' academic life satisfaction and positively affect students' mind wandering and cognitive failures. Additionally, smartphone addiction is positively related to failures of students' self-regulation. Besides the negative influences of students' cognitive failures on their academic life satisfaction, cognitive failures mediated negatively the relationship between mind wandering and students' academic life satisfaction. Finally, students' mind wandering mediated the relationship between smartphone addiction, self-regulation failure, and academic life satisfaction.

Discussion: The study introduces fresh insights into the study variables that can be used to expand the literature on academic life satisfaction. The study provides theoretical and practical contributions to students, educators, and policymakers of education.

Keywords: smartphone addiction, self-regulation failures, mind wandering, cognitive failures, academic life satisfaction, Egypt, KSA

Introduction

The satisfaction students derive from academic life significantly impacts their outcomes in various learning environments. For instance, high academic satisfaction is closely linked to heightened levels of student motivation, performance, academic resilience, learning efficiency, and academic commitment and success.[1] Academic life satisfaction pertains to the positive emotional state arising from a subjective assessment of the quality of learning experiences.[2] According to Elshaer and Huang,[3] it involves students' perceived value, engagement, and well-being during their academic experiences. As a result, understanding students' ability to guide their own learning and attain satisfaction has become an extremely popular subject among educators, educational researchers, and policymakers alike. It was argued that the usage of smartphones has experienced a significant surge, which has subsequently led to addiction and problematic utilization.[4] Moreover, the compulsive use of smartphones leads to addiction, which detrimentally impacts the individual's everyday

Received: 14 November 2023
Accepted: 8 February 2024
Published: 18 March 2024

life. In this regard, researchers argue that smartphone addiction and self-regulation failures frequently link to performance and accuracy problems during hard and concentration-required academic activities.

In general, the linkage between being excessively attached to smartphones and students' contentment with their academic lives is intricate and subject to change dependent on other variables. For instance, international research on university students has found links between excessive smartphone usage and negative psychological conditions, mind wandering, and cognitive failures.[5,6] Twenge et al[7] stated that the excessive utilization of smartphones has been identified as a crucial element that leads to a decrease in the satisfaction of life. For example, a five-year follow-up research conducted in the United States on 500,000 youths between the ages of 13 and 18 found that kids who use cellphones for extended periods of time are more likely to have mental health issues including depression. Furthermore, teenagers who use smartphones for over three hours a day are 34% more likely to feel suicidal than their counterparts who do not use smartphones as frequently. Investigating inappropriate smartphone usage among university students and determining whether it can be predicted by academic delaying and quality of life is crucial because students who develop addictive behaviors to smartphones typically neglect other tasks and responsibilities and have a poorer standard of life.[6] Similarly, Hollis and Was[8] claimed that off-task thinking would necessarily be detrimental to students' progress because they are frequently expected to concentrate on difficult activities for their education. These stray thoughts are fairly prevalent; in our daily lives, our minds wander 30% to 50% of the time.[9,10] Mind wandering is described as individuals' involvement with internally generated and unrelated thoughts prompted by external stimuli or internal mental cues, especially when diverting their attention from a current task.[11] It commonly denotes the diversion of attention from the present situation and task involvement by thinking about irrelevant things.[12,13]

Recent research has begun to study mind-wandering experimentally using a variety of activities that are known to cause people to lose focus, such as reading a dry book[10] or sluggish sustained attention tests. Randall et al[14] claimed that this subject of mind wandering could be both beneficial and detrimental to crucial outcomes like performance and creativity, which makes it quite complicated. Dane[15] stated that the content, rather than the existence of mind wandering, is what counts in order to resolve this discrepancy. Depending on the conditions, mind-wandering might be adaptive or non-adaptive. Several theories of mind-wandering exist today, each emphasizing a distinct component of this phenomenon. According to the executive failure concept, mind-wandering results from an inability to concentrate on important information,[16] while the perceptual decoupling concept contends that mind-wandering is essentially a process of disconnecting from the world outside, allowing it to be committed to internal activities.[17,18] Alternatively, it has been proposed that mind-wandering is caused by deficiencies in meta-cognition, or the ability to pay attention to one's own ideas.[19] Some controversy surrounds the cognitive processes responsible for the phenomena of mind-wandering.[10,18,20] Numerous variables, including boredom, anxiety, split attention,[21–23] memory overload, decreased attention and alertness, and accidental learning, have been linked to the prevalence of cognitive failures.[1,24]

While it is well-recognized that mind wandering has an impact on academic performance, there have been relatively few experimental investigations on the subject, and models that combine personal and external factors are even sparse.[25] Furthermore, performance and observational metrics have low construct validity. Those evaluations might not always convey the intended meaning. Poor academic performance, for instance, can be explained by cognitive problems even if it may not be due to attentional errors.[26] When a task is excessively tough, low performance could be a sign of issues with particular cognitive abilities, including processing working or speed memory. In fact, most research classifies these distracting activities as mental noise. However, it seems possible that mind-wandering is an outcome of various activities rather than a unitary activity.[25] Observable factors to understand mental wandering should thus be used with caution.

Mind wandering occurs often in typical classes, as would be expected, and classroom research confirms this finding.[27] One of the reasons influencing students' mind wandering is smartphone addiction. Smartphone use has increased dramatically during the previous decade.[28] Junco[29] and Wood et al[30] indicated that juggling with social media and associated technology resulted in lower academic performance. From this perspective, smartphone addiction is particularly worrisome since smartphones, like gambling games, are unintentionally engineered to be very addictive.[31] Thus, one distinctive function that we investigate from this introduction is that students' addiction to smartphone activities will result in mind wandering that leads to cognitive failures, and this mind-wandering will result in lower performance in class.

Also, another potential distractor in an educational setting is the student's personality. In this regard, Adam et al[32] identified self-regulation failures to produce learning failures and are strongly correlated with low motivation, insufficient goal-setting, and subpar academic achievement. Castonguay et al[33] describe the failure of self-regulation as an individual acting ineffectively (misregulation) or a person's failure to act (under regulation) in attempting to begin, change, or block a behavior. Balkis and Duru[34] argued that students' self-regulation failures negatively affect their academic life satisfaction. This is because the deficiency in the ability of students to regulate themselves can result in a decreased level of academic satisfaction, ultimately leading to inadequate academic performance. In the same context, enhancing self-regulatory skills was found to improve academic performance and cognitive abilities among students with learning difficulties.[35] Additionally, Vanessa et al[36] argued that negative consequences can arise from internet and mobile phone addiction, most notably dependence and behavioral addiction. Conformingly, the excessive use of mobile phones among students resulted in cognitive failures, which include loss of control, craving, and conflict.[37,38] Despite the fact that self-regulation failures have been demonstrated to affect individuals' well-being in other domains such as healthcare,[39] this remains not sufficiently researched in the educational arena. Self-regulation abilities increase the action's flexibility, making it easier for people to adjust their behavior and mind to changing conditions and social pressures.[40] Otherwise, individuals who possess poor self-regulation abilities struggle to control their minds, emotions, thoughts, actions, and time efficiently and struggle to make effective use of their resources.[41]

However, despite the active study of academic life satisfaction, many questions associated with the influences of technology use and personality traits and behaviors among university students remain unsolved. To date, rare or few research studies have investigated the influences of both technology usage and self-regulation failures on academic life satisfaction considering the roles of mind wandering and cognitive failures among university students. Kuang-Tsan and Fu-Yuan[42] argued that more research is needed to reduce smartphone addiction and enhance life satisfaction considering the moderating influences of personality traits among university students. Also, Lim[6] mentioned that further research is required to thoroughly investigate the different variables that act as mediators in the link between smartphone addiction and students' life satisfaction. Hence, the main purpose of our study is to determine how significantly smartphone addiction and self-regulation failures affect students' academic life satisfaction, taking into account the mediating role of mind wandering and cognitive failures.

The present study contributes to a deeper understanding of whether the links between smartphone addiction, self-regulation failures, and students' academic life satisfaction are mediated by mind wandering and cognitive failures. Further, the proposed framework, see Figure 1, would help fill out the above-mentioned gaps in the literature (i.e.[6,42] Guided by this framework, the study will introduce a comprehensive analysis of the determinants that impact the contentment of students' academic life at the universities in two different countries (ie Egypt and KSA). Finally, the

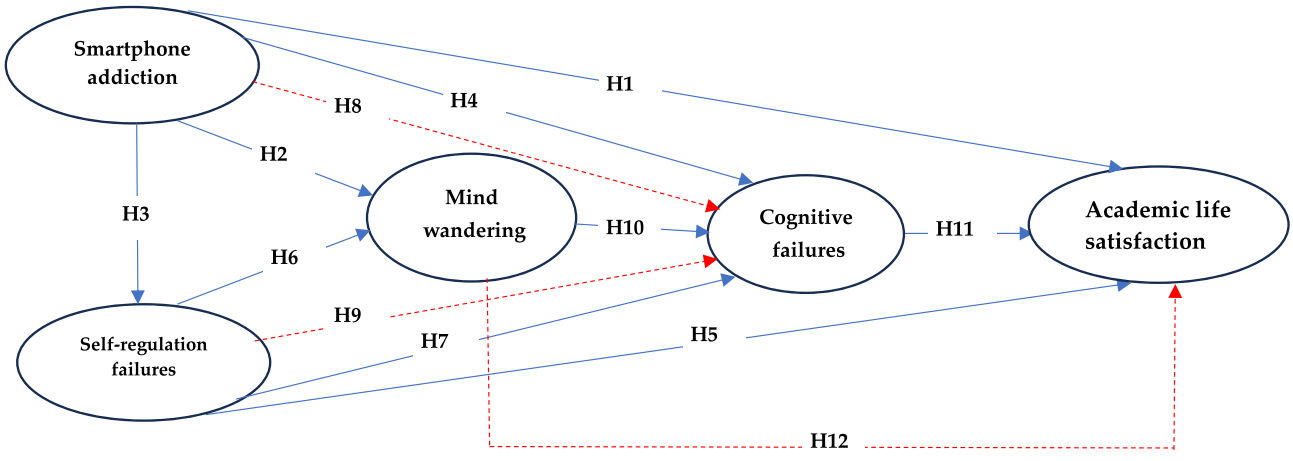

Figure 1 The framework of the research study. Blue arrows indicate direct relationships. Red, dotted arrows indicate indirect relationships.

study will provide students, educators, and policymakers of education with practice implications to overcome such determinants.

Literature Review

Students' brains are the primary focus of education, an intangible service.[43] Students should be viewed as customers in this scenario, according to Cavallone et al.[44] Students' satisfaction data in academic contexts assists colleges and universities in making their curricula more relevant to the requirements of a changing marketplace.[3] Academic satisfaction, which is defined as satisfaction with the achievement of academic objectives or aspirations,[45] has attracted attention in the field of empirical research[46] because high-quality education leads to better opportunities for future learning. Academic satisfaction is seen as a domain- particular satisfaction in which graduates perceive their educational experience as an environmental component that can provide appropriate resources to enable them to pursue their professional goals.[45]

Much research has been conducted in recent years in an attempt to clarify the relationship, triggers, and effects of students' academic satisfaction. Lent et al[47] proposed a theoretical framework of academic satisfaction based on components derived from Social Cognitive Career Theory (SCCT), which included self-efficacy, expectations for outcomes, achievement of goals, and perceived educational and social support by students. In the same vein, Elshaer and Huang[3] proposed a model with the goal of identifying the factors that contribute to student satisfaction in an international learning environment, stating that work-integrated learning, academic integration, classroom environment, and campus climate all play a significant role in student satisfaction. Therefore, there are many interventions, both personal and psychological, that students are likely to impact the process of achieving academic life satisfaction. Overall, our study looks at the roles of smartphone addiction and self-regulation failure on students' life satisfaction, mind wandering, and cognitive failures. It also sought to explore the consequences of students' mind wandering and cognitive failures on their academic life satisfaction.

Smartphone Addiction, Mind Wandering, Cognitive Failures, and Academic Life Satisfaction

The American Society of Addiction Medicine defines addiction as

> A treatable, chronic medical disease involving complex interactions among brain circuits, genetics, the environment, and an individual's life experiences. People with addiction use substances or engage in behaviors that become compulsive and often continue despite harmful consequences.

Consequently, the term addiction has traditionally been linked to substances like drugs, alcohol, and activities such as gambling, which is called pathological addiction.[48,49] Pathological addiction refers to an abnormal, compulsive dependence on a substance, behavior, or activity, often with negative consequences for one's physical or mental health. Also, pathological addiction implies a clinical condition that significantly impairs one's ability to function in various domains. It involves an individual's inability to control their engagement in addictive behavior, cravings, withdrawal symptoms, and a negative impact on various aspects of life.[50–52] Therefore, it includes substance abuse (alcohol, drugs) or behavioral addictions (gambling, gaming, shopping).[53]

On the other hand, the recognition of technology addiction emerged in the mid-1990s, marking a new type of societal concern, particularly as the media began to focus more on the concept of computer or internet addiction. It was observed that individuals addicted to mobile phones displayed comparable characteristics to those associated with other recognized forms of addiction, referring to social addiction.[49] Social addiction is not a standard term, it could be interpreted as excessive dependence on social interactions facilitated by technology, such as social media addiction or internet addiction. This might involve an overreliance on online communication, constant checking of social media, and a potential negative impact on real-world social interactions.[54] Social media addiction, online gaming addiction, or compulsive internet use might be considered as forms of social addiction. Consequently, social addiction may involve excessive smartphone use that negatively affects social dynamics and norms without necessarily meeting the criteria for a clinical addiction. From the above-mentioned critics, pathological addiction is a broader term encompassing various

types of compulsive dependencies, including substances and behaviors.[55] In contrast, social addiction might be a colloquial way of describing addictive behaviors related to excessive social interactions facilitated by technology, particularly in the digital realm.[55–57] Hence, smartphone addiction can be a social problem rather than a pathological addiction. In this view, the excessive use of smartphones is seen more as a reflection of changing social norms and the integration of technology into daily life.[20] It may be perceived as a societal challenge rather than an individual mental health issue. Accordingly, we can refer to smartphone addiction as the uncontrollable and excessive utilization of smartphones, impacting various fundamental daily activities and resulting in adverse outcomes.[56–58] Additionally, it is commonly characterized by compulsive and problematic behavioral patterns related to smartphone use, the difficulty in effectively regulating or controlling this usage, the presence of adverse withdrawal symptoms, an escalating tolerance necessitating increased use, and functional impairment.[20,59]

In almost every aspect of society, smartphones are incredibly popular. Through amusement, social networking (public posting and direct messaging), speedy information (but potentially inaccurate), and to a smaller extent more constructive activities (such as reading a textbook), smartphones serve as a source of continual connectedness. According to Jiang,[60] for access to these options/services, many users claim to rely completely on their smartphones. According to a recent study by Norville,[61] 55% of 299 college students admitted to checking their smartphones every ten minutes or less. Because smartphones attract attention that should be focused on other things, they may be especially addicting for those who are prone to mind wandering. Typically, mobile addicts also engage in excessive use and develop a psychological desire to always be tied to their devices. Although technology addiction can affect people of any age, it is especially common among students who use mobile phones. One of the biggest and most significant demographics and the most frequent smartphone users has been recognized as college students.[62]

Despite the obvious advantages associated with technology, worry has developed about the possibility that excessive smartphone use might have negative consequences.[63] There is mounting evidence linking smartphone use and smartphone-enabled behaviors (such as social media, navigation, and information search) to core cognitive processes like attention,[64] knowledge and memory,[65] delay of fulfillment,[66] and executive function.[67] Huey and Giguere[68] claimed that students whose cell phones were physically taken away during class had greater levels of course understanding, fewer feelings of anxiety, and a greater degree of awareness than the control group in their study concerning the impact of the use of smartphones on course comprehension. Smartphones may have a close connection to mind wandering, a subject that has gotten a lot of attention recently, because of their attention-grabbing aspects and the ubiquity of distraction when using them (such as alerts, changeable content streams, etc.).[13] As a result, students are confronted with challenging circumstances, struggle to maintain a healthy balance in their lives, have time management problems and a propensity for procrastination, feel excessive pressure to achieve, and struggle to control their study and test anxieties.[69] Kuss et al[37] argued that the excessive use of mobile phones among students resulted in cognitive failures, which include loss of control, craving, and conflict. Negative consequences can arise from internet and mobile phone addiction, most notably dependence and behavioral addiction.[36] Besides, Zhang et al[38] found a positive relationship between mobile phone addiction and cognitive failures among adolescents in China. As a result, the negative impacts of smartphone addiction on the mind may result in cognitive failures and significantly influence students' academic life satisfaction. It ought to be handled as a crucial educational problem.

The aforementioned hypothesis is developed in this regard:

Hypothesis 1: Smartphone addiction is significantly related to students' academic life satisfaction.

Hypothesis 2: Smartphone addiction is significantly related to students' mind wandering.

Hypothesis 3: Smartphone addiction is significantly related to students' self-regulation failure.

Hypothesis 4: Smartphone addiction is significantly related to students' cognitive failures.

Self-Regulation Failures, Mind Wandering, Cognitive Failures, and Academic Life Satisfaction

Self-regulation is the term used to describe the process of changing one's behavior. The motivational process known as self-regulation directs the amount of time and effort spent working toward a goal (e.g.,[70,71]). One of the main issues with the student's condition is self-regulation failures. Self-regulation is a process that involves being conscious of one's own capacity for learning. Recent research has focused on self-regulation in the classroom setting since it is understood to be crucial for student academic success.[32] Self-regulation behaviors are continually required in educational settings because they are essential for success with instructors and students, adhering to classroom regulations, and paying close attention to the teacher.[72] Self-regulation comprises a wide range of elements that may be utilized to build useful, productive learning environments. Good self-regulators are healthier, happier, and more effective when they can control the situations and urges that get in the way of achieving their goals (e.g.,[71,73]). On the other side, ineffective self-regulation reduces attention and results in high levels of anxiety and stress, which eventually lowers academic performance. Unmotivated people are less likely to devote the necessary amount of mental energy to achieving a goal. Given the significance of self-regulation to adaptation and performance, it is crucial to comprehend the methods for improving it. It turns out that developing the correct incentive can aid in improving self-regulatory ability and success. When someone is trying to manage their studies, for instance, the justifications they use to support their claim might determine whether or not their goal-regulation strategy is effective.[74] Self-regulation, according to Zimmerman,[75] is crucial for human survival since it is closely related to social acceptance and group dependence. This is because individuals depend on other people for the majority of their needs. There are several stages that self-regulatory processes go through, including goal setting, self-control, goal accomplishment, self-evaluation, self-efficiency, self-regulatory failure, etc.[76]

Additionally, the occurrence of cognitive failures among students has been associated with their inability to self-regulate. For instance, procrastination, which can be considered a failure in self-regulation, is associated with deficiencies in the cognitive aspects of executive function. Krönke et al[77] argued that self-regulation deficiencies have the potential to result in cognitive deficiencies as a result of compromised performance monitoring and decreased activation of cognitive control mechanisms. Students exhibiting the personality trait of neuroticism are at a heightened risk of experiencing cognitive failures such as forgetfulness, inattentiveness, and accidents.[78] Conformingly, Annette et al[35] found that interventions directed at enhancing self-regulatory skills, such as cognitive-behavioral programs, have demonstrated improved academic performance and cognitive abilities among students with learning difficulties.

Numerous research studies have found that employing self-regulation techniques benefits academic performance.[79] For instance, metacognition, which involves the awareness of one's own knowledge and limitations, can be employed as a self-regulation strategy to enhance academic achievement. When students are taught to think metacognitively and engage in self-regulatory learning, they have been found to experience greater success in their academic pursuits. Furthermore, training in cognitive and metacognitive learning strategies has been shown to reduce academic procrastination and increase self-efficacy among students.[80] Highly self-regulated students frequently find it simpler to manage negative learning issues and fit into various learning situations.[81] According to Park and Kim,[82] while self-regulation failures did have a detrimental impact on student's performance, self-regulation success did have a beneficial impact. Self-regulation abilities, according to Baumeister et al,[40] increase the action's flexibility, making it easier for people to adjust their behavior and mind to changing conditions and social pressures.[83,84] Otherwise, individuals who possess poor self-regulation abilities struggle to control their minds, emotions, thoughts, actions, and time efficiently and struggle to make effective use of their resources.[41]

Therefore, the following hypothesis is formulated:

Hypothesis 5: Self-regulation failures negatively affect students' academic life satisfaction.

Hypothesis 6: Self-regulation failures relate to students' mind wandering.

Hypothesis 7: Self-regulation failures relate to students' cognitive failures.

Mind Wandering: The Roles of Smartphone Addiction and Self-Regulation Failures

Mind wandering is a potentially harmful psychological phenomenon that is believed to occur 50% of the time during conscious contemplation.[9] Previous studies sought to address the concept of consciousness by investigating how the mind travels between many, sometimes unconnected, thoughts. This wandering can be harmful to performance since it diverts attention away from one's present activity. Mind wandering has been characterized in a variety of ways by researchers. Mind wandering was described by Smallwood and Schooler[13] as the transfer of attentional capacity from an exterior main task to an interior alternate task. Similarly, Andrews-Hanna et al[85] offered an alternate definition that describes mind wandering as an alternation of the attentional apparatus from outward objectives to interior self-generated cognition. While Khayretdinova[86] identified mind-wandering as a cognitive activity that frequently takes place while people are at rest and idle.

Students frequently experience many distractions at once, and they quickly lose focus in class. One significant distraction for today's students is the addiction to smartphones.[87] People frequently use their smartphones to pass the time when waiting in line, riding the bus, or just relaxing,[88] which is a result of the popularity of smartphones growing. When using a smartphone, one's degree of mind-wandering increases, as proven by an experiment by Markowitz et al.[87] Similarly, smartphones are frequently regarded as a distraction that causes a change in human attention.[89,90] Additionally, other research has shown that students who connect with their smartphones while performing academic tasks, resulting in multitasking, have inferior academic performance (e.g.,[91]). Furthermore, Shelton et al[92] asserted that using a smartphone during classes/lectures has the same impact on concentration; students who were diverted by a mobile phone buzzing during the lecture produced worse scores on the subsequent test than those who remained focused on the lectures. Students were shown to be distracted by messages they received on their cellphones in research by Mendoza et al[89] that produced similar findings.

Self-regulation is crucial for the successful pursuit of goals through the avoidance of diversions and the prevention of self-interruptions. Self-regulation refers to a person's motivation and ability to inhibit a desire that contradicts a self-regulated objective or value.[93] Self-regulation demands a goal or norm for optimal behavior in a specific context as its foundation. The present condition can be compared to the standard by monitoring ideas and behaviors.[40] As a result, any failure in self-regulation may cause mind wandering and poor performance. Majid[94] contended that cognitive failures arise due to a combination of internal and external factors that impact an individual's performance, resulting in mistakes. As a consequence, the following hypotheses are developed.

Hypothesis 8: The students' mind-wandering mediates the relationship between smartphone addiction and cognitive failures.

Hypothesis 9: The students' mind-wandering mediates the relationship between self-regulation failures and cognitive failures.

Hypothesis 10: Students' mind wandering is significantly related to students' cognitive failures.

Cognitive Failures, Mind Wandering, and Academic Life Satisfaction

Cognitive failure is described as an error in accomplishing an action that an individual is typically capable of accomplishing. Van der Linden et al[95] expanded the concept of cognitive failure to include a psycho-physiological condition that happens after doing cognitively demanding activities over a lengthy period of time and coincides with modifications in energy, processing of information, and mood. Cognitive failure may be caused by internal ideas (such as mind wandering) or external distractions.[96,97] Likewise, external factors can come from inputs in the individual's surroundings, while internal factors can come from the individual himself. Individuals suffering from cognitive failures suffer from psychological and cognitive repercussions, as well as a deficit in one or more cognitive processes. Attention, determination, memory, learning, and solving problems are all examples of cognitive abilities.[98] Consequently, Cognitive failure has been shown as a major predictor of behavior in difficult and unstructured activities. Furthermore, a person's cognitive capacity might readily influence their learning process.[99] Similarly, Hong et al[100] reported that while utilizing

technological gadgets for learning, cognitive failure as a psychological attribute was found to be adversely connected with users' learning desire and students' satisfaction. In this regard, student satisfaction is crucial when assessing educational programs since it is correlated with the caliber of student achievement.[101]

According to Mittner et al,[102] mind wandering is a complicated variable that reflects different states of awareness and may show itself in a variety of ways. According to their model, mind-wandering levels might include "total detachment", in which the individual is insensitive to task-related/external inputs. Nearly half of all waking time is spent with mind wandering, which is very frequent.[103] Thus, it is commonly viewed as a shifting in awareness from a center of focus to transitory ideas. Focus shifts may be deliberate, caused by a cognitive system that is overworked, or occur when performing a task that is automated, routine, or low engagement.[104] Previous studies have used experience sampling, self-ratings/reports, observations made during learning or in the course of research, and other methods to quantify wandering of mind. Hence, mind wandering is a common cognitive occurrence that may be either helpful (adaptive) or negative (ie, a failure to self-monitor one's attention) in nature. It has been connected to individuals' imagination, creativity, and planning for the future.[105] Different scholars argue that many people pay a high price for their mind wandering.[106] Attentional slip-ups can sometimes have even more harmful consequences (for example, when a doctor is operating on a patient, or a pilot is flying an aircraft). In the educational context, several studies, for example, show that mind wandering can impair working memory, continued focus, and comprehension when reading.[106,107]

So, the following hypotheses are proposed:

Hypothesis 11: Students' cognitive failures are negatively related to academic life satisfaction.

Hypothesis 12: The students' cognitive failures mediate the relationship between mind wandering and academic life satisfaction.

Methods

Participants

Undergraduate students enrolled in the universities in Egypt and the Kingdom of Saudi Arabia were the participants, based on the goals of the research. Students represent different colleges in both universities such as the College of Education, Special education, Tourism and Hotels, Commerce, Sciences, Artificial Intelligence, Engineering, Law etc. Both countries were chosen because they represent two different continents (Africa and Asia). Additionally, the household income differs in both countries which may affect students' use of technology and behaviors. Thus, we opt for undergraduate students as a research sample for several reasons. These students are easily accessible on university campuses, offering a convenient and available population for our study. This accessibility streamlines both the recruitment process and data collection. Additionally, choosing to work with undergraduate students is often a more cost-effective approach compared to recruiting participants from other groups, as they typically demonstrate a willingness to participate in studies without necessitating substantial financial incentives. Moreover, undergraduate students exhibit shared characteristics such as age range, educational background, and similar life experiences, even when considering different countries. This shared homogeneity simplifies the research process by minimizing variability in the sample and facilitating the identification of patterns or trends. Furthermore, the inclusion of undergraduate students allows researchers to navigate ethical considerations more seamlessly. Universities often have established procedures for obtaining informed consent, and ethical concerns are generally fewer in comparison to studies involving vulnerable or special populations.

Procedures

Approval for the materials and procedures was secured from the Ethics Committees. Informed consent was acquired from the students participating in the study. Participants were informed that their questionnaire responses would be treated with anonymity and confidentiality, and the gathered data would exclusively be utilized for academic research purposes. Hence, we contacted the university's IT department after acquiring formal authorization to send the questionnaire to students via their official emails. Also, we shared the online survey's link to student groups on social media through the

snowplowing procedures. The cover letter accompanied by the email confirms that students can stop at any time of the survey without penalty and that all information provided is strictly confidential. Furthermore, students were notified that the survey could be completed in less than 20 minutes. A reminder email was sent to students after two weeks to encourage them to fill the survey out. After one month, March 2023, we received 1005 surveys (653 Egyptians and 352 Saudis). About 55 surveys were removed due to invalid responses. Hence, only 950 surveys were valid for further analyses. Of these 950 students, 52.2% were female, 67.3% were Egyptian, and 66.4% were in the 3rd - 4th educational level. Finally, all students were aged between 19–23 years old.

Measures

The proposed study model was tested using a survey-based quantitative research technique. The online questionnaire was used to collect data through two sections. Additionally, two screening questions about smartphone time usage were directed to students

> How many times do you check your phone per hour? Do you use your cell phone for more than six hours in the day?

Only students who checked their phones more than seven times within one hour and spent more than three hours daily using their cell phones were asked to continue filling out the questionnaire. Section A of the questionnaire includes measures of the research variables, whereas section B gathered demographic information from students (eg gender, age, educational level). In addition, to confirm the validity and reliability of the measures, literature-based constructs were utilized in this study as follows:

Self-regulation failure was assessed by a 5-item scale retrieved from Cosnefroy et al,[108] with response options of (1: "strongly disagree" and 5: "strongly agree"). "I always back off when it's time to study; Starting to study always takes a lot of effort on my part; and I have trouble finishing when I'm doing my homework" were examples of the scale items.

Smartphone addiction was measured, based on a previously published study by Kwon,[109] with a 10-item scale. Responses were rated on a scale of (1: "not at all" and 5: "always"). Sample items were "Missing planned work due to smartphone use; Having a hard time concentrating in class, while doing assignments, or while working due to smartphone use".

Mind wandering was assessed through 25 indicators adapted from Lopez et al,[110] with response options of (1: "strongly disagree" and 5: "strongly agree"). Examples of the indicators were

> Do not remember what you were just told because you were not attentive, realize you were doing or did something without thinking about it, think how hard it is to concentrate

Cognitive failures have relied on the 25-item scale, scored on a four-point Likert scale (1: "never" and 4: "very often"), retrieved from De Paula et al.[111] Sample items of the scale were "Do you fail to notice signposts on the road?; Do you bump into people?"

Academic life satisfaction was assessed by a 5-item scale derived from Schmitt et al[112] rated on a five-point Likert scale (1: "strongly disagree" and 5: "strongly agree"). For instance, "All in all, I am satisfied with the education I can get in this college.; I'm satisfied with the intelligence of my teachers here".

Analysis Techniques

Descriptive statistics and frequencies of the participants were obtained using SPSS version 24.0. To test the research hypotheses, we utilized the PLS-SEM technique. We ran the WarPPLS-SEM to analyze the research data. For many reasons such as small samples; many indicators; development theories and predictions, the PLS approach was widely used in most scientific research.[113] Before testing the hypotheses, the study's measurement and structural model were confirmed.

Measurement Model Assessment

First of all, the convergent validity for the two models (eg, Egyptians and Saudi students) was tested by loadings of the research factors, composite reliability (CR), and the constructs' average variance extracted (AVE). Further, CR and Cronbach's Alpha were used to check reliability. As shown in Table 1 CR and Cronbach's α are greater than the preferable value of 0.7 which supports the reliability of all models 114. Besides, the item loadings were above.60[114] except for CF1,2,3,9,10,24 and ALS2,5 were lower than 0.60, the AVE values are greater than 0.5[115] and the CR values were higher than 0.7,[116] which corroborates the convergent validity. Values of the Heterotrait-Monotrait (HTMT) ratio of correlation is lower than the threshold of 0.9,[117] see Table 2, which proves the discriminant validity. The Heterotrait-Monotrait Ratio of Correlations (HTMT) is suggested as an alternative to the Fornell-

Table 1 Results of All the Measurement Models

Item/Construct	Loadings		Egypt				KSA			
	EGY.	KSA	Cronbach's Alpha.	CR	AVE	VIFs	Cronbach's Alpha.	CR	AVE	VIFs
Cognitive Failure			0.948	0.953	0.532	3.707	0.941	0.947	0.5	3.752
CF4	0.643	0.630								
CF5	0.691	0.681								
CF7	0.679	0.644								
CF8	0.723	0.697								
CF11	0.678	0.640								
CF12	0.746	0.734								
CF13	0.763	0.738								
CF14	0.734	0.713								
CF15	0.656	0.625								
CF16	0.781	0.755								
CF17	0.710	0.683								
CF18	0.766	0.750								
CF19	0.732	0.709								
CF20	0.745	0.719								
CF21	0.794	0.772								
CF22	0.746	0.695								
CF23	0.727	0.726								
CF25	0.788	0.783								
Mind wandering			0.902	0.931	0.772	4.153	0.897	0.928	0.763	4.03
FS1	0.835	0.786								
FS2	0.846	0.797								
FS3	0.610	0.611								
FS4	0.719	0.734								
FO1	0.798	0.787								
FO2	0.879	0.862								
FO3	0.804	0.838								
FO4	0.839	0.847								
UNA1	0.862	0.914								
UNA2	0.862	0.914								
FIN1	0.886	0.897								
FIN2	0.882	0.897								
Self-regulation			0.893	0.913	0.542	3.995	0.878	0.903	0.512	3.421
SR1	0.782	0.577								
SR2	0.635	0.758								
SR3	0.784	0.713								
SR4	0.694	0.757								
SR5	0.787	0.697								
SR6	0.716	0.776								
SR7	0.780	0.663								
SR8	0.610	0.798								
SR9	0.806	0.761								

(*Continued*)

Table 1 (Continued).

Item/Construct	Loadings		Egypt				KSA			
	EGY.	KSA	Cronbach's Alpha.	CR	AVE	VIFs	Cronbach's Alpha.	CR	AVE	VIFs
Academic Life satisfaction			0.862	0.919	0.793	1.135	0.850	0.913	0.781	1.214
ALS1	0.962	0.966								
ALS3	0.965	0.966								
ALS4	0.724	0.691								
Smartphone addiction			0.934	0.944	0.627	2.563	0.926	0.938	0.603	2.486
MPH1	0.825	0.812								
MPH2	0.814	0.789								
MPH3	0.705	0.672								
MPH4	0.804	0.790								
MPH5	0.856	0.850								
MPH6	0.772	0.751								
MPH7	0.792	0.767								
MPH8	0.731	0.701								
MPH9	0.799	0.804								
MPH10	0.810	0.811								

Larcker criterion and the examination of cross-loadings for assessing discriminant validity in SEM. The superiority of HTMT over these methods is argued based on the limitations and potential shortcomings of the latter. For instance, HTMT is argued to be more sensitive to violations of discriminant validity compared to the Fornell-Larcker criterion. It is believed to offer a more accurate assessment, especially in situations where traditional criteria may not adequately identify issues. Furthermore, HTMT is proposed as a more robust alternative, demonstrating better performance in a variety of situations through Monte Carlo simulation studies. Additionally, HTMT is rooted in the multitrait-multimethod matrix, allowing for a more comprehensive evaluation of discriminant validity. Finally, Henseler et al[117] demonstrate its superior performance compared to the Fornell-Larcker criterion and the evaluation of (partial) cross-loadings in detecting problems in discriminant validity. Finally, the greatest value of VIF (4.15) is less than 5, see Table 1, referring to the absence of multicollinearity between the model's structures.[118]

Prior to conducting data analysis, we tested a baseline equation using G*Power statistical software, considering a small impact size (Cohen's d = 0.10), a correlation relationship of 0.50 among repeated measurements, a bidirectional hypothesis, and an alpha error probability of 0.05 with 0.99 power.[119] A minimum of 407 samples is recommended for the current study by the G*Power results. Hence, the sample of the current study represents sufficient statistical power to examine the hypotheses suggested.

Table 2 Heterotrait-Monotrait Ratio (HTMT)

Construct	Egypt (n=639)					KSA (n=311)				
	1	2	3	4	5	1	2	3	4	5
1- Cognitive failure										
2- Self-regulation	0.86					0.846				
3- Academic Life satisfaction	0.295	0.355				0.418	0.436			
4- Mobile phone addiction	0.761	0.817	0.291			0.755	0.809	0.389		
5- Mind wandering	0.888	0.891	0.388	0.77		0.898	0.887	0.474	0.772	

The Structural Model

We evaluated the structural models of the Egyptian and Saudi students after the measurement models were achieved. According to Hair et al,[116] the structural model is evaluated using the goodness-of-fit indices (GoF), R^2, *p* values, effect sizes (f^2), and the path coefficient' significances (β).[120]

Model Fit in Egypt

Results of the model, see Figure 2, revealed that the R^2 values were 33%, 59%, 69%, and 74% for all the dependent variables of the model which indicates that the dependent variables interpret about 33 −74% of changes in the independent variables of the model reflecting a sequential explanatory power.[121] As shown in Table 3 and Figure 2 both β and *P* values indicate statistical significance between the model variables. According to Kock,[122] the f^2 values of 0.02, 0.15, and 0.35 represent a small, medium, and large effect. This confirms that the model's correlations have all effects see Table 3. Finally, the GoF of the model was 0.620 which refers to a large effect.[122] For additional information on the Egyptian model fit indices, refer to Appendix A.

Model Fit in the KSA

The results referred to a large effect of the model's Goodness- fits indices GoF_{KS} = 0.599),[122] and the R^2 values of the independent variables explain 32%, %56, %66 and % 74 of the Saudi model reflecting a sequential explanatory power.[121] Additionally, the f^2 values had small, medium, and large effects[122] for the Saudi model. In the same vein, the β and *P* values of the Saudi model support statistical relationships between the research variables, see Table 3 and Figure 3. For further details on the model fit indices for the Saudi model, see Appendix A.

Results

Results of the Direct Relationships

Our findings showed that smartphone addiction negatively affects students' academic life satisfaction in both countries through a direct (β_{Eg}= −0.066*P <0.05; β_{KS}= −0.117**P* <0.05) and indirect (3 segments) (β_{Eg}= −0.080**P <0.05; β_{KS}= −0.095*P <0.05) relationship, supporting H1. Further, smartphone addiction significantly positively affects students' mind wandering (β_{Eg}= 0.198***P* <0.001; β_{KS}= 0.190***P* <0.001), which supports H2 in the Egyptian and Saudi models. Similarly, smartphone addiction is positively related to students' self-regulation failures (β_{Eg}= 0.766****P* <0.001; β_{KS}= 0.557***P* <0.001) and cognitive failures (β_{Eg}= 0.218****P* <0.001; β_{KS}= 0.160****P* <0.001), Hence, H3 and H4 are supported, respectively, see Figures 2 and 3.

On the other hand, as shown in Figures 2 and 3, the research findings show that a negative direct (β_{Eg}= −0.298****P* <0.001; β_{KS}= −0.214****P* <0.001) and indirect (β_{Eg}= −0.086***P* <0.05; β_{KS}= −0.095**P* <0.05) relationship between students' self-regulation failures and academic life satisfaction in both countries were found, supporting H5. Besides, the results confirm the positive influence of students' self-regulation failures on their mind wandering (β_{Eg}=

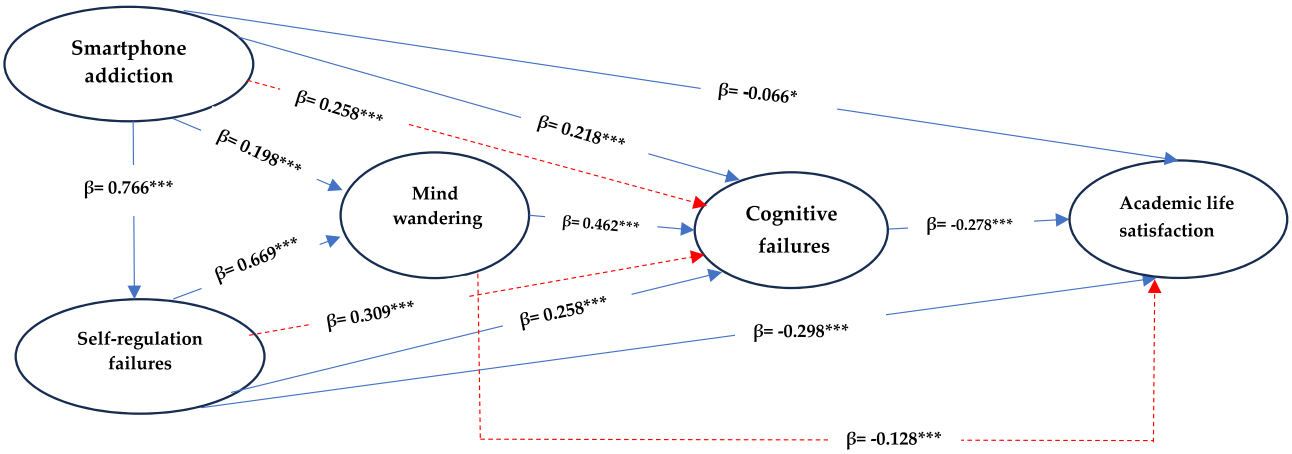

Figure 2 Results of the Egyptian model. Blue arrows indicate direct relationships. Red, dotted arrows indicate indirect relationships. *p < 0.05; ***p < 0.001.

Table 3 Results of the Hypotheses Testing in the Egyptian and Saudi Models

No	Hypothesis	Egypt			KSA		
		β	Decision	f^2	β	Decision	f^2
H1	Smartphone addiction –> academic life satisfaction	−0.066*	Supported	−0.027	−0.117*	Supported	0.053
	Smartphone addiction –>mind wandering- > cognitive failures–> academic life satisfaction	−0.080*		0.033	−0.095*		0.043
H2	Smartphone addiction –>mind wandering	0.198***	Supported	0.141	0.268***	Supported	0.190
H3	Smartphone addiction –> self-regulation failures	0.766***	Supported	0.587	0.746***	Supported	0.557
H4	Smartphone addiction –>cognitive failures	0.218***	Supported	0.158	0.160***	Supported	0.113
H5	Self-regulation failures–> academic life satisfaction	−0.298***	Supported	0.159	−0.214***	Supported	0.108
	Self-regulation failures –>mind wandering- > cognitive failures–> academic life satisfaction	−0.086***	Supported	0.046	−0.095*	Supported	0.048
H6	Self-regulation failures–> mind wandering	0.669***	Supported	0.549	0.590***	Supported	0.466
H7	Self-regulation failures–> cognitive failures.	0.258***	Supported	0.205	0.233***	Supported	0.180
H8	Smartphone addiction –>mind wandering –> cognitive failures.	0.290***	Supported	0.211	0. 318***	Supported	0.224
H9	Self-regulation failures –> mind wandering –>cognitive failures.	0.309***	Supported	0.245	0. 317***	Supported	0.245
H10	Mind wandering- > cognitive failures	0.462***	Supported	0.380	0. 538***	Supported	0.448
H11	Cognitive failures –> academic life satisfaction.	−0.278***	Supported	0.146	−0.300***	Supported	0.158
H12	Mind wandering–> cognitive failures –> academic life satisfaction	−0.128***	Supported	0.043	−0.162***	Supported	0.066

Notes: *p < 0.05; ***p < 0.001.

0.669***P <0.001; β_{KS}= 0.590***P <0.001) and cognitive failures (β_{Eg}= 0.258***P <0.001; β_{KS}= 0.233***P <0.001), indicating that H6 and H7 are accepted respectively.

Similarly, our results indicate that there is a significant correlation between students' mind wandering and cognitive failures (β_{Eg}= 0.462***P <0.001; β_{KS}= 0. 538***P <0.001), supporting H10. Finally, students' cognitive failures were found to affect students' academic life satisfaction (β_{Eg}= −0.278***P <0.001; β_{KS}= −0.300***P <0.001), supporting H11, see Figures 2 and 3, Table 3.

The Mediation Results

We used Kock's[123] suggested mediation methodology to investigate the mediation effects. This approach offers more efficiency and reliability than the approaches presented by Preacher and Hayes[124] and Hayes Preacher.[125] This is because the mediation method proposed by Preacher and Hayes exhibits certain potential weaknesses. Specifically, the approach assumes a causal relationship between variables (ie assumption of causality), which may not always be accurate. Consequently, establishing causality in observational studies proves to be a challenging task. Additionally, the method relies on the assumption of linear relationships between variables, and if the relationships are non-linear, the outcomes may not faithfully represent the true nature of

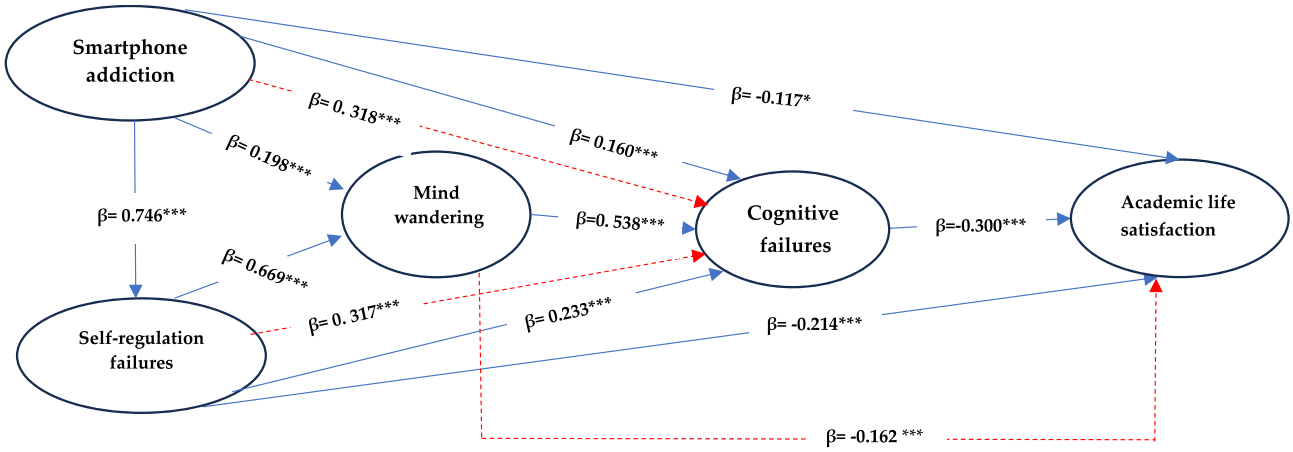

Figure 3 Results of the Saudi model. Blue arrows indicate direct relationships. Red, dotted arrows indicate indirect relationships. *p < 0.05; ***p < 0.001.

Table 4 Results of the Multi-Group Analysis (MGA)

Path	Δ β	*P*-values	Confidence Interval (95%)
Smartphone addiction -> academic life satisfaction	0.024	0.448	(−0.038, 0.087)
Smartphone addiction -> mind wandering	0.009	0.767	(−0.053, 0.072)
Smartphone addiction –> self-regulation failures	0.013	0.68	(−0.05, 0.076)
Smartphone addiction –> cognitive failures	0.009	0.78	(−0.054, 0.072)
Self-regulation failure -> academic life satisfaction	0.046	0.153	(−0.017, 0.108)
Self-regulation failure -> mind wandering	0.026	0.414	(−0.037, 0.089)
Self-regulation failure –> cognitive failures	0.017	0.598	(−0.046, 0.08)
Mind wandering -> cognitive failures	0.008	0.792	(−0.054, 0.071)
Cognitive failures -> academic life satisfaction	0.029	0.368	(−0.034, 0.092)

the associations. Another notable concern is the normality assumption associated with this method, particularly in the context of bootstrapping confidence intervals. Violations of normality assumptions can impact the accuracy of the results in certain instances. Lastly, the reliability of the results from mediation analyses can be influenced by sample size, with smaller samples potentially yielding less dependable outcomes.

As can be seen in Figures 2 and 3, Table 3, in both countries, our research showed a strong and direct relationship between smartphone addiction and cognitive failures as well as mind wandering. The research findings illustrated that the cumulative sum (three paths) of the indirect relationships between smartphone addiction and cognitive failures was highly significant in Egypt (β = 0.526***p<0.001, f^2= 0.383) and KSA (β = 0.554***p<0.001, f^2= 0.391), with a large effect size in both countries.[126] Besides, the Bootstrapped Confidence Interval does not straddle with the value of zero, confirming full mediation effects in Egypt (β = 0.290***p<0.001 f^2= 0.211), and KSA (β = 0.318***p<0.001 f^2= 0.224) and supporting H8. In the same vein, the research findings confirmed the direct relationship between student's self-regulation failures and cognitive failures as well as student's self-regulation failures and mind wandering in both countries. Also, the cumulative sum (one path) of the indirect relationship between student's self-regulation failures and cognitive failures was very significant in Egypt (β = 0.309***p<0.001, f^2= 0.245) and KSA (β = 0.317***p<0.001, f^2= 0.245), with a medium effect size in both countries.[126] The results supported H9 due the Bootstrapped Confidence Interval does not straddle the value of zero, in Egypt (β = 0.290***p<0.001 f^2= 0.211), and KSA (β = 0.317***p<0.001 f^2= 0.245).

There are direct correlations between mind-wandering and cognitive failures as well as between cognitive failures and students' academic life satisfaction in both countries. These associations were mediated by cognitive failures. Also, the cumulative sum (one path) of the indirect relationship between mind-wandering and academic life satisfaction was significant in Egypt (β = - 0.128, p<0.001, f^2= 0.043) and KSA (β = −0.161***p<0.001, f^2= 0.066), with a small effect size in both countries.[126] Hence, H12 is supported because the Bootstrapped Confidence Interval does not straddle the value of zero.

The Measurement Invariance and Multi-Group Analysis (MGA)

Before we ran the PLS-MGA, we applied measurement invariance analysis using constrained latent growth with the loading method.[122] According to the results of *p*-values (two-tailed) which were not significant (P >0.05), which in turn means that the loadings do not change significantly between the Egyptian and Saudi models. Hence, the PLS-MGA was run to assess any discrepancies between the models' paths for each country. The results of the PLS-MGA confirmed that paths do not have varied significances (P > 0.05) between the two countries. As shown in Table 4, there are no differences between Egypt and KSA.

Discussions

Fundamentally, the current study corroborated that greater levels of students' smartphone addiction, self-regulation failures, mind wandering, and cognitive failures were linked with worse levels of academic life satisfaction among university students, while smartphone addiction and self-regulation failures were associated with higher levels of mind wandering and cognitive failures in two countries namely Egypt and KSA. Although the PLS-MGA analysis using

WarPLS-SEM confirmed that there are no differences between the paths in both models (eg, Egypt and KSA), however, these findings will help generalize the research outcomes. The presence of shared customs, traditions, language, and religious beliefs can indicate similarities between students from Egypt and Saudi Arabia. Additionally, the education system in KSA is largely led by Egyptian educators and there is a growing number of Egyptian teachers from kindergartens to colleges. Such pivotal reasons may diminish these differences in Egypt and KSA in terms of students' smartphone addiction, self-regulation failures, mind wandering, cognitive failures, and academic life satisfaction. More importantly, the current study extended the existing literature on relating students' smartphone addiction, self-regulation failures, mind wandering, cognitive failures, and academic life satisfaction. These fresh insights into these variables can be used to expand the literature on academic life satisfaction.

Our results revealed that smartphone addiction negatively affected students' academic life satisfaction in both countries through a direct and indirect relationship. These results align with earlier research. (e.g.,[127,128]) that confirmed the negative relationship between smartphone addiction and students' academic life satisfaction. Similarly, the findings of two different studies conducted on Korean teenagers indicate that as the addiction index of smartphones among adolescents increased, their subjective happiness levels decreased.[129] Additionally, the more they increased their smartphone usage, the less satisfied they were with their lives.[5] Hence, the more the students decrease their addiction to smartphones, the more their academic life satisfaction levels increase. Besides, the negative effects on student's academic life satisfaction, these negative influences were extended to their academic performance. According to Samaha and Hawi,[4] student's chances of being addicted to smartphones had a negative impact on their academic performance. Our study emphasizes the necessity of creating public awareness and implementing efficient preventive measures for students in Egypt and KSA as the excessive usage of mobile phones hurts their level of satisfaction.

Clearly, smartphone addiction significantly affected students' mind wandering in terms of checking their smartphones during lectures, and the estimated effects of smartphone addiction on mind wandering were in line with earlier studies.[130] Evidence has developed indicating a strong link between the use of smartphones and social, interpersonal, and psychological wellness (mind wandering), cognition, mental health, and academic problems, implying that smartphone addiction can have serious ramifications for students. Previous research on the consequences of smartphone addiction revealed similar results; Scott et al[131] discovered that smartphone gadgets were connected with decreased interpersonal abilities, mental agility, and understanding. Additionally, Laramie[132] found that heavy use and dependency on mobile phones were associated with feelings of isolation and loneliness, implying that smartphone addiction may result in mind wandering. Furthermore, inappropriate smartphone use has been linked to low confidence,[133] anxiety, and mood disorders,[131] particularly in groups of young students.

Moreover, prior research has provided well-established evidence that the excessive use of smartphones is linked to unfavorable emotional and behavioral outcomes. In the same vein, our research revealed a link that was statistically significant between smartphone addiction and failures of students' self-regulation failures. The results presented herein are consistent with earlier research by Atiri et al[134] and Hong et al.[132] Evidence of such a relationship is that heavy users of smartphones among students experience time wastage as a direct result of their inability to exercise restraint over their usage, which in turn affects their cognitive skills, level of satisfaction, and finally their academic performance. This finding was confirmed by Zhao et al[135] who argued that individuals who possess elevated levels of intrinsic self-regulation are inclined to possess superior time-management competencies and display more adaptable behaviors.

In addition to the direct significant relationship between student's smartphone addiction and cognitive failures. It is worth highlighting that in our findings, mind wandering played the full mediation impact between smartphone addiction and cognitive failures. The results are in line with prior research studies. For instance, Zhang et al[38] found a positive link between teenagers' phone addiction and cognitive failures in China. Further, the research finding also confirmed the direct significant relationship between self-regulation failures and cognitive failures and the mediating role of mind wandering between self-regulation failures and cognitive failures. These results argued that the student's inability to self-regulate is a causative aspect of cognitive failures in Egypt and KSA. Previous studies examining the outcomes of self-regulation failures have yielded comparable findings (e.g.,[77,80]). For example, Krönke et al[77] argued that self-regulation deficiencies have the potential to result in cognitive deficiencies as a result of compromised performance monitoring and decreased activation of cognitive control mechanisms.

On the other hand, notable direct and indirect negative relationships between students' self-regulation failures and academic life satisfaction in both countries were found. Our findings are related to the results of Balkis and Duru,[34] who discovered a negative correlation between self-regulation failures and academic life satisfaction among students. Our research finding has revealed that the deficiency in the ability of students to regulate themselves can result in a decreased level of academic satisfaction, ultimately leading to inadequate academic performance. Individual factors, such as time management skills, motivation, and emotional well-being, can influence self-regulation and academic life satisfaction. Thus, we emphasize the critical significance of self-regulation in academic achievement and emphasize the need for students to develop and improve their self-regulation abilities. Additionally, there are some critical issues related to the entire education system and societal environment in both countries. For instance, the structure and demands of the educational systems in Middle Eastern countries may contribute to self-regulation failures. High-stakes examinations, rigid curriculum structures, and a lack of flexibility in learning environments may place significant stress on students, impacting their ability to regulate their learning effectively. Besides, cultural factors in Middle Eastern countries, such as societal expectations and pressure to excel academically, can contribute to self-regulation failures. The emphasis on academic achievement and competition may create a stressful environment, leading to difficulties in managing one's learning and academic responsibilities. Another common issue is that high parental expectations for academic success can contribute to self-regulation failures if students feel intense pressure to meet these expectations. The fear of disappointing parents may hinder students' ability to regulate their learning effectively and find satisfaction in their academic pursuits.

Similarly, worry has grown about the possible detrimental effects of self-regulation failure on students' behavior, resulting in mind wandering. According to the study's findings, self-regulation failure is positively associated with high rates of mind wandering. Sullivan and Davis[136] found that failures of self-regulation were linked to high rates of students' mind wandering. The link between self-regulation and mind wandering was investigated among university students (e.g.,[40,82]), which is defined as the motivational mechanism that regulates the amount of effort and time spent working towards a goal.[70,71] In general, self-regulation is a finite resource and depletion of this resource results in a decreased ability to regulate oneself further. In compliance with the study's findings, there is a strong link between students' final course grades and self-regulation issues including mind wandering and slipping more behind in their academic work.[137] The structural equation framework shown in Figures 2 and 3 depicts the research findings, which show approximately equal standardized impacts of smartphone addiction and self-regulation failure on mind wandering.[73,89]

The current study confirmed the significant correlation between students' mind wandering and cognitive failures, adding to prior research findings. Mind wandering predicted increased accessibility of cognitive errors in our study (direct impact). Interestingly, such a harmful effect of mind wandering appears among students with limited self-regulation and high use of smartphones (indirect impact). Mind wandering may have a direct impact on cognition, which may explain its mood-lowering effects. That is, it is possible that when students' thoughts wander, they are more likely to think negatively about themselves, with mind wandering having a direct link to higher cognitive failures. In this line, mind wandering is frequently related to decreased executive control,[105,138] suggesting a phenomenon that has a negative impact on mood (cognitive failures). In particular, mind-wandering levels may include "complete detachment", in which the individual is unresponsive to task-related/external stimuli.[102] Mind wandering had an influence on cognitive failures that were not only attributable to mood fluctuations. These outcomes are significant in explaining the processes through which smartphone addiction[29,30] and self-regulation problems in daily life[32] impact mind wandering.

Furthermore, the results revealed that cognitive failures are triggered by mind wandering.[106,107] Few research studies have explicitly explored the link between mind wandering, cognitive failures, and satisfaction among students to date.[94] The authors discovered a relationship between cognitive failures and students' academic life satisfaction as well as a significant relationship between mind wandering and cognitive failures. Additionally, the study's findings showed that cognitive failures mediate the relationship between mind wandering and academic life satisfaction. These results align with previous research that suggests cognitive failures may play a mediating role between the antecedents of mind wandering and a variety of academic outcomes (such as performance, satisfaction, value, etc.).[139] Related research has

shown a range of academic performance-related indicators, including work satisfaction, to be highly correlated with mind wandering and cognitive failures.[140]

Our findings imply that it is advantageous to focus greater emphasis on spotting students who, for whatever cause, use smartphones compulsively or have self-regulation failures. Students might benefit from a variety of measures (such as guiding, training, and support) or by changing various components of teaching methods, shorter lectures, or more frequent breaks, depending on the causes of their mind wandering. Therefore, we suggest that cognitive failures are caused by mind wandering to the point where they may influence students' academic life satisfaction. The study also suggested that a variety of circumstances, including smartphone addiction and difficulties with self-regulation, might cause mind wandering.

Implications

In general, the current research presents a comprehensive analysis of the determinants that impact the contentment of students' academic life in Egypt and KSA. Furthermore, it recommends feasible measures to curtail the issue, which could significantly enhance their academic achievements and welfare across different domains. The findings of the study confirm that academic life satisfaction is a complicated topic. Also, the addiction to smartphones and students' failure to exercise self-regulation in response to stimuli in their internal and external environments are two factors that are revealed to influence the occurrence of mind wandering, cognitive failures, and finally satisfaction with academic life among university students. According to the study, mind wandering might be intentional or unintentional, task-related or irrelevant, internal or outwardly directed, and have varying degrees of cognitive failures and academic life satisfaction. Hence, the current study adds to the body of literature by examining students' smartphone addiction, failures of self-regulation, mind wandering, the causes of this tendency, and projections of how this process may relate to cognitive failures, which in turn may have an adverse effect on student's satisfaction with their academic lives.

Although not all of the variables discovered in this study are equally significant, they are the key ones that define the antecedents of difficulties that occur often in regular lectures and affect students and have an impact on their academic performance. The research presents proof that heavy use of smartphones has a noteworthy direct and indirect impact on academic life satisfaction among university students. The amount of reading students does and their involvement in group activities related to academic tasks decline as they spend more time on their smartphones. Additionally, students' capacity to self-regulate is hampered by smartphone addiction.

It is a well-known fact that cell phones are utilized in people's daily lives. However, smartphone addiction among students promotes mind wandering during instructional tasks. This study discovered that excessive smartphone use has a detrimental impact on self-regulation, mind wandering, and cognitive ability. Based on these findings, it is advised that students limit their smartphone use and addiction and prioritize their cognitive and academic objectives. Additionally, the anticipated findings of this study are concerned with the failure of the self-regulation activities and the increased mind wandering of the students due to the intense use of smartphones. Failure to self-regulate not only exacerbates mind-wandering but also increases the risk of cognitive failure and interferes with students' academic and extracurricular activities. It causes students to lose self-confidence in their cognitive skills and academic endeavors.

Moreover, this study offered empirical evidence for the relationship between cognitive failures and students' academic life satisfaction. The perception of cognitive failures may arise the development or maintenance of unpleasant symptoms associated with academic satisfaction. Particularly, mind wandering, a common kind of off-task thinking, is strongly linked to students' cognitive failures. Cognitive failure is associated with poorer academic activity. This association stems from one's proclivity to make mistakes and slip-ups in performance. The current study also addressed the question of how or why mobile phone addiction and self-regulation failures contribute to mind wandering by revealing their direct effects, as well as by revealing the mediating role of mind wandering between smartphone addiction and students' cognitive failures as well as the self-regulation failures and students' cognitive failures, respectively. The findings indicate that smartphone addiction and self-regulation failure increased cognitive failures in academic life among students who experienced high levels of mind-wandering in class. Therefore, according to the results of the study's model testing, smartphone addiction, and self-regulation failures are strongly linked with mind wandering. As a result, we must pay more attention to the negative impacts of these activities on students' states of awareness. The

potentially harmful impacts of these activities can be minimized by limiting rumination on mobile phone-related material and controlling unpleasant self-regulation experiences. Creating the skills to more accurately recognize mind wandering serve to clarify potential learning obstacles and direct efforts to make education more successful. Thus, the current study addressed the gap left by prior studies by focusing on the influence of smartphone addiction on students' mind wandering. Additionally, the study highlights the impact of self-regulation failures on students' mind wandering.

Furthermore, our findings might be used to make practical applications. The study of mind wandering, along with its causes and consequences, has a big impact on how well students learn. Given the amount of attention necessary for learning, research suggests that mind wandering in classrooms is particularly concerning. With technology becoming more widely available, distraction is constant, making it more tempting for students to indulge in "off-task thinking" and disengagement. Our findings supported the link between mind-wandering behavior and academic life satisfaction levels. Therefore, it is imperative that students acquire techniques for improving their ability to concentrate and cope with mind wandering. The negative impact of smartphone addiction and self-regulation issues on mind wandering stresses the importance of the knowledge that may be obtained from this study. Also, since cognitive failures serve as a link between mind wandering and students' satisfaction with their academic lives, educators could break this link by taking a variety of steps (such as providing guidance, training, and support) or by altering different aspects of teaching strategies, such as giving students shorter lectures or more frequent breaks, depending on the root causes of their mind wandering. These results may also assist lecturers support the academic engagement of students and provide treatments to lessen mind-wandering. The study's findings suggest that lecturers should follow a lesson design strategy that involves making the content both accessible and challenging enough to lower the number of cognitive resources that can be utilized for mind-wandering and raise success rates in cognitive activities. Additionally, lecturers may use less strenuous technology gadgets exercises to encourage students' conscious capacity to develop their creativity and problem-solving skills. Lecturers may also incorporate less time-consuming technological activity in order to allow and promote the conscious potential to enhance students' problem-solving and creativity skills.

Despite the study's contributions to theory and practice, there were some limitations. One limitation is the relative dearth of representative samples from different backgrounds; while the majority of the studies focused on young people, this study was about university students drawn from two Arabic countries, which restricted their generalizability. Also, because only Nine hundred and fifty undergraduates from four universities in Egypt and Saudi Arabia were chosen for the study's sample, the generalizability of its results will still be constrained. Thus, when generalizing to wage earners, teenagers, and other people from other cultures, the findings of this study should be evaluated with care. Another limitation of this study was the fact that the study's respondents were mostly young adults, in the range of 20 years old. Age may combine with personality characteristics – self-regulation – or cognitive ability to influence cognitive failures, and this study cannot address such ideas.

This study launched a new line of inquiry by focusing on the influence of smartphone addiction and self-regulation failures on student success rather than on classroom atmosphere in general. This study solely included tertiary-level students. Future studies should be conducted with students in various educational contexts, such as high schools. Also, future studies should use a more representative sample and make sure that cognitive failures and self-regulation are addressed with regard to students' personality characteristics in order to alleviate some of the limitations mentioned above. So, future studies should not only look at the causes of mind wandering but also the variables that prevent it, as well as examine various motivational theories to give evidence of the function of diverse mitigating factors. For example, the study's findings revealed that smartphone addiction and self-regulation failures had a significant impact on students' inclination to mind wander, highlighting the importance of integrating attentional and motivational literature. In addition, it would be fascinating to examine this topic using a qualitative approach and using open-ended participant replies and code them according to personality, age, and the study's subject. Researchers might look at how the above content characteristics change between students who report more purposeful mind wandering and people who report erratic mind wandering. Finally, it would be intriguing to investigate whether there are predictors for each type of mind wandering in the data by looking at academic integration-related characteristics that may influence it.

Ethical Approval

The authors confirm that this research survey has been reviewed by the ethical committee and determined that it used appropriate procedures to minimize risks to human subjects and that adequate provision was made for the confidentiality and data anonymity of participants in any published record. Additionally, this study is being conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of the Faculty of Tourism and Hotels, University of Sadat City. Any data obtained in connection with this study will remain anonymous. Finally, we consider the participant who voluntarily decides to participate in this study as an approved informed consent.

Acknowledgments

Princess Nourah bint Abdulrahman University, Deanship of Scientific Research Riyadh, Saudi Arabia.

Funding

This study is supported via funding from Prince Sattam bin Abdulaziz University project number (PSAU/2024/R/1445).

Disclosure

The authors report no conflicts of interest in this work.

References

1. Kao PC. The interrelationship of loneliness, smartphone addiction, sleep quality, and students' attention in English as a Foreign Language Class. *Int J Environ Res Public Health*. 2023;20(4):3460. doi:10.3390/ijerph20043460
2. Sánchez-Cardona I, Ortega-Maldonado A, Salanova M, Martínez IM. Learning goal orientation and psychological capital among students: a pathway to academic satisfaction and performance. *Psychol Schools*. 2021;58(7):1432–1445. doi:10.1002/pits.22505
3. Elshaer A, Huang R. Perceived value within an international hospitality learning environment: antecedents and outcomes. *J Hospit Leis Sport Tour Educ*. 2023;32(C):100429. doi:10.1016/j.jhlste.2023.100429
4. Samaha M, Hawi NS. Relationships among smartphone addiction, stress, academic performance, and satisfaction with life. *Comput Human Behav*. 2016;57:321–325. doi:10.1016/J.CHB.2015.12.045
5. Ko JH, Kim SM. The Influence of smartphone dependency on the life satisfaction of adolescents—With a focus on the mediating effect of aggression. *J Commun Welf*. 2020;75(4):139–164. doi:10.15300/jcw.2020.75.4.139
6. Lim SA. Relationship Between Korean adolescents' dependence on smartphones, peer relationships, and life satisfaction. *Child Youth Care Forum*. 2023;52:603–618. doi:10.1007/s10566-022-09703-y
7. Twenge JM, Martin GN, Campbell WK. Decreases in psychological well-being among American adolescents after 2012 and links to screen time during the rise of smartphone technology. *Emotion*. 2018;18(6):765–780. doi:10.1037/emo0000403
8. Hollis RB, Was CA. Mind wandering, control failures, and social media distractions in online learning. *Learn Instruction*. 2016;42:104–112. doi:10.1016/j.learninstruc.2016.01.007
9. Killingsworth MA, Gilbert DT. A wandering mind is an unhappy mind. *Science*. 2010;330(6006):932. doi:10.1126/science.1192439
10. McVay JC, Kane MJ. Why does working memory capacity predict variation in reading comprehension? On the influence of mind wandering and executive attention. *J Exp Psychol Gen*. 2012;141(2):302–320. doi:10.1037/a0025250
11. Kum BH, Main EA, Cheung RY. Cross-lagged relations between delayed actions and the wandering mind. *Pers Individ Dif*. 2024;217:112448. doi:10.1016/j.paid.2023.112448
12. Fell J, Chaieb L, Hoppe C. Mind wandering in anxiety disorders: a status report. *Neurosci Biobehav Rev*. 2023;155:105432. doi:10.1016/j.neubiorev.2023.105432
13. Smallwood J, Schooler JW. The science of mind wandering: empirically navigating the stream of consciousness. *Annual Rev Psychol*. 2015;66:487–518. doi:10.1146/annurev-psych-010814-015331
14. Randall JG, Oswald FL, Beier ME. Mind-wandering, cognition, and performance: a theory-driven meta-analysis of attention regulation. *Psychol Bull*. 2014;140(6):1411. doi:10.1037/a0037428
15. Dane E. Where is my mind? Theorizing mind wandering and its performance-related consequences in organizations. *Acad Manage Rev*. 2018;43(2):179–197. doi:10.5465/amr.2015.0196
16. McVay JC, Kane MJ. Conducting the train of thought: working memory capacity, goal neglect, and mind wandering in an executive-control task. *J Exper Psychol*. 2009;35(1):196–204. doi:10.1037/a0014104
17. Smallwood J, McSpadden M, Schooler JW. When attention matters: the curious incident of the wandering mind. *Mem Cognit*. 2008;36:1144–1150. doi:10.3758/MC.36.6.1144
18. Smallwood J. Why the global availability of mind wandering necessitates resource competition.2011: reply to McVay and Kane. *Psychol Bull*. 2010;136(2):202–207. doi:10.1037/a0018673
19. Fox KCR, Christoff K. Metacognitive facilitation of spontaneous thought processes: when metacognition helps the wandering mind find its way. In: *The Cognitive Neuroscience of Metacognition*. Berlin, Heidelberg: Springer; 2014:293–319.
20. Zhang MX, Wu AM. Effects of smartphone addiction on sleep quality among Chinese university students: the mediating role of self-regulation and bedtime procrastination. *Addict Behav*. 2020;111:106552. doi:10.1016/j.addbeh.2020.106552
21. Malaeb D, Akel M, Salameh P, Hallit S, Obeid S. Boredom proneness, loneliness, and smartphone addiction among Lebanese young adults: the mediating role of depression, anxiety, and stress. *Prim Care Comp CNS Disord*. 2022;24(6):43747. doi:10.4088/PCC.21m03092

22. Robertson IH, Manlya T, Andradea J, Baddeleya BT, Yienda J. `Oops!': performance correlates of everyday attentional failures in traumatic brain injured and normal subjects. *Neuropsychologia*. 1997;35(6):747–758. doi:10.1016/S0028-3932(97)00015-8
23. Susmitha TS, Rao SJ, Doshi D. Influence of smartphone addiction on sleep and mental wellbeing among dental students. *Clin Epidemiol Global Health*. 2024;25:101447. doi:10.1016/j.cegh.2023.101447
24. Martens MJE. *Is the smartphone a performance killer?: The effect of the frequency and intrusiveness of smartphone alerts on the task performance of University students*. [Master's thesis]. University of Twente;. 2017.
25. van Vugt M, Taatgen N, Sackur J, Bastian M. Modeling mind-wandering: a tool to better understand distraction. In: Proceedings of the 13th International Conference on Cognitive Modeling. Groningen: University of Groningen; 2015:252.
26. Nurgitz R. *Mind Wandering and Academic Success: Insight into Student Learning and Engagement*. [Electronic theses and dissertations]. University of Windsor; 2019. Available from: https://scholar.uwindsor.ca/etd/7828. Accessed March 11, 2024.
27. Unsworth N, McMillan BD, Brewer GA, Spillers GJ. Everyday attention failures: an individual differences investigation. *J Exp Psychol*. 2012;38(6):1765–1772. doi:10.1037/a0028075
28. Marzouk A. Egypt's image as a tourist destination: an exploratory analysis of DMO's social media platforms. *Leisure/Loisir*. 2022;46(2):255–291. doi:10.1080/14927713.2021.1971554
29. Junco R. The relationship between frequency of Facebook use, participation in Facebook activities, and student engagement. *Comput Educ*. 2012;58:162–171. doi:10.1016/j.compedu.2011.08.004
30. Wood E, Zivcakova L, Gentile P, Archer K, De Pasquale D, Nosko A. Examining the impact of off-task multi-tasking with technology on real-time classroom learning. *Comput Educ*. 2012;58(1):365–374. doi:10.1016/j.compedu.2011.08.029
31. Harris B, Regan T, Schueler J, Fields SA. Problematic mobile phone and smartphone use scales: a systematic review. *Front Psychol*. 2020;11:672. doi:10.3389/fpsyg.2020.00672
32. Adam NL, Alzahri FB, Cik Soh S, Abu Bakar N, Mohamad Kamal NA. Self-Regulated Learning and Online Learning: a Systematic Review. In: Badioze Zaman H, Smeaton AF, Shih TK, et al. editors. *Advances in Visual Informatics*. Cham, Switzerland: Springer; 2017.
33. Castonguay A, Miquelon P, Boudreau F. Self-regulation resources and physical activity participation among adults with type 2 diabetes. *Health Psychol Open*. 2018;5(1):2055102917750331. doi:10.1177/2055102917750331
34. Balkis M, Duru E. Procrastination, self-regulation failure, academic life satisfaction, and affective well-being: underregulation or misregulation form. *Eur J Psychol Educ*. 2016;31(3):439–459. doi:10.1007/S10212-015-0266-5
35. Annette L, Barbara M. Motivational regulation strategies, academic self-concept, and cognitive learning strategies of university students: does academic self-concept play an interactive role? *Eur J Psychol Educ*. 2021;2021:1–20. doi:10.1007/S10212-021-00583-9
36. Vanessa R, Frederic G, Ursula O, Xavier C. *Internet and Mobile Phone Addiction*. IGI Global; 2015. doi:10.4018/978-1-4666-8239-9.CH066
37. Kuss DJ, Griffiths MD, Binder JF. Internet addiction in students: prevalence and risk factors. *Computers in Human Behavior*. 2013;29(3):959–966. doi:10.1016/j.chb.2012.12.024
38. Zhang B, Peng Y, Luo XS, et al. Mobile phone addiction and cognitive failures in Chinese adolescents: the role of rumination and mindfulness. *J Psychol Afr*. 2021;31(1):49–55. doi:10.1080/14330237.2020.1871239
39. Barlow MA, Wrosch C, Mcgrath JJ. Goal adjustment capacities and quality of life: a meta-analytic review. *J Person*. 2020;88(2):307–323. doi:10.1111/jopy.12492
40. Baumeister RF, Schmeichel BJ, Vohs KD. Self-regulation and the executive function: the self as controlling agent. In: Kruglanski A, Higgins E, editors. *Social Psychology: Handbook of Basic Principles*. 2nd ed. New York: Guilford; 2007:516–539.
41. Duru E, Duru S, Balkis M. Analysis of relationship among burnout, academic achievement and self-regulation. *Educ Sci*. 2014;14(2):1274–1284. doi:10.12738/estp.2014.4.2050
42. Kuang-Tsan C, Fu-Yuan H. Study on relationship among university students' life stress, smart mobile phone addiction, and life satisfaction. *J Adult Dev*. 2017;24:109–118. doi:10.1007/s10804-016-9250-9
43. Paricio J. Students as customers: a paradigm shift in higher education. *Deb J Cult Power Soc*. 2017;131(3):137–149. doi:10.28939/iam.debats-en.2017-11
44. Cavallone M, Ciasullo MV, Douglas J, Palumbo R. Framing higher education quality from a business perspective: setting the conditions for value co- creation. *Stud Higher Educ*. 2021;46(6):1099–1111. doi:10.1080/03075079.2019.1672644
45. Presti AL, Capone V, Aversano A, Akkermans J. Career competencies and career success: on the roles of employability activities and academic satisfaction during the school-to-work transition. *J Car Develop*. 2022;49(1):107–125. doi:10.1177/0894845321992536
46. Tessema M, Ready K, Yu W. Factors affecting college students' satisfaction with major curriculum: evidence from nine years of data. *Int J Humanities Social Sci*. 2012;2:2.
47. Lent R, Singley D, Sheu H, Schmidt JA, Schmidt L. Relation of Social-Cognitive Factors to Academic Satisfaction in Engineering Student. *J Career Assess*. 2007;15(1):87–97. doi:10.1177/1069072706294518
48. Chamberlain SR, Lochner C, Stein DJ, et al. Behavioural addiction—a rising tide? *Eur Neuropsychopharmacol*. 2016;26(5):841–855. doi:10.1016/j.euroneuro.2015.08.013
49. Nayak JK. Relationship among smartphone usage, addiction, academic performance and the moderating role of gender: a study of higher education students in India. *Comput Educ*. 2018;123:164–173. doi:10.1016/j.compedu.2018.05.007
50. Ford M, Håkansson A. Problem gambling, associations with comorbid health conditions, substance use, and behavioural addictions: opportunities for pathways to treatment. *PLoS One*. 2020;15(1):e0227644. doi:10.1371/journal.pone.0227644
51. Bisen SS, Deshpande YM. Understanding internet addiction: a comprehensive review. *Mental Health Rev J*. 2018;23(3):165–184. doi:10.1108/MHRJ-07-2017-0023
52. Chancellor S, Nitzburg G, Hu A, Zampieri F, De choudhury M. Discovering alternative treatments for opioid use recovery using social media. In: Proceedings of the 2019 CHI conference on human factors in computing systems; 2019:1–15.
53. Yau YH, Potenza MN. Gambling disorder and other behavioral addictions: recognition and treatment. *Harv Rev Psych*. 2015;23(2):134–146. doi:10.1097/HRP.0000000000000051
54. Dumitrescu M, Dumitrescu N, Turliuc Ş. The social media addiction: what have we learned so far?–A review. *BRAIN Br Res Artif Intellig Neurosci*. 2023;14(1):117–137. doi:10.18662/brain/14.1/410
55. Panova T, Carbonell X. Is smartphone addiction really an addiction? *J Behav Addic*. 2018;7(2):252–259. doi:10.1556/2006.7.2018.49

56. Sumuer E, Kaşıkcı DN. The role of smartphones in college students' mind-wandering during learning. *Comput Educ*. 2022;190:104616. doi:10.1016/j.compedu.2022.104616
57. Sunday OJ, Adesope OO, Maarhuis PL. The effects of smartphone addiction on learning: a meta-analysis. *Comput Hum Behav Rep*. 2021;4:100114. doi:10.1016/j.chbr.2021.100114
58. Billieux J, Maurage P, Lopez-Fernandez O, et al. Can disordered mobile phone use be considered a behavioral addiction? An update on current evidence and a comprehensive model for future research. *Curr Addict Rep*. 2015;2:156–162. doi:10.1007/s40429-015-0054-y
59. Lin Y-H, Chiang C-L, Lin P-H, et al. Proposed diagnostic criteria for smartphone addiction. *PLoS One*. 2016;11(11):e0163010. doi:10.1371/journal.pone.0163010
60. Jiang LJ. An empirical study on the construction of school motto culture in china's universities. *J Part Sch Fujian Provin Committ Commu Part Chin*. 2018;2:116–120.
61. Norville GA. *Smartphone Addiction, Use Purpose, and The Wandering Mind*. [Master Thesis]. Wayne State University; 2020.
62. Al-Barashdi H, Bouazza A, Jabur N. Smartphone addiction among university undergraduates: a literature review. *J Sci Res Rep*. 2015;4(3):210–225. doi:10.9734/JSRR/2015/12245
63. Elshaer A, Huang R, Marzouk A. Tourists' selfies storytelling: preferences, intentions, and concerns for practice in the tourism and hospitality industry. *J Vacat Mark*. 2022;2022:1–20. doi:10.1177/13567667221145712
64. Stothart C, Mitchum A, Yehnert C. The attentional cost of receiving a cell phone notification. *J Exp Psychol*. 2015;41(4):893–897. doi:10.1037/xhp0000100
65. Sparrow B, Liu J, Wegner DM. Google effects on memory: cognitive consequences of having information at our fingertips. *Science*. 2011;333(6043):476–478. doi:10.1126/science.1207745
66. Wilmer HH, Chein JM. Mobile technology habits: patterns of association among device usage, intertemporal preference, impulse control, and reward sensitivity. *Psychonomic Bull Rev*. 2016;23(5):1607–1614. doi:10.3758/s13423-016-1011-z.
67. Barr N, Pennycook G, Stolz JA, Fugelsang JA. The brain in your pocket: evidence that Smartphones are used to supplant thinking. *Computers in Human Behavior*. 2015;48:473–480. doi:10.1016/j.chb.2015.02.029
68. Huey M, Giguere D. The impact of smartphone use on course comprehension and psychological well-being in the college classroom. *Innov High Educ*. 2022;48:527–537. doi:10.1007/s10755-022-09638-1
69. Džubur A, Koso-Drljević M, Lisica D. Understanding cognitive failures through psychosocial variables in daily life of students. *J Evol Med Den Sci*. 2020;9(45):3382–3386. doi:10.14260/jemds/2020/743
70. Bandura A. Social cognitive theory of self-regulation. *Organizat Beha Human Dec Proc*. 1991;50(2):248–287. doi:10.1016/0749-5978(91)90022-L
71. Wang L. The role of students' self-regulated learning, grit, and resilience in second language learning. *Frontiers in Psychology*. 2021;12:800488. doi:10.3389/fpsyg.2021.800488
72. Montroy JJ, Bowles RP, Skibbe LE. The effect of peers' self-regulation on preschooler's self-regulation and literacy growth. *J App Develop Psycholo*. 2016;46:73–83. doi:10.1016/j.appdev.2016.09.001
73. Tangney JP, Baumeister RF, Boone AL. High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. *J Person*. 2004;72:271–324. doi:10.1111/j.0022-3506.2004.00263.x
74. Muraven M. Autonomous self-control is less depleting. *J Res Personality*. 2008;42(3):763–770. doi:10.1016/j.jrp.2007.08.002
75. Zimmerman BJ. Attaining self-regulation: a social cognitive perspective. In: Boekaerts M, Pintrich PR, Zeidner M, editors. *Handbook of Self-Regulation*. San Diego, CA, US: Academic Press; 2000:13–39. doi:10.1016/B978012109890-2/50031-7
76. Hassan AM, Bala MM, Mannir MS, Kareem WB. Self-regulatory learning and active learning approaches on students of technical college psychomotor achievement in furniture craft. *Indian J Vocat Educ*. 2020;2020:26–28.
77. Krönke KM, Wolff M, Mohr H, et al. Monitor yourself! Deficient error-related brain activity predicts real-life self-control failures. *Cogn Affect Behav Neurosci*. 2018;18:622–637. doi:10.3758/s13415-018-0593-5.
78. Nuh Y, Eralp B. A structural equation modeling analysis of relationships among university students' readiness for e-learning, self-regulation skills, satisfaction, and academic achievement. *Res Pract Technol Enhanc Learn*. 2021;2021:1. doi:10.1186/S41039-021-00162-Y
79. Teng MF, Ying Z. Assessing self-regulated writing strategies, self-efficacy, task complexity, and performance in English academic writing. *Assess Writ*. 2023;57:100728. doi:10.1016/j.asw.2023.100728
80. Wasyilah W, Yusrizal Y, Suhrawardi I. Application of self-directed learning model to improve student's independence and critical thinking skills. *J Penel Pend IPA*. 2021;7(4):651–659. doi:10.29303/JPPIPA.V7I4.784
81. Sun JC-Y, Rueda R. Situational interest, computer self-efficacy and self-regulation: their impact on student engagement in distance education. *Brit J Educ Technol*. 2012;43(2):191–204. doi:10.1111/j.1467-8535.2010.01157.x
82. Park S, Kim NH. University students' self-regulation, engagement and performance in flipped learning. *Europ J Train Dev*. 2022;46(1/2):22–40. doi:10.1108/EJTD-08-2020-0129
83. Cotoman V, Davies A, Kawagoe N, et al. Un (COIL) ing the pandemic: active and affective learning in times of Covid-19. *Polit Sci Politics*. 2022;55(1):188–192.
84. Rasmussen B, Hutchinson A, Lowe G, et al. The impact of covid-19 on psychosocial well-being and learning for Australian nursing and midwifery undergraduate students: a cross-sectional survey. *Nurse Educ Prac*. 2022;58:103275. doi:10.1016/j.nepr.2021.103275
85. Andrews-Hanna J, Smallwood R, Spreng RN, et al. The default network and self-generated thought: component processes, dynamic control, and clinical relevance. *Ann NY Acad Sci*. 2014;1316(1):29–52. doi:10.1111/nyas.12360
86. Khayretdinova M. *Mind Wandering in a Smartphone World: the Impact of Pervasive Smartphone Usage on Mind Wandering and Attentional Restoration*. [Master's thesis]. Harvard University Division of Continuing Education; 2022.
87. Markowitz DM, Hancock JT, Bailenson JN, Reeves B. Psychological and physiological effects of applying self-control to the mobile phone. *PLoS One*. 2019;14(11):e0224464. doi:10.1371/journal.pone.0224464
88. Deloitte. Global mobile consumer survey, US edition: overview of results; 2018.
89. Mendoza JS, Pody BC, Lee SK, McDonough IM. The effect of cellphones on attention and learning: the influences of time, distraction, and nomophobia. *Computers in Human Behavior*. 2018;86:52–60. doi:10.1016/j.chb.2018.04.027

90. Ward AF, Duke K, Gneezy A, Bos MW. Brain drain: the mere presence of one's own smartphone reduces available cognitive capacity. *J Assoc Cons Res*. 2017;2(2):140–154. doi:10.1086/691462
91. Junco R, Cotten SR. A 4 U: the relationship between multitasking and academic performance. *Comput Educ*. 2012;59(2):505–514. doi:10.1016/j.compedu.2011.12.023
92. Shelton JT, Elliott EM, Eaves SD, Exner AL. The distracting effects of a ringing cell phone: an investigation of the laboratory and the classroom setting. *J Environ Psychol*. 2009;29(4):513–521. doi:10.1016/j.jenvp.2009.03.001
93. Billore S, Anisimova T, Vrontis D. Self-regulation and goal-directed behavior: a systematic literature review, public policy recommendations, and research agenda. *J Busin Res*. 2023;156:113435. doi:10.1016/j.jbusres.2022.113435
94. Majid AS. Cognitive failure among students of the mathematics department in college of basic education. *J Pedag Invent Pract*. 2022;8:80–89.
95. van der Linden D, Frese M, Sonnentag S. The impact of mental fatigue on exploration in a complex computer task: rigidity and loss of systematic strategies. *Human Factors*. 2003;45(3):483–494. doi:10.1518/hfes.45.3.483.27256
96. Broadbent DE, Cooper PF, FitzGerald P, Parkes KR. The Cognitive Failures Questionnaire (CFQ) and its correlates. *Br J Clin Psychol*. 1982;21(1):1–16. doi:10.1111/j.2044-8260.1982.tb01421.x
97. Farah H, Zatmeh S, Toledo T, Wagner P. Impact of distracting activities and drivers' cognitive failures on driving performance. *Adv Transp Stud*. 2016;1:71–82.
98. Koechlin H, Coakley R, Schechter N, Werner C, Kossowsky J. The role of emotion regulation in chronic pain: a systematic literature review. *J Psychosom Res*. 2018;107:38–45. doi:10.1016/j.jpsychores.2018.02.002
99. Hong J-C, Hwang M-Y, Szeto E, Tsai CR, Kuo Y-C, Hsu W-Y. Internet cognitive failure relevant to self-efficacy, learning interest, and satisfaction with social media learning. *Computers in Human Behavior*. 2016;55(A):214–222. doi:10.1016/j.chb.2015.09.010
100. Hong J-C, Tai K-H, Hwang M-Y, Kuo Y-C, Chen J-S. Internet cognitive failure relevant to users' satisfaction with content and interface design to reflect continuance intention to use a government e-learning system. *Computers in Human Behavior*. 2017;66:353–362. doi:10.1016/j.chb.2016.08.044
101. Chang SHH, Smith RA. Effectiveness of personal interaction in a learner-centered paradigm distance education class based on student satisfaction. *J Res Technol Educ*. 2008;40(4):407–426. doi:10.1080/15391523.2008.10782514
102. Mittner M, Hawkins GE, Boekel W, Forstmann BU. A neural model of mind wandering. *Trend Cognit Sci*. 2016;20(8):570–578. doi:10.1016/j.tics.2016.06.004
103. Christoff K, Irving ZC, Fox KC, Spreng RN, Andrews-Hanna JR. Mind-wandering as spontaneous thought: a dynamic framework. *Nat Rev Neurosci*. 2016;17:718–731. doi:10.1038/nrn.2016.113
104. Carriere JSA, Seli P, Smilek D. Wandering in both mind and body: individual differences in mind wandering and inattention predict fidgeting. *Canad J Experim Psychol*. 2013;67(1):19–31. doi:10.1037/a0031438
105. Schooler JW, Mrazek MD, Franklin MS, et al. The middle way: finding the balance between mindfulness and mind-wandering. In: Ross BH, editor. *The Psychology of Learning and Motivation*. Vol. 60. Burlington: Academic Press; 2014:1–33.
106. Mooneyham BW, Schooler JW. The costs and benefits of mind-wandering: a review. *Canad J Experim Psychol*. 2013;67(1):11–18. doi:10.1037/a0031569
107. Schad DJ, Nuthmann A, Engbert R. Your mind wanders weakly, your mind wanders deeply: objective measures reveal mindless reading at different levels. *Cognition*. 2012;125:179–194. doi:10.1016/j.cognition.2012.07.004
108. Cosnefroy L, Fenouillet F, Maze C, Bonnefoy B. On the relationship between the forethought phase of self-regulated learning and self-regulation failure. *Issu Educat Res*. 2018;28(2):329–348.
109. Kwon M, Kim DJ, Cho H, Yang S. The smartphone addiction scale: development and validation of a short version for adolescents. *PLoS One*. 2013;8(12):e83558. doi:10.1371/journal.pone.0083558
110. Lopez A, Caffò AO, Tinella L, Bosco A. The four factors of mind wandering questionnaire: content, construct, and clinical validity. *Assessment*. 2023;30(2):433–447. doi:10.1177/10731911211058688
111. De Paula JJ, Costa DS, Miranda DMD, Romano-Silva MA. Brazilian version of the Cognitive Failures Questionnaire (CFQ): cross-cultural adaptation and evidence of validity and reliability. *Brazilian Journal of Psychiatry*. 2017;40:312–315. doi:10.1590/1516-4446-2017-2227
112. Schmitt N, Oswald FL, Friede A, Imus A, Merritt S. Perceived fit with an academic environment: attitudinal and behavioral outcomes. *J Vocational Behav*. 2008;72(3):317–335. doi:10.1016/j.jvb.2007.10.007
113. Alsetoohy O, Ayoun B, Abou-Kamar M. COVID-19 pandemic is a wake-up call for sustainable local food supply chains: evidence from green restaurants in the USA. *Sustainability*. 2021;13(16):9234. doi:10.3390/su13169234
114. Hair JF, Sarstedt M, Pieper TM, Ringle CM. The use of partial least squares structural equation modeling in strategic management research: a review of past practices and recommendations for future applications. *Long Ran Plann*. 2012;45(5–6):320–340. doi:10.1016/j.lrp.2012.09.008
115. Fornell C, Larcker DF. *Structural Equation Models with Unobservable Variables and Measurement Error: Algebra and Statistics*. Los Angeles, CA: Sage publications Sage CA; 1981.
116. Hair JF, Risher JJ, Sarstedt M, Ringle CM. When to use and how to report the results of PLS-SEM. *Eur Bus Rev*. 2019;31(1):2–24. doi:10.1108/EBR-11-2018-0203
117. Henseler J, Ringle CM, Sarstedt M. A new criterion for assessing discriminant validity in variance-based structural equation modeling. *J Academy Marketing Sci*. 2015;43:115–135. doi:10.1007/s11747-014-0403-8
118. Ringle CM, Sarstedt M, Mitchell R, Gudergan SP. Partial least squares structural equation modeling in HRM research. *Int J Human Resour Manage*. 2020;31(12):1617–1643. doi:10.1080/09585192.2017.1416655
119. Faul F, Erdfelder E. *GPOWER: A Priori, Post-Hoc, and Compromise Power Analyses for MS-DOS Computer Program*. Bonn, FRG: Bonn University, Department of Psychology; 1992.
120. Abou Kamar M, Albadry OM, Sheikhelsouk S, Ali Al-Abyadh MH, Alsetoohy O. Dynamic capabilities influence on the operational performance of hotel food supply chains: a mediation-moderation model. *Sustainability*. 2023;15(18):13562. doi:10.3390/su151813562
121. Chin WW. How to write up and report PLS Analyses. Handbook of partial least squares: concepts, methods, and applications. *Sprin Hand Comput Stat*. 2010;2010:1.
122. Kock N. *WarpPLS User Manual: Version 7.0*. Laredo, TX, USA: ScriptWarp Systems; 2020.

123. Kock N. Advanced mediating effects tests, multi-group analyses, and measurement model assessments in PLS-based SEM. *International J E-Collab*. 2014;10(1):1–13. doi:10.4018/ijec.2014010101
124. Preacher KJ, Hayes AF. SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behav Res Methods Instrum Comput*. 2004;36(4):717–731. doi:10.3758/BF03206553
125. Hayes AF, Preacher KJ. Quantifying and testing indirect effects in simple mediation models when the constituent paths are nonlinear. *Multivar Behav Res*. 2010;45(4):627–660. doi:10.1080/00273171.2010.498290
126. Kock N. *WarpPLS User Manual: Version 7.0*. ScriptWarp Systems; 2022.
127. Hale K, Cihan A, Fikret S, Zülbiye K. The Relationship Between Smartphone Addiction and Life Satisfaction: faculty of Sport Sciences Students. *Intern J Psychol Educ Stud*. 2020;7(1):86–95. doi:10.17220/IJPES.2020.01.008
128. Lopez-Fernandez O. *Internet and Mobile Phone Addiction*. Health and Educational Effects; 2019; doi:10.3390/BOOKS978-3-03897-605-9
129. Nam M, Kim H, Kwon Y. Factors influencing subjective happiness index of health behavior, smartphone addiction, suicidal ideation among college students. *J Digital Convergence*. 2013;11(10):557–569.
130. Billieux J. Problematic use of the mobile phone: a literature review and a pathways model. *Curr Psychiatry Rev*. 2012;8:299–307. doi:10.2174/157340012803520522
131. Scott DA, Valley B, Simecka BA. Mental health concerns in the digital age. *J Men Health*. 2016;15:604–613. doi:10.1007/s11469-016-9684-0
132. Laramie D. *Emotional and behavioral aspects of mobile phone use*. [Unpublished doctoral dissertation]. Los Angeles, CA: Alliant International University; 2007. Available from http://gradworks.umi.com/32/68/3268867.html. Accessed March 11, 2024.
133. Hong F, Chiu SS, Huang DA. model of the relationship between psychological characteristics, mobile phone addiction and use of mobile phones by Taiwanese university female students. *Computers in Human Behavior*. 2012;28:2152–2159. doi:10.1016/j.chb.2012.06.020
134. Atiri SO, Ipietegha VL, Popoola O. *Understanding the Relationship Between Self-Regulation and Smartphone Addiction Among Undergraduates of the University of Lagos, Nigeria*. University of lagos; 2020; doi:10.26772/CJSMS2020050204
135. Zhao J, Meng G, Sun Y, Xu Y, Geng J, Han L. The relationship between self-control and procrastination based on the self-regulation theory perspective: the moderated mediation model. *Curr Psychol*. 2021;40:5076–5086. doi:10.1007/s12144-019-00442-3
136. Sullivan Y, Davis F. Self-regulation, mind wandering, and cognitive absorption during technology use. *Comput Educ*. 2022;176:104363. doi:10.24251/HICSS.2020.548
137. Boshoff-Knoetze A, Duminy L, Du Toit Y. Examining the effect of self-regulation failure on academic achievement in emergency remote teaching and learning versus face-to-face. *J Appl Res High Educ*. 2023;15(2):342–354. doi:10.1108/JARHE-08-2021-0305
138. Schooler JW, Smallwood J, Christoff K, Handy TC, Reichle ED, Sayette MA. Meta-awareness, perceptual decoupling and the wandering mind. *Trend Cognit Sci*. 2011;15(7):319–326. doi:10.1016/j.tics.2011.05.006
139. Wallace JC, Vodanovich SJ, Restino BM. Predicting cognitive failures from boredom proneness and daytime sleepiness scores: an investigation within military and undergraduate samples. *Pers Individ Dif*. 2003;34:635–644. doi:10.1016/S0191-8869(02)00050-8
140. Kass SJ, Vodanovich S, Callender A. State-trait boredom: relationship to absenteeism, tenure, and job satisfaction. *J Busin Psychol*. 2001;16(2):317–327. doi:10.1023/A:1011121503118