

Article

# Internet Addiction, Phubbing, Psychological Variables and Self-Perception of Mathematical Competence in College Students

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**Abstract:** Internet Addiction (IA) and phubbing are prevalent, disruptive behaviours among university students. The aim of this study was to explore the relationship between IA and Phubbing with psychological variables (impulsiveness, self-esteem, and psychological distress), academic performance and self-perception of mathematical competence (SMC), as well as possible gender differences. Results showed ( $n = 715$ ; Mean Age = 21.7) gender differences in lack of planning, emotional investment and somatisation and IA correlated positively with app addiction, mobile addiction, and psychopathology. A total of 26.3% of IA can be explained by a lack of self-control, time and performance management, mobile phone addiction, anxiety and psychological distress. Finally, 71% of students believe that the use of new technologies has worsened their SMC and this is correlated with impaired communication, obsession with mobile phones, IA (Total Phubbing Scale) and impulsiveness. Our results indicate the importance of taking into account psychological variables that affect the development of IA, phubbing, and SMC in the university population.

**Keywords:** internet addiction (IA); phubbing; mathematical competence; gender differences; academic performance; psychological variables

**MSC:** 97D99



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## 1. Introduction

Information and Communication Technologies (ICT) allow immediacy in the transmission of information, the establishment of non-physical social links and the generation of knowledge [1]. If the frequency and intensity of its use are inappropriate, it can end up being a potentially risky behaviour for individuals [2], leading to the development of “compulsive Internet use”, “cyber addiction” or “Internet addiction” (IA) [3,4]. IA is included in the “Impulse Control and Behavioural Addictions Disorders” [5] and presents characteristics such as: salience, changes in mood, tolerance, abstinence, social conflict, and relapse as well as pleasure, craving, and persistence, and is ever-present in the person’s behavioural repertoire. Across the European population as a whole, the prevalence of IA is between 1–9% [6], in Spain, 3.7% and, among 14–24-year-olds, 11.3% [7]. In terms of the university population specifically, the figures are between 6–40%, and are difficult to compare given the methodological differences between studies [8].

IA generates negative interference in several vital areas of the individual [9], such as psychological and physical health, specifically in the university population [10–12]. Within this population, an association has been described between IA and consequences such as: sleep and eating disorders [13,14], mood instability [13], feelings of guilt when offline [15], low frustration tolerance, low self-esteem, depression, lack of impulse control [12], poor academic performance [16], poor hygiene habits, changes in leisure, irritability or even stealing in order to use devices [17,18]. Such consequences ultimately compromise the quality of life and well-being of young people [12,14,19].

Linked to this increased use of mobile phones, a new maladaptive behaviour has emerged known as “phubbing”. This describes when somebody ignores a person in a context of social interaction by paying attention to the mobile phone [20], which compromises the person’s psychological well-being [21,22]. Specifically, phubbing can lead to psychological impairment or distress [23], depressive states [24], loneliness, hopelessness, insecurity and alexithymia, low self-concept, somatization, and hostility [25]. Such behaviours are directly negatively related to performance at work, studies, social identity, personal relationships [26], and family relationships [27,28], which are particularly relevant for university students.

One of the personality traits that have been found to be most predisposing to developing IA is impulsiveness [29–31]. In the context of university students, high impulsiveness has been linked to difficulties in concentration [32], hopelessness, and anxiety [33]. More specifically, impulsiveness is closely related to concentration difficulties due to the fact that phones provide a high number of stimuli that decrease boredom or frustration [34]. Conversely, low levels of self-control are a mediating variable in the development of IA [35]. In this regard, impulsiveness can be taken into account as an element in behavioural interventions to address IA and phubbing, as together with lack of self-control, it is related to the general health and personal well-being [36,37] of young people.

Similarly, while there are studies that indicate that the use of ICTs favours academic engagement [1,38,39], others have found that the academic success of students with IA and/or phubbing is significantly compromised [18,24,40–42]. This fact is especially relevant in difficult disciplines such as mathematics -present in many social or health studies subjects [43,44]—which are also perceived by students as highly complex [45–47] even showing anxiogenic reactions to them [44,48,49]. Some of the cognitive processes negatively affected by IA and phubbing -especially relevant in the process of learning mathematics- are attentional processes as they involve students multitasking; texting and social networking are the behaviours that most interfere with academic performance [50,51] leading to increased cognitive fatigue [18]. Other effects on cognitive processes include poor time management and planning [52], procrastination [53], and reduced dedication to and achievement of learning goals [53]. It has even been proposed that poor academic performance could be a significant predisposing factor—along with other factors such as difficulties in self-regulation—in the development of IA [17] and phubbing. This relationship between IA, phubbing, and academic performance is especially relevant in mathematics and changing the negative prior attitudes in university students towards these subjects is complex [54] and this may contribute negatively to their mathematical achievement and learning. In addition, self-perceived mathematical competence (SMC), negative prior experiences, and achievement motivation are all processes that affect performance in these subjects [34,55,56]. SMC is related to a component of affection towards the subject, a cognitive component (beliefs), and a behavioural component (moving towards or away from the subject) [57]. As previously mentioned, the use of ICT in the academic university setting is a constant—including in subjects that include mathematical content—, so from the high levels shown by the data of IA and phubbing, it is relevant to know how students use ICT in this area [56,58]. Consequently, studying the relationship between this use and SMC in university students could decrease the perception of complexity and increase their academic performance in these subjects.

In summary, a large proportion of university students nowadays use ICT and inappropriate use of ICT may compromise their psychological well-being, their SMC, and consequently their academic and personal success. Currently, there are few studies linking IA, phubbing, SMC, and academic performance in the university setting. Consequently, the objectives of this study are: (1) to analyse the relationship between IA and phubbing with psychological variables (impulsiveness, self-esteem, and psychological distress), app and mobile phone addiction, and academic performance, as well as possible differences in these variables across gender; (2) to study the relationship between IA with psychological variables and academic performance by establishing a predictive model of the variables; (3) to investigate the relationship between IA, Phubbing and SMC in the university population. First, a review of the literature related to the aforementioned objectives has been carried out. Second, we will describe the materials and methods sections including the study design and participants, procedure, instruments, and statistical analysis of this study. Thirdly, we will explain the results obtained based on the objectives of this study, and finally, we will carry out the discussion section explaining our results based on the related literature as well as practical implications, limitations, and future lines of research.

## 2. Materials and Methods

### 2.1. Study Design and Participants

This observational and prospective study is part of the research project “Phubbing, IA and Tutorial Action Plan in students of 11 degrees and 2 double degrees at the University of Barcelona” (REDICE 20-2401), and included a convenience sample of 715 university students. Participants came from 10 degree programmes at the University of Barcelona (UB) and one degree at Abat Oliba CEU University (UAO CEU), both universities located in Barcelona, Spain. Data collection took place during the academic years 2020–2021 and 2021–2022. The inclusion criteria for selecting participants were as follows: students enrolled in degree programmes at UB or UAO CEU; students who signed the informed consent form and who completed the questionnaires administered. The exclusion criteria were: reporting fatigue or a physical condition that made it difficult to complete the protocol and refusing to participate in the study or not signing the informed consent form. All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki, and the Ethics Committee of UB and UAO CEU (ref. 006) approved the protocol.

### 2.2. Procedure

The REDICE researchers of the 10 degree programmes at UB and UAO CEU were contacted, the protocol of the questionnaires to be administered was presented and a form with a presentation of the project, a copy of the protocol, and a participation consent form were all sent via email. They were asked to explain and encourage students in their degree programmes to answer the study protocol. The time required to complete the protocol ranged from 10 to 30 min. Subjects’ participation was completely voluntary and they were able to cease participation without any negative consequences. Moreover, all participants were informed of the study procedures, data collection, and anonymisation of all personal data.

### 2.3. Instruments

The questionnaires used in the evaluation protocol will be described below:

- (a) **Socio-demographic questionnaire:** included questions about the student (age, sex, current academic year, degree studied, academic performance (average of the academic record from the university) and whether the student works and type of working day) and family (who the student lives with and whether both parents work or not).
- (b) **Phubbing Scale (PS)** [26,59]. This is a scale that assesses mobile and internet addiction and interference in communication of 10 items with five Likert-type response alternatives, ranging from 1 (never) to 5 (always). An example of such items is:

“When I am with my family, I am always busy with my mobile phone”. The first five questions make up the first factor: communication impairment. The remaining five questions make up the second factor: obsession with mobile phones. The reliability of the two factors is between 0.85 and 0.76, respectively.

- (c) **Barrat Impulsiveness Scale (BIS-11)** [60]. BIS-11 is one of the most commonly administered self-reports in both research and clinical practice [61] to assess impulsiveness, lack of attention, and lack of self-control and planning. BIS-11 consists of 13 Likert-type items from which participants are asked to report the frequency of various behaviours ranging from 1 (rarely or never) to 4 (always or almost always). The total score range varies between 13 and 52. The reliability of the scale lies between 0.75 and 0.84.
- (d) **Smartphone Application-Based Addiction Scale (SABAS)** [62]. The SABAS is a short and easy-to-administer questionnaire to detect the risk of smartphone addiction [62]. It consists of 6 Likert-type items from which students are asked to report the frequency of different behaviours ranging from 1 (strongly disagree) to 6 (strongly agree). An example of an item would be: “If I cannot use or access my smartphone when I feel like it, I feel sad, in a bad mood or irritable” and “Conflicts have arisen between me and my family (or friends) because of my smartphone use”. The total score range varies between 6 and 36. The reliability of the scale is 0.81.
- (e) **Rosenberg Self-Esteem Scale (RSES)** [63]. This is one of the most widely used scales in the assessment of self-esteem, particularly in adolescents [64]. It is a 10-item unidimensional instrument that assesses self-perception, feelings, and self-worth related to self-respect and self-acceptance. A Likert-scale response with 4 response options from 1 (strongly agree) to 4 (strongly disagree) is used. Test-retest reliability is around 0.84.
- (f) **The Internet Addiction Test (IAT)** [4]. The IAT is an instrument for the assessment of IA symptoms with 20 items, rated on a five-point Likert scale from 1 (rarely) to 5 (always). The minimum score is 20 and the maximum score is 100. The questionnaire also offers two additional factors: emotional investment and time management and performance. The instrument has a reliability index ranging from 0.89 to 0.91.
- (g) **The Brief Symptom Inventory (BSI-18)** [65]. This includes 18 items divided into three dimensions (somatisation, depression, and anxiety) and a total score (General Psychological Distress Index) for clinical and community populations. Participants were asked to respond in relation to how they had felt over the past 7 days and each item was rated on a 5-point Likert scale from 0 (not at all) to 4 (extremely). Reliability is between 0.81 and 0.90.

In order to carry out the third objective, a sub-sample of 56 students from UAO CEU was used. Specifically, this subgroup was administered the socio-demographic questionnaire, the PS scale, the BIS-11 and the SMC and mobile phone use questionnaire. The latter was created ad hoc to assess the SMC of university students and has the following characteristics:

- (h) **SMC and mobile phone use.** This questionnaire includes 16 questions: 1 binary question (Did you take any mathematics subject during the Baccalaureate (for at least one year)?); 2 numerical questions [Approximate average grade for subjects in the Degree in Psychology related to mathematics (Statistics, Research Methodology and other related subjects, (numerical to 1 decimal place)]; and 12 Likert-type questions. In the latter items, participants reported the extent to which they agreed or disagreed with various statements related to SMC and mobile phone addiction, with possible answers ranging from 1 (strongly disagree) to 4 (strongly agree). An example of an item would be: “The use of technology (mobile, internet, applications) has worsened my ability to solve a mathematical problem involving several calculations mentally” and “My ability to make probabilistic estimations (e.g., mental rules of three) in everyday mathematical problems has decreased with the use of technology (mobile, internet, applications)” (See Supplementary File S1).

#### 2.4. Statistical Analysis

Several analyses were carried out of the variables included in this study in a series of steps. Firstly, descriptive analyses were carried out of the following variables (socio-demographic characteristics, phubbing, IA, impulsiveness, mobile phone app addiction, self-esteem, mobile phone addiction, psychological distress, and academic performance) and preliminary analyses were carried out to characterise the samples, inspect statistical assumptions and examine the associations of the variables in this study. In the description of the results, the IA (Total Phubbing Scale) was taken as the total score on the instrument measuring Phubbing. Secondly, and before checking the normal distribution and homoscedasticity of the data, Student's *t*-test was used to analyse differences between groups (men and women) in the IA scales (Total Phubbing Scale) and the rest of the scales used in the study, as well as the correlations between the IA (Total Phubbing Scale) and the psychosocial variables of the study. In the case of significant differences between men and women, the magnitude of these differences was interpreted with Cohen's *d* using the scales described by the author [66]. Specifically, a Cohen's *d* around 0.20 was considered a small effect, around 0.50 a medium effect, and above 0.80 a large effect. Finally, simple stepwise regression equations were performed to examine the relationship between IA (Total Phubbing Scale) and the psychosocial variables being studied. Statistical Package for the Social Sciences (SPSS), version 23.0, was used for statistical analysis. The significance level used in all analyses was 5% ( $p = 0.05$ ).

### 3. Results

#### *Sample Characteristics*

The sample consisted of 715 university students, 82.1% female, and 17.9% male, with a mean (*M*) age of 22.1 years (standard deviation (*SD*) = 4.6). A total of 20.1% were in their first year, 30.8% in their second year, 17.8% in their third year, 24.3% in their fourth year, and 7% in their fifth year (double degree programmes). The students came mainly from the Faculty of Information and Audiovisual Media (36.4%), from the Faculty of Primary Education (14.0%), from the Faculty of Early Childhood Education (11.0%) and from the Faculty of Psychology (10.5%). A total of 92.4% were single-degree students and 7.6% were double-degree students. The average academic performance score was 7.5 (*SD* = 0.8) and the students with the highest score were those with a double degree in teaching (*M* = 8.3), and those with the lowest score were those in Geography and History [ $F(9.714) = 18.813$ ,  $p < 0.001$ ]. In addition, the students with the best grades were those in the fifth year vs. those in the second or third year ( $F(4.714) = 5.160$ ,  $p < 0.001$ ). The description of the sample can be found in Table 1. In relation to socio-demographic data and internet use, the majority of pupils live with both parents (60.7%), started using the internet mostly in primary school (73.3%), and mainly use it for surfing, watching films, and adult content (60.7%). A total of 42.7% work part-time and what usually stresses them the most about their degree is excessive workload (85%) (see Table 2).

**Table 1.** Description of the sample ( $n = 715$ ).

Variable		<i>n</i>	%
<b>Gender</b>	Male	128	17.9
	Female	587	82.1
<b>Age in years *</b> (Mean; SD)		22.1 (4.6)	
<b>Academic year</b>	1st	144	20.1
	2nd	220	30.8
	3rd	127	17.8
	4th	174	24.3
	5th	50	7.0
<b>Undergraduate degrees</b>	Information and audiovisuals	260	36.4
	Primary Education	100	14.0
	Early Childhood Education	79	11.0
	Psychology	75	10.5
	Double teaching	56	7.8
	Social work	53	7.4
	Geography and History	31	4.3
	Arts	30	4.2
	ESCAC	30	4.2
	Pedagogy	8	1.1
<b>Grade ** (Mean; SD)</b>		7.5 (0.8)	

\* The age range is between 18 and 56 years. \*\* The range of scores is between 5 and 10. Note. SD: Standard Deviation.

As for the first objective, on the PS Scale [59] students obtained a mean score of 21.3 (SD = 4.6) on the IA scale (Total Phubbing Scale), a high score for mobile and internet obsession (M = 11.9, SD = 2.5), followed by communication impairment (M = 9.3, SD = 2.5). This shows that the overall degree of phubbing reported by our students is in the moderate range. On the other hand, results on the BIS-11 [60] showed that students in our sample scored low on impulsiveness with a mean of 22.8 (SD = 5.3). Specifically, they scored low for lack of attention (M = 8.8, SD = 3.0) and moderate for lack of self-control (M = 8.1, SD = 2.5) and lack of planning (M = 5.9, SD = 1.7). Addiction to mobile apps assessed using the SABAS [62] showed a mean score of 16.3 (SD = 4.8) indicating a low level in this questionnaire. As regards the assessment of self-esteem using the RSES [63], the sample as a whole obtained a mean score of 26.5 (SD = 2.5), which indicates a moderate level of self-esteem and self-worth. On the other hand, the IAT questionnaire [4] showed emotional investment related to mobile phone addiction of 12.69 (SD = 8.5), while time management and performance gave scores of 11.9 (SD = 7.0) and the total score for mobile phone addiction was 24.9 (SD = 14.3). This means our students showed low scores for emotional investment, time management and performance, and mobile addiction. Finally, the results of the BSI-18 [65] showed a mean score for somatisation of 61.5 (SD = 6.4), for depression, 64.7, (SD = 5), for anxiety, 64.2 (SD = 5.4) and for psychological distress, 66.5 (SD = 5.5). In percentage terms, 18% of students showed clinically significant symptoms for somatisation, 38% for depression, 28% for anxiety, and 44% for psychological distress. Additionally, the pathological risk score for somatisation was 22%, for depression, 31%, for anxiety, 41%, and for psychological distress, 6% (see Table 3).

**Table 2.** Sociodemographic data and internet use ( $n = 715$ ).

Variable	<i>n</i>	%
<b>Living situation</b>		
Both parents	418	60.7
Single-parent	131	18.3
Other	166	23.2
<b>Both parents work</b>		
Yes	490	68.5
No	225	31.5
<b>First use of the internet</b>		
Infant school	83	11.6
Primary	524	73.3
Secondary	90	12.6
University	18	2.5
<b>Internet content</b>		
Surfing, films, and adult content	434	60.7
Games	192	26.9
Browsing and messaging	89	12.4
<b>Currently working?</b>		
No	410	57.3
Yes, part-time	305	42.7
<b>The most stressful part of the degree</b>		
Excessive workload	608	85
Placement	29	4.1
Financial difficulties	60	8.4
Conflicts with peers	18	2.5

**Table 3.** Internet addiction scores in the total sample ( $n = 715$ ).

Variable	Sample Total ( $n = 715$ ) M (SD)
<b>Phubbing (PS)</b>	
Communication Impairment	9.3 (2.5)
Mobile obsession	11.9 (2.5)
IA (Total Phubbing Scale)	21.3 (4.6)
<b>BIS-11</b>	
Lack of attention	8.8 (3)
Lack of self-control	8.1 (2.5)
Lack of planning	5.9 (1.7)
Impulsiveness	22.8 (5.3)
<b>SABAS</b>	
	16.3 (4.8)
<b>RSES</b>	
	26.5 (2.5)
<b>IAT</b>	
Emotional investment	12.69 (8.5)
Time management and performance	11.9 (7)
Mobile addiction	24.9 (14.3)
<b>BSI-18</b>	
Somatisation	61.5 (6.4)
Depression	64.7 (5)
Anxiety	64.2 (5.4)
Psychological distress	66.5 (5.5)

Note. SD: Standard Deviation; PS: Phubbing Scale; IA: Internet Addiction (Total Phubbing Scale); BIS-11: Impulsiveness Scale; SABAS: App Addiction Scale; RSES: Rosenberg Self-Esteem Scale; IAT: Internet Addiction Scale; BSI-18: Psychopathological screening.

As for possible differences between men and women in the IA (Total Phubbing Scale) and the rest of the variables, significant differences were found in age [M = 24.1 men vs. M = 21.6 women;  $t(1.713) = 5.640, p = 0.001$ ] and no significant differences were found in academic performance ( $p = 0.259$ ). With regard to IA (Phubbing Scale), no differences were found between men and women, with both groups showing the same levels of impairment in communication, obsession with mobile phones, and IA (Total Phubbing Scale). As for impulsiveness (BIS-11 scale), differences were found between men and women in lack of planning [ $t(1.713) = 5.146, p = 0.001$ ] with men having moderately more difficulties in planning than women (Cohen’s  $d = 0.512$ ) and no differences were found in the rest of the factors of this scale. Regarding addiction to mobile phone applications (SABAS questionnaire) and self-esteem (RSES scale), no significant differences were found between men and women. As for mobile phone addiction (IAT questionnaire), differences were found between men and women in emotional investment [ $t(1.713) = 2.091, p = 0.037$ ] with men scoring higher on this variable with a small effect size (Cohen’s  $d = 0.188$ ). With regard to psychopathological screening, moderate differences (Cohen’s  $d = 0.335$ ) were found between men and women in somatisation [ $t(1.713) = -3.266, p = 0.001$ ], i.e., men showed fewer symptoms of somatisation than women. See Table 4.

**Table 4.** Internet addiction scores in men and women ( $n = 715$ ).

Variable	Male ( $n = 128$ ) M (SD)	Female ( $n = 587$ ) M (SD)	t	p	Effect Size
<b>Phubbing (PS)</b>					
Communication Impairment	9.5 (3.0)	9.3 (2.9)	0.744	0.457	-
Mobile obsession	11.7 (2.6)	12.1 (2.5)	-1.345	0.180	-
<b>IA (Total Phubbing Scale)</b>	21.3 (4.9)	21.4 (4.6)	-0.213	0.831	-
<b>BIS-11</b>					
Lack of attention	9.0 (3.0)	8.7 (3.0)	0.819	0.413	-
Lack of self-control	7.8 (2.8)	8.1 (2.5)	-1.00	0.318	-
Lack of planning	6.6 (1.7)	5.7 (1.7)	5.146	<b>0.001</b>	<b>0.512</b>
Impulsiveness	23.5 (5.5)	22.6 (5.2)	1.690	0.091	-
<b>SABAS</b>	15.9	16.3	1.713	0.385	-
<b>RSES</b>	26.5	26.4	0.252	0.801	-
<b>IAT</b>					
Emotional investment	14.3 (9.8)	12.6 (8.2)	2.091	<b>0.037</b>	<b>0.188</b>
Time management and performance	11.3 (7.5)	12.1 (6.9)	-1.169	0.243	-
Mobile addiction	26.6 (16.5)	24.7 (13.8)	0.673	0.501	-
<b>BSI-18</b>					
Somatisation	59.8 (6.0)	61.9 (6.5)	-3.266	<b>0.001</b>	<b>0.335</b>
Depression	64.5 (5.3)	64.8 (5.0)	-0.556	0.557	-
Anxiety	63.7 (5.7)	64.4 (5.3)	0.385	0.222	-
Psychological distress	65.7 (5.4)	66.7 (5.5)	0.637	0.051	-

Note. SD: Standard Deviation; PS: Phubbing Scale; IA: Internet Addiction (Total Phubbing Scale); BIS-11: Impulsiveness Scale; SABAS: App Addiction Scale; RSES: Rosenberg Self-Esteem Scale; IAT: Internet Addiction Scale; BSI-18: Psychopathological screening. Bold values indicate the significance at the 5% level.

As concerns the second objective of our research, regarding the possible relationship between IA (Total Phubbing Scale) and the rest of the psychological variables and academic performance, a simple linear correlation was carried out. To interpret these results, a very low correlation will be considered to exist with an index between 0.01 and 0.19, a low correlation between 0.2 and 0.39, a moderate correlation between 0.40 and 0.69, a high correlation between 0.7 and 0.89 and a very high correlation between 0.9

and 1 [67]. The IA (Total Phubbing Scale) correlated positively and significantly with 11 of the 13 variables analysed: lack of attention ( $r = 0.184; p = 0.001$ ), lack of self-control ( $r = 0.227; p = 0.001$ ), impulsiveness ( $r = 0.221; p = 0.001$ ), app addiction ( $r = 0.687; p = 0.001$ ), emotional investment ( $r = 0.405; p = 0.001$ ), time management and performance ( $r = 0.469; p = 0.001$ ), mobile phone addiction ( $r = 0.474; p < 0.001$ ) as well as all psychopathological screening scales [(somatisation ( $r = 0.181; p < 0.001$ ); depression ( $r = 0.229; p < 0.001$ ); anxiety ( $r = 0.251; p < 0.001$ ) and psychological distress ( $r = 0.244; p < 0.001$ )]. As can be seen, students with higher scores for IA (Total Phubbing Scale) also score more highly for lack of attention, lack of self-control, impulsiveness, app addiction, emotional investment, time management and performance, mobile phone addiction, somatisation, depression, anxiety, and psychological distress, see Table 4. Academic performance correlated negatively and significantly with lack of attention ( $r = -0.202; p = 0.001$ ), lack of planning ( $r = -0.126; p = 0.002$ ), impulsiveness ( $r = -0.186; p = 0.001$ ); self-esteem ( $r = 0.121; p = 0.002$ ), emotional investment ( $r = -0.093; p = 0.013$ ), time management and performance ( $r = -0.104; p = 0.006$ ), mobile phone addiction ( $r = -0.106; p = 0.004$ ), somatisation ( $r = -0.089; p = 0.017$ ) and psychological distress ( $r = -0.084; p = 0.025$ ). That is, students with poorer academic performance scored more highly for lack of attention, lack of planning, impulsiveness, self-esteem, emotional investment, time management and performance, mobile phone addiction, somatisation, and psychological distress (see Table 5).

**Table 5.** Correlation between IA (Total Phubbing Scale) and the rest of the psychological variables and academic performance.

	IA (Total Phubbing Scale)		Academic Performance	
	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
IA (Total Phubbing Scale)	1		−0.021	0.604
Academic performance	−0.021	0.604	1	
<b>BIS-11</b>				
Lack of attention	<b>0.184</b>	<b>0.001</b>	−0.202	<b>0.001</b>
Lack of self-control	<b>0.227</b>	<b>0.001</b>	−0.055	0.178
Lack of planning	0.010	0.800	−0.126	<b>0.002</b>
Impulsiveness	<b>0.221</b>	<b>0.001</b>	−0.186	<b>0.001</b>
<b>SABAS</b>	<b>0.687</b>	<b>0.001</b>	0.021	0.594
<b>RSES</b>	−0.068	0.086	<b>0.121</b>	<b>0.002</b>
<b>IAT</b>				
Emotional investment	<b>0.405</b>	<b>0.001</b>	−0.093	<b>0.013</b>
Time management and performance	<b>0.469</b>	<b>0.001</b>	−0.104	<b>0.006</b>
Mobile addiction	<b>0.474</b>	<b>0.001</b>	−0.106	<b>0.004</b>
<b>BSI</b>				
Somatisation	<b>0.181</b>	<b>0.001</b>	−0.089	<b>0.017</b>
Depression	<b>0.229</b>	<b>0.001</b>	−0.068	0.067
Anxiety	<b>0.251</b>	<b>0.001</b>	−0.013	0.737
Psychological Distress	<b>0.244</b>	<b>0.001</b>	−0.084	<b>0.025</b>

Note. IA: Internet Addiction (Total Phubbing Scale); BIS-11: Impulsiveness Scale; SABAS: App Addiction Scale; RSES: Rosenberg Self-Esteem Scale; IAT: Internet Addiction Test; BSI: Psychopathological screening. Bold values indicate the significance at the 5% level.

Linked to the second objective, stepwise linear regression analysis was carried out to explore the predictive capacity of the variables taken into consideration in IA (Total Phubbing Scale) across the whole sample, regardless of gender. As such, we included those predictor variables for which IA (Phubbing Scale) showed statistically significant correlations in the correlation analysis previously explained. The hierarchical regression model of the predictive ability of the independent variables showed that the four variables that best accounted for IA (Total Phubbing Scale) were: lack of self-control, time management and performance, mobile phone addiction, anxiety, and psychological distress (see Table 5). All these variables together explain 63.4% of the variance in IA (Total Phubbing Scale) (adjusted  $R^2 = 0.263$ ) and we can see a significant linear relationship between IA (Total

Phubbing Scale) and these variables ( $F(3.713) = 44.713; p = 0.000$ ) with a good fit on the regression line. This means 26.3% of IA (Total Phubbing Scale) can be explained by a lack of self-control, time management and performance, mobile phone addiction, anxiety, and psychological distress (see Table 6).

**Table 6.** Hierarchical regression between IA (Total Phubbing Scale) and the rest of the study variables in the total sample.

Model	Non-Standardised Coefficients		Standardised Coefficients		
	$\beta$	Typical Error	$\beta$	<i>t</i>	<i>p</i>
<b>Constant</b>	12.301	2.138		5.753	<b>0.001</b>
<b>BIS-11</b>					
Lack of self-control	0.258	0.065	0.142	3.976	<b>0.001</b>
<b>IAT</b>					
Time management and performance	0.158	0.053	0.237	3.001	<b>0.003</b>
Mobile addiction	0.077	0.027	0.230	2.795	<b>0.005</b>
<b>BSI</b>					
Anxiety	0.164	0.056	0.189	2.955	<b>0.003</b>
Psychological Distress	0.112	0.056	0.133	1.989	<b>0.040</b>

Note. Phubbing: Phubbing Scale; BIS-11: Impulsiveness Scale; IAT: Internet Addiction Test; BSI: Psychopathological screening. Bold values indicate the significance at the 5% level.

Finally, we will examine the results of the last objective studying the relationship between IA (Total Phubbing Scale), Phubbing, and SMC in a university population. After analysing the data from the sample of 715 participants, it was observed that 64.3% reported difficulties with mathematics, and so it was decided to further analyse this objective in a sub-sample of 56 students from UAO CEU [(85.7% were female; mean age 21.4 years (SD = 1.7) and mean grade 7.2 (SD = 0.8)]. In this case, the students in the sample obtained a moderate score on the Phubbing questionnaire of 20.1 (SD = 4.5, range 8 to 30), a moderate score on mobile and internet obsession (M = 10.1, SD = 3.0), followed by impaired communication (M = 9.9, SD = 2.6). This indicates that the IA (Total Phubbing Scale) reported by the students is in the moderate range. In terms of impulsiveness, the students in our sample obtained a moderate score of 32.1 (SD = 5.8, range 21 to 40). On the other hand, students believed they have a low SMC (4 out of 10). A total of 78.6% of students say they use new technologies (mobile, internet, apps) to perform simple mathematical calculations in their daily life (such as adding, subtracting, multiplying, and dividing) and 71.0% of students believe that the use of new technologies has worsened their SMC when performing simple everyday operations. Furthermore, no significant differences in SMC were found between males and females and SMC did not correlate with age, nor with academic performance. However, correlations were found between SMC and communication impairment ( $r = 0.353, p = 0.001$ ), mobile phone obsession ( $r = 0.541, p = 0.012$ ), IA (Total Phubbing Scale) ( $r = 0.552, p = 0.001$ ) and impulsiveness ( $r = 0.363, p = 0.006$ ).

#### 4. Discussion

The first objective of this study was to investigate the relationship between IA (Total Phubbing Scale) and Phubbing with psychological variables (impulsiveness, self-esteem, and psychological distress), app and mobile phone addiction, and academic performance, as well as possible differences in these variables for gender. As for the description of these variables, the moderate score obtained for IA (Phubbing Scale) in our study seems to be in line with those presented in the recent article [68], which aimed to study the relationship between demographic variables, personality, social network addiction and the fear of missing out with IA and phubbing in a sample of 938 university students. With regard to app addiction, our students showed very similar scores when compared to the results and

similar scores for emotional investment, time management, and performance, and IA when compared with the results of the sample (also Spanish) [27,69]. As regards self-esteem, our students showed worse self-esteem compared to the Spanish sample, and, comparing our results with those with a sample of 136 students from the same university, the young people in this research showed greater levels of somatisation, depression, anxiety, and psychological distress than students from the same university two years ago [64,70]. Furthermore, possible gender differences were studied, showing that males in our sample presented more difficulties with planning (impulsiveness questionnaire BIS-11) than females.

In general, few studies have addressed gender differences in impulsiveness in young people with IA. However, our data contradict those obtained by another study where differences were observed between adolescent males and females exhibiting IA, with females exhibiting greater impulsiveness along with higher rates of non-adaptive mobile phone use than males [71]. Our results also do not reproduce the trends found in a study where females exhibited higher rates of IA along with lower values of self-control, thus denoting more impulsive behaviour in terms of their use of the virtual environment [72]. Differences in methodology and age between their sample and ours (range 14–19 years vs. mean 22 years, respectively) could explain the discrepancy between our data and theirs, leading us to hypothesise that perhaps as age increases, impulsiveness in females tends to decrease with regard to IA. Studies with larger, longitudinal samples and the inclusion of other gender-differentiating variables could provide further insight into this issue. Secondly, the fact that the men in our sample showed higher levels of emotional investment in the Internet addiction scale is controversial when compared with the findings of studies with Spanish university samples [73], although they are in line with the findings of other studies with non-Spanish samples [74,75]. In general, research points to the existence of gender differences in internet use and phubbing, with men and women showing different patterns of use [68,76], so our data seem to be in line with this information. Somatisation is yet another element where differences have been observed between men and women, the latter presenting greater levels of somatisation, and this result is in line with many studies that link the presence of higher rates of somatisation in young people presenting IA [77–79].

The second objective of the research concerned the relationship between IA (Total Scale Phubbing), with psychological variables, and academic performance, establishing a predictive model of the variables taken into consideration on IA. The IA predictive model showed that 26.3% of IA can be explained by mobile addiction, lack of self-control, time management, anxiety and psychological distress. In line with other studies, our results highlight the importance of assessing the number of hours spent on mobile phones and the presence of clinical symptomatology as predictors of IA among young people [80]. In addition, a lack of self-control in IA and phubbing has been highlighted in other studies similar to ours, in which both the number of hours spent, compulsive behaviour towards the mobile phone, and other demographic and psychological variables such as isolation, depression, and attitudes towards the academic area may act as predictors of IA [81,82] and phubbing. Furthermore, in samples of Spanish university students, it has also been found that IA aggravates students' depressive and anxiogenic states and reduces their capacity for self-control [30]. These variables, together with low self-esteem, low physical activity, and low academic self-efficacy were associated with IA as indicated in the recent meta-analysis [83]. Also related to this second objective, it was found that students with poorer academic performance showed a greater lack of attention, planning, impulsiveness, self-esteem, emotional investment, time management and performance, mobile phone addiction, somatisation, and psychological distress in line with other studies. Our findings are in line with previous research, confirming the fact that IA interferes with the attention-related processes required to read or follow a class [44,45], hinders students' time organisation [47] and, consequently, academic performance [17]. This is an emotional investment that also has physical (e.g., lack of sleep) and psychological consequences [26] which ultimately compromises their quality of life [20].

As regards the third objective, which sought to explore the relationship between IA, phubbing and SMC in the university population, it was surprising that those who reported better SMC indicated greater levels of impaired communication, mobile obsession, IA (Total Phubbing Scale) and impulsiveness. Our study opens up an interesting new line of research related to the fact that students who perceive themselves as more competent may devote attentional resources to perform a multitude of tasks in the course of their classes, including checking their mobile devices [44,45]. The importance of teachers employing active teaching strategies that link theory and practice [54] may lead to improved sustained attention during lessons in mathematical subjects, using their mobile devices to consult subject-related information and interact with each other in the course of collaborative activities [58].

Related to possible practical implications, our results indicate a relationship between SMC and impaired communication. The direction of this relationship needs to be understood in depth, but it underlines the importance of communication in mathematics learning, in particular, as previous research has indicated, two-way communication between student and teacher [44]. Similarly, the integration of pedagogical tools in mathematics subjects as part of psychology degree programmes, such as apps [84] or open-source online editors [58], can foster improved interaction between teachers and students. Our results have also alerted us to the role played by a high degree of impulsiveness, which may result in students finding in IA and phubbing behaviour a way to reduce levels of anxiety and distress. Developing pedagogical strategies taking into account certain student personality traits that increase levels of mathematics anxiety will result in better learning and performance in mathematical subjects at university. Finally, the fact that SMC does not correlate in our research with academic performance may be due to the fact that the mathematical content studied by the members of our sample represents a minor part of their academic curriculum. However, our results highlight the role played by teachers' willingness and proposed use of ICT in the classroom, as this can be a positive modelling element with a clear purpose of improving teaching-learning processes [85]. Moreover, following the comprehensive model of university tutoring [86] in tutoring, the student's learning skills can be evaluated, such as planning and time management, attention and concentration, cognitive functions related to the SMC, and academic performance. In addition, in university tutoring, signs of risk for AI or phubbing can be detected that will affect academic performance, including subjects related to mathematics that, as mentioned, are perceived as very complex [45–47]. In addition, in this discipline, communication is especially important in the learning process between teacher and student [44], a fact that would help reduce anxiogenic reactions towards them [44,48,49]. In this first psychoeducational intervention of AI and phubbing within university tutoring, some guidelines for students could be included, such as [87]: Recommend establishing a predefined schedule for mobile use, with particular emphasis on moving the device away during study time or suggest looking for rewarding leisure spaces where you do not have to resort to the use of mobile phones.

In conclusion, ICT is fully implemented in the university academic environment, including in the teaching of subjects with mathematical content. Inappropriate use may lead to IA and phubbing, low SMC, lack of self-control, poor time management and performance, anxiety, and psychological distress, all of which may negatively affect students in their intellectual activity. The predictive model of IA shown highlights the importance of proper management of time spent on mobile phones, the regulation of impulsiveness, the use of self-control, and anxiety strategies, all variables that should be included in educational and clinical prevention and intervention programmes. Specifically, at the educational level, some of the pedagogical recommendations for the teaching of mathematics that have been mentioned above can be deduced, such as: the use of ICT resources to increase students' attention and involvement in classes, the use of ICT as spaces to improve communication between teachers and students, the importance of considering students as individuals, taking into account personal traits that influence their learning, and considering the subjects

themselves as an educational space for healthy use of ICT, thus preventing addictive behaviour in students.

This study does have certain limitations. Firstly, our sample comprised mainly of female university students, and the results cannot be generalized. Future studies should include male students from other types of university degrees and use broader samples to corroborate the results of this study. Also, our sample consisted of students from a single country, so the extent to which the results can be generalised is limited. Future research could include samples from other geographical areas for comparison. Similarly, longitudinal studies on the population already suffering from IA could have an impact on improving prevention and intervention in this area. Methodological differences in the type of questionnaires used in the different studies may hinder comparability between them, and the descriptive design of this work prevents the establishment of causal relationships. Finally, the inclusion of other cognitive, psychosocial and academic variables could be the subject of future research. Despite these limitations, this study adds to the scarce literature available on the relationship of IA and Phubbing with psychological variables, SMC, and academic performance, variables that should be taken into account in order to increase the psychological and emotional well-being of young people.

**Supplementary Materials:** The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/math10152631/s1>, Supplementary File S1: Questionnaire on self-perception of mathematical competence and Internet Addiction.

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