Problematic Smartphone Use and University Students' Academic Performance

Corrado Petrucco[a,1], Daniele Agostini[b]

[a]University of Padua, Dept. of Philosophy, Sociology, Pedagogy and Applied Psychology – Padua (Italy)

[b]University of Trento, Dept. of Psychology and Cognitive Sciences – Trento (Italy)

Abstract

One of the most pressing emergent educational issues addressed by the international research literature concerns the effects that excessive or problematic smartphone use can have on students' academic performance. An exploratory study was thus carried out with 46 students enrolled in a five-year degree program at the University of Padova (Italy) who were asked to provide their perceptions of their level of smartphone dependence and academic performance. Findings seem to indicate a significant correlation between high levels of smartphone addiction, difficulty concentrating while studying, and a frequent tendency to procrastinate on completing assigned tasks. Responses regarding smartphone distraction during in-person classes were particularly interesting: over 75% of respondents reported using their smartphones frequently in class. In order of importance, their reasons for doing so were to view and answer social media messages (61%), "boredom" due to the teaching strategies employed by some teachers in presenting lessons (41%), and the need to take a break from concentrating in class (35%). Lastly, smartphone use and its effects on academic performance involve three principal components: usage time, distraction in class, and frequency of smartphone checks. Smartphone usage time seems to have a direct negative effect on exam grades. Distraction in class is most significant for respondents who use their smartphones for messaging, while the frequency with which respondents check their smartphones is inversely proportional to their age. To limit these problems, we suggest that proven educational and teaching strategies be used to raise students' awareness of smartphone addiction, encourage students to participate actively, and use the smartphone as a teaching tool. As the study's findings are based on a self-report questionnaire, they reflect students' perceptions. To more accurately assess and confirm these findings, planned future fieldwork will monitor smartphone dependence during class and determine the actual amount of time students spend on their smartphones and how it correlates with academic performance.

KEYWORDS: Smartphone Addiction, Higher Education, Innovative Teaching, Educational Technology, Mobile Phones.

1. Introduction: Smartphone Addiction

1.1 A particular kind of addiction

The concept of technology addiction or dependence is by no means new and refers to the excessive and disordered use of a specific device, such as a video gaming console or a personal computer, for surfing the Web. Smartphone addiction or Problematic Smartphone Use (PSU) (Kuss et al., 2018) is usually classified under the broader heading of behavioural addiction, or in other words, a behaviour that results in dependence and at the same time can also cause a series of physical symptoms (APA, 2013). Though very similar to other forms of dependence, smartphone addiction is riskier because the smartphone has become an indispensable tool we carry wherever we go.

There can be many signs of dependence, including:

- Loss of a sense of time.

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[1] corresponding author - email: corrado.petrucco@unipd.it – address: via Beato Pellegrino, 28, 35137, Padua (IT)

- Difficulty in completing tasks involving work, family or school commitments.
- Euphoria when online, and anxiety and depression when offline,
- Using and/or keeping the smartphone on during the night, and lastly
- "Phantom vibration syndrome", or the continual tension about missing a call or text.

1.2 Nomophobia and interpersonal relationships

If deprived of their phone for some reason, people with smartphone addiction can show signs of restlessness and anxiety, developing into a syndrome that has been dubbed nomophobia or no mobile phone phobia (Yildirim & Correia, 2015). Nomophobia chiefly entails (Bragazzi, Re & Zerbetto, 2019):

- The fear of being unable to communicate;
- The feeling of being disconnected from virtual communication platforms and thus not being kept up to date in real-time;
- The fear of not being able to access potentially important information;
- The fear of giving up the convenience of having a smartphone.

The smartphone is a highly personal device that can inspire strong emotional attachment, which can relieve everyday stress (Cho, Kim & Park, 2017). As such, it is very similar to what psychology calls a "comfort object" or "transitional object" that provides emotional security but can create anxiety if unavailable. This form of addiction appears to be particularly prevalent among young people (De-Sola Gutiérrez, 2016): several studies suggest that dependence in younger age groups is heavily influenced by factors associated with family and/or social environments. Poor family functioning, for example, with conflict and lack of communication, can be highly predictive of smartphone addiction in adolescents (Li et al., 2018). Accordingly, the risk of addiction is especially high in schools and universities precisely because of the problems that can arise in peer relationships (Jeong & Gweon, 2020). The more critical these relationships become, the more strongly they correlate with smartphone addiction: indeed, the lack of quality relationships can exacerbate excessive phone use. It is thus not surprising that with the social distancing measures introduced during the pandemic and the decision to adopt distance teaching, many students spent excessive amounts of time online with their smartphones, increasing their dependence and developing symptoms of anxiety and depression (Servidio et al., 2021).

2. Diagnosing smartphone addiction

2.1 Smartphone Addiction Scale

"Diagnosing" smartphone addiction is not easy, as it involves considering a wide range of *qualitative* factors (psychosomatic manifestations, felt emotions, etc.) and *quantitative* factors (usage time, number of online interactions, etc.). The most widely used instrument for gauging the level of dependence is the SAS, Smartphone Addiction Scale (Kwon et al., 2013). Though the SAS is useful, it relies on self-perceptions and thus does not provide objectively measured data. Several studies, in fact, have found that self-report estimates of smartphone usage are not entirely reliable (Wilcockson, Ellis, & Shaw, 2018). There is also a short version of the SAS, the SAS-SV, which has been adapted in several languages and cultural contexts (including Italy) and targets adolescents. It consists of 10 items tapping various aspects of smartphone addiction (Table 1).

Table 1 - Smartphone Addiction Scale Short Version for Adolescents (Kwon et al., 2013).

n.	SAS-SV Scale items
1	Missing planned work due to smartphone use.
2	Having hard time concentrating in class, while doing assignments, or while working due to smartphone use.
3	Feeling pain in the wrists or at the back of the neck while using a smartphone.
4	Won't be able to stand not having a smartphone.
5	Feeling impatient and fretful when I am not holding my smartphone.
6	Having my smartphone in my mind even when I am not using it.
7	I will never give up using my smartphone even when my daily life is already greatly affected by it.
8	Constantly checking my smartphone so as not to miss conversations between other people on Twitter or Facebook.
9	Using my smartphone longer than I had intended.
10	The people around me tell me that I use my smartphone too much.

3. Smartphone addiction and distraction effects

3.1 Distraction effects caused by smartphones

Threats to students' attention in class by no means began with the smartphone: "mind wandering" has long been recognised as a problem (Wammes, 2019). However, mind wandering is innate to everyone's mental life and does not require cognitive activity of any kind in interacting. By contrast, using smartphones calls for significant cognitive effort to deal with the continual feedback required by social media, for example, and thus aggravates the problem of inattention (Marty-Dugas et al., 2018). Several studies have found that, on average, 50% to 70% of students check their smartphones at least once during a lecture and that few are able to resist the temptation (Atas & Çelik, 2019). A smartphone ringtone or notification heard during a lesson or while doing an assignment that requires concentration reduces academic performance just as much as actively using the phone (Stothart et al., 2015). Even the smartphone's mere presence is a critical factor significantly reducing the brain's available cognitive capacity (Ward et al., 2017). Models have recently been developed that seek to formalise the most essential variables operating in distractive smartphone use (Throuvala et al., 2021), finding that such use is driven primarily by the need for validation and control of self-presentation on social media and can be amplified by syndromes such as FOMO, or Fear Of Missing Out and the need to seek reassurance from continual feedback and new posts (Elhai et al., 2020).

3.2 The challenges of integrating smartphones into teaching

The use of smartphones in formal educational settings can thus be a powerful distraction, but whether it is or not also depends on teachers' ability to hold their students' attention: it appears that students engage more with their smartphones primarily when they are bored by the lesson (Green, 2019) or when topics they consider less critical are being covered (Bolkan & Griffin, 2017). However, the problem also arises when teachers attempt to use smartphones in specific learning activities with the BYOD (Bring You Our Own Device) model. In such cases, the student is required to perform two simultaneous and cognitively challenging tasks: listen to what the teacher is saying and at the same time, work with the mobile device. This multitasking is frequent and inevitable, and according to recent studies, can have a negative impact not only on attention but also on recall, comprehension and efficiency in completing academic tasks (May & Elder, 2018). The risks for learning processes are high. Extensive research literature demonstrates that students who do not use smartphones in class take notes more effectively, have better recall of lecture content, and show higher overall performance than those who do (Flanigan & Titsworth, 2020). Even students who are interested in the lecture and attentive may attempt to multitask with their smartphones, with the same negative impacts we have just described. The time spent on the smartphone outside the school setting is also an important indicator, as it often interferes with students' rest, relaxation and studying. (Gui & Gerosa, 2021; Lee et al., 2014).

4. Methodology

This exploratory study collected data and evidence for future work with larger samples. The research questions were as follows:

1. How much does excessive smartphone use influence university students' academic performance? What are the possible causes of excessive use?
2. Are there strategies that teachers can implement to curb the potential harm caused by smartphone addiction?

4.1 Instruments and sample

To answer the research questions, we created a questionnaire with 19 items (Table 2). Only a few of these items were taken from the SAS-SV because the goal was not only to measure the level of smartphone dependence but also to determine which habits involved in students' relationship with the smartphone can have a negative impact on academic performance and the number and nature of the smartphone's distraction effects. The ultimate aim is thus to gather information that can be useful in making students aware of the problem and proposing solutions to it.

The questionnaire, which mainly consisted of items on a 5-point Likert scale, was administered online to 46 students (F=43, M=3) with an average age of 24 years, all enrolled in the first year of the five-year degree program in Education Sciences and Primary Education Sciences for the academic year 2021/2022.

4.2 Analyses

The analysis of the responses from the questionnaire involved multiple stages and was conducted using Jamovi software, an open-source platform that utilises R as its engine. The initial stage of the analysis involved generating descriptive and frequential statistics to provide a preliminary overview of the

Table 2 - Adapted Questionnaire Items.

n.	Questionnaire items
	Demographics
1	Age
2	Gender
3	Current grade point average
	Smartphone usage
4	Average daily hours of smartphone use
5	Right number of hours of smartphone use for people your age
6	What do you normally use your smartphone for?
7	I use my smartphone even when I should be finishing more important things. (5-point Likert scale)
8	I spend more time on my smartphone than I should. (5-point Likert scale)
9	I use my smartphone in bed until late and fall asleep with it on. (5-point Likert scale)
10	Constantly checking my smartphone so as not to miss conversations between other people on Twitter, Instagram, Facebook or other social media. (5-point Likert scale)
11	I prefer studying with my smartphone than with my computer. (5-point Likert scale)
12	What are the greatest difficulties you have studying with your smartphone rather than your computer?
	Distractions in class and while studying
13	What is the greatest source of distraction during in-person classes? (5-point Likert scale)
14	If you use your smartphone during class, what are the reasons?
15	Do you think teachers ought to prohibit smartphone use during class? (5-point Likert scale)
16	When I'm studying, I manage to concentrate only for short periods. (5-point Likert scale)
	Openness to proposals
17	Do you think it would be useful to attend a seminar on how to deal with excessive smartphone dependence and its consequences on academic performance? (5-point Likert scale)
18	Do you think it would be useful to attend a seminar on how to deal with excessive smartphone dependence and its social consequences? (5-point Likert scale)
	Optional item
19	If you were told you could choose a big gift, would you pick a new smartphone, or something else?

collected data. Subsequently, a correlation matrix was constructed to identify potential interactions between variables. The third stage involved conducting a Principal Component Analysis (PCA) to synthesise the data and identify latent variables. Another correlation matrix was then created to examine any correlations between the components identified in the PCA and other variables. Finally, a logistic regression analysis was conducted to determine the influence of the identified components and other relevant variables on the students' grade point average (GPA).

5. Results

The situation emerging from descriptive analysis was as follows:

- There is no consensus among students about how much time should be spent on the smartphone daily: responses range from "less than an hour" to "5 hours", though the majority think the right time is between 1 and 2 hours.
- Most respondents use their smartphones more than they think they should (median 4 hours). However, the number of hours considered right and the actual number of use are directly proportional.
- The smartphone is the second-greatest source of distraction during class (76%), immediately after talking to classmates (80%).
- 60% of the respondents say that the smartphone is a source of distraction because of notifications from social media or chatgroups.
- 41% of the respondents say that the smartphone is a source of distraction because lessons are boring.
- Only a minority (median Likert score 2 out of 5) thinks that instructors should prohibit smartphone use in the classroom.
- Smartphones are used chiefly with chat apps (89%) and social networks (74%). 72% of the respondents carry out personal web searches, and only 63% use the smartphone to make calls.
- Few respondents use smartphones instead of computers for academic tasks (median 2).
- Respondents are open to being educated in correct smartphone use (median 4 for both proposed seminars).

A correlation matrix was then constructed, which provided some interesting insights.

Distraction and grades

There is a fairly sizable negative correlation (r=-0.453, p=0.002) between having a smartphone as the most significant source of distraction in class and grade point

average (GPA); respondents who are distracted by talking with classmates do not seem to have the same problem. Lastly, as can be expected, respondents who are not distracted in class are more likely to do well on exams (r=0.389, p=0.008).

Grades and night-time smartphone use

A small negative correlation (r=-0.322, p=0.031) exists between GPA and falling asleep while using the smartphone in bed until late at night.

Smartphone distraction and procrastination

Respondents who are distracted by their own smartphone in class are also likely to be distracted by other people's phones (r=0.482, p=<.001) and generally use their smartphones even when they ought to be finishing more important things (r=0.524, p=< .001).

Types of smartphone distraction

The findings confirm that the smartphone activities that cause the most distraction during class are messaging and using chat apps (r=0.392, p=0.008). All other activities do not influence classroom distraction. Using messaging and chat apps also interferes with concentration while studying (r=0.494, p=<.001), as does using the smartphone despite having more urgent commitments (r=0.510, p=< .001). Interestingly, respondents who use their smartphone to make calls tend not to be distracted by their phone during class (r=-0.305, p=0.042), indicating that this is a radically different way of using the phone than messaging.

As the second step, we sought to summarise the data and find latent variables with Principal Component Analysis.

Three particularly significant components were identified (Table 3) and labelled as follows:

1. Smartphone usage time;
2. Generic distraction in class;
3. Frequency of smartphone checks.

Table 3 - Principal Component Analysis: statistics.

Component	SS Loadings	% of Variance	Cumulative %
1 Time	4.01	13.8	13.8
2 Distraction	3.52	12.1	25.9
3 Frequency of use	3.02	10.4	36.4

Analysing these components with a correlation matrix confirmed some earlier findings and brought several new points to light: the "smartphone usage time" component is negatively correlated with GPA (r=-

0.327, p=0.029) and positively correlated with both proposed seminars (r=0.358 and r=0.337).

The "frequency of smartphone checks" component has a strong negative correlation with student age (r=-0.535, p<.001); in other words, younger students check their phones more frequently than older students.

The "generic distraction in class" component, which includes all types of distraction, does not seem to affect the other variables. However, it is influenced by variables such as using the smartphone with chat apps (p=0.043). It is interesting to note that searching the Web for study purposes—which is part of this component—has a negative factor loading (-0.429). This is borne out by the correlation matrix as regards distraction caused by "studying other things" during class (r=-0.298, p=0.047).

Lastly, a logistic regression analysis was run. The students' GPA was the dependent variable, while the independent variables included in the model were the three principal components identified in the PCA: 'smartphone usage time', 'generic distraction in class', and 'frequency of smartphone checks'. These components were selected as independent variables because they represented key dimensions of smartphone use and its effects on academic performance, as identified in the PCA. The results confirm that the component that can have the most negative influence on GPA is "smartphone usage time" (p=0.030).

6. Discussion

After organising and interpreting the findings of the various analyses, we can say that our sample shows that excessive smartphone use undoubtedly negatively influences academic performance. This confirms the findings of several studies and meta-analyses (Amez & Baert, 2020; Kates, 2018).

In particular, smartphone distraction in class directly influences academic performance, unlike other types of distraction. The data show that the activity with the most deleterious effect on attention and the ability to study is the use of messaging and chat apps, as found earlier by Carrier et al. (2015).

This can be explained by the push notifications and previews displayed on the smartphone home screen: messaging apps keep the user's attention by making it possible to read messages (and, in some case, to respond) directly on the phone's notification panel.

Other literature maintains that social media use causes the most distraction and disturbance in class and while studying (Dontre, 2021). However, this is not entirely at odds with our findings, given that social media often provide messaging functions.

In analysing the distraction mechanisms, respondents who are distracted by their smartphones in class are also likely to be distracted by other people's smartphone activity, making them even more vulnerable to adverse effects during class.

In addition to causing distraction in class and while studying, excessive smartphone use leads to habits that can undermine students' productivity in informal, non-university settings. For example, it can encourage procrastination, or in other words, using the smartphone when there are more pressing things to be done, thus putting off essential commitments or activities (Li, Gao & Xu; 2020; Rozgonjuk, Kattago & Täht, 2018; Yang, Asbury & Griffiths, 2019). Similarly, habitual smartphone use at bedtime (Geng et al., 2021) can result in poor sleep quality, leading in turn to consequences such as anxiety and depression (Huang et al., 2020; Mac Cárthaigh, Griffin & Perry, 2020; Yang et al., 2020; Lanaj, Johnson & Barnes, 2014; Demirci, Akgönül & Akpinar, 2015). All these habits and their consequences can potentially be detrimental to academic performance: nine per cent of the respondents report using their smartphones for more than five hours a day, the threshold after which there is an increased risk of sleep problems (Huang et al., 2020).

Some respondents state that they are not distracted during class and, in fact show better academic performance. However, what sets these students apart? In general, they spend less time on their smartphones and are older than the others. Above all, they use their phones less frequently and do not feel the urge to check continually for notifications and news.

One positive sign is that the respondents realise that they use their smartphones too much, and those who use them most are also the most open to the proposed seminars on responsible smartphone use.

7. Conclusions

On the basis of the foregoing considerations, we can formulate several proposals for dealing with problematic smartphone use:

- *Students should be made more mindful of smartphone addiction* through targeted seminars and courses, given that respondents— and especially those who use their smartphones most — are open to such a proposal. Schools or universities can be the settings where addictive behaviours in smartphone usage emerge most prominently, precisely because they come into direct conflict with institutional, behavioral rules. However, within these settings, educators can intervene with targeted activities to make students aware of the problem and implement specific programs, sometimes akin to actual "detox programs", yielding intriguing experimental results (Schmuck, 2020). Typically, these initiatives involve not only enforcing punitive actions, such as phone confiscation or shutdown, but also working on mindfulness processes and cognitive-behavioural therapies (Lan et al., 2018).

- *Using teaching strategies where the student is not merely a passive listener*, as in the classic professorial lecture, could help solve most of the problems caused by distraction.

- *The smartphone should be used as an active teaching tool*: lectures are seen as a frequent cause of student boredom, and students who take an active and interactive attitude towards their smartphone will be less likely to use it for activities that are not consistent with classwork. This approach appears to have positive effects on student's academic performance (Han & Yi, 2019; Ng et al., 2017) and, at the same time, seems not to lead to the negative effects of using the smartphone for other purposes (Lin et al., 2021).

- *Students should be encouraged to use apps that help deal with smartphone addiction* and limit usage time, such as Digital Wellbeing, Hold and Forest.

Recent research reports seem to confirm that students who have been involved in one or more such initiatives show significantly lower levels of observed distraction, as well as increased mindful awareness and sense of self-efficacy in dealing with excessive smartphone use (Gámez-Guadix & Calvete, 2016; Throuvala, 2020). The smartphone itself can help if it is used as a tool for active learning and/or together with digital wellbeing apps to limit its use and reduce problematic behavior such as procrastination (Lukas & Berking, 2018): as we have seen, it is not the device itself that is problematic, but its excessive use in inappropriate settings. We thus believe that potential solutions should show a common denominator: all should approach the problem from an educational perspective.

Limitations

The study is based on students' self-reported perceptions and should be extended numerically with a larger group, qualitatively with a more heterogeneous group and methodologically to include objective "field" observations of students' behaviour during class to determine whether their problematic smartphone use is confirmed, underestimated or overestimated. Due to the aforementioned reasons, the results can not be generalised at the moment.

Attribution

Although this paper is the result of joint research between the two authors, and each of them supervised and reviewed the paper as a whole, single paragraphs can be attributed as follows: 1, 2, 3: C. Petrucco; 4, 5: D. Agostini; 6: C. Petrucco & D. Agostini.

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