



The Psychological Impact of Online Learning During the COVID-19 Pandemic. A Survey on a Sample of Italian Undergraduates

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Abstract. The COVID-19 pandemic created a risk to all educational system levels, ranging from primary to university grades, due to social restriction measures of isolation worldwide.

Switching from the traditional educational system to Online Learning (OL) was challenging for many undergraduates due to the lack of Internet connectivity or digital devices and a suitable home study environment. Therefore, a survey study on a sample of 1069 undergraduates (78.5% female; Mage = 21.72; SD = 4.05) investigated the interrelation among psychological skills for managing learning habits and strategies, academic achievement, social interaction, and mental health problems during the COVID-19 pandemic was performed. Results showed a significant effect of the COVID-19 pandemic on study variables related to online learning due to individual differences in self-efficacy, academic motivation, and anxiety. Moreover, university students reported higher physical and mental health problems since the COVID-19 pandemic has had a significant psychological impact.

Keywords: Online Learning · university students · Self-efficacy · Trait anxiety · Mental Health · COVID-19

1 Introduction

The COVID-19 pandemic created a risk to all educational system levels, ranging from primary to university grades, due to social restriction measures of isolation worldwide [1]. Online Learning (OL) was challenging for many university students because of the lack of Internet connectivity or digital devices and a suitable home study environment [2]. Uncertainty, plan modification, and delays in the graduation and post-graduation plans timeline are reported by literature [3] and lower scores in the final examinations, especially in all students with low Internet connectivity or limited access to devices [4, 5].

A recent review study about the COVID-19 pandemic on university students reports a significant impact on mental health with increasing stress levels, anxiety, and depressive symptoms because of changed delivery and uncertainty of university education, technological concerns of online courses, being far from home, social isolation, decreased

family income, and future employment [6]. It must be noted that these impacts have been observed in universities across the world [7]. During the COVID-19 pandemic, anxiety had the highest prevalence among mental health disorders among university students [8].

To better understand the negative consequences of the COVID-19 pandemic on mental health, scholars investigated psychological variables that could predict or prevent developing anxiety or depression, such as self-efficacy and academic motivation.

Self-efficacy, which refers to beliefs in one's capabilities to organize and execute all actions required to produce given attainments, seems to be a strong predictor for mental health in a sample of 3190 Turkish [9]. Self-efficacy beliefs are also strongly associated with the negative effect of the COVID-19 pandemic on individuals' goal pursuits. People with low self-efficacy beliefs from before to during the pandemic were unsure or did not believe they could still carry out their goals and either abandoned or were uncertain they could pursue their goals [10]. Significant associations between self-efficacy and perceived ineffectiveness of OL are reported, too [11].

Another crucial psychological variable that seems to affect the OL of students during the COVID-19 pandemic is academic motivation. As defined in the theoretical framework of Self-Determination Theory [12], academic motivation refers to the individual level of regulation and self-determination to pursue an academic goal. It ranges along a continuum from intrinsic motivation to amotivation alongside six different forms of motivation – i.e., intrinsic regulation, integration, identification, introjection, external regulation, and amotivation. They are categorized into two main groups: *autonomous* – i.e., intrinsic, integrated, and identified motivation – and *controlled* – i.e., introjected, external, and amotivation, respectively. In detail, intrinsic motivation drives people to attain personal aims such as enjoyment, curiosity, satisfaction, and interest. Integrated motivation drives people to pursue goals related to an individual's self and unique value system, whereas identified motivation pursues behaviors acknowledged for their underlying benefits. Introjected motivation drives behaviors moved by external sources internalized, and external regulation drives behaviors entirely moved by external causes. Finally, amotivation drives behaviors categorized by lack of intention or interest in the activity. A recent study compared two samples of Italian and Portuguese children in grades 1 to 9 involved in OL activities during the COVID-19 pandemic and found a decrease in students' academic motivation in Italy and Portugal, although higher in Italian students. Results also indicated that students with low levels of academic motivation also decreased participation in extracurricular activities [13]. Similar associations between academic motivation and COVID-19 distress are reported in a sample of undergraduate students who also decreased their sense of belonging to their university [14].

In Italy, university institutions switched to OL in March 2020, in the middle of the semester, with multiple direct consequences for students forced not to attend classes and laboratories physically and limited the traditional face-to-face contact with their teachers and between themselves.

The present paper aims to describe the impact of OL during the COVID-19 pandemic on a sample of undergraduates considering their psychological profiles and a series of variables related to their OL activities, such as learning habits and strategies, and their academic achievement.

In the literature, most studies compared the effectiveness of OL with face-to-face learning activities showing that specific learning strategies are necessary to enhance students' quality of interactions in OL systems. For example, students must apply strategies to identify relevant information, process information and learning materials, keep learning on track, organize learning and materials, and avoid internal and external distractions [15]. Compared to traditional classrooms, the OL is more suitable for self-regulated students who can do synergic actions of thoughts, feelings, and efforts to plan and achieve personal learning goals [16]. Furthermore, recent studies show that during the COVID-19 pandemic, university students often obtained lower scores in the final examinations, especially in all those cases of students having problems at home with Internet connectivity or limited access to devices [4].

The study measured students' mental health troubles and requests for help during the COVID-19 pandemic since these variables have had little attention to date [4, 17].

A survey performed on a sample of undergraduate students participating in the OL activities during the COVID-19 s-wave Italian lockdown phase in March-May 2021 was designed to gain these aims.

2 Method

Participants

A total sample of 1028 undergraduates attending courses for the first-level degree participated in the survey.

Table 1 shows the socio-demographic composition of our sample. Specifically, our sample is mainly composed of female (78.4%) in-course students (96.2%) attending the first year of bachelor's degree courses (60.5%) in the humanities area (59.6%) with a mean age of 21.10 years ($SD = 2.45$). In addition, during the COVID-19 social restriction measures, a high percentage of students lived in big city apartments (48.8%), but a minority were in small city areas (26%), even if all were with their parents (94.1%).

Table 1. Socio-Demographic Composition of the total sample of university students (N = 1028)

	%
Gender	
F	78.4
M	21.6
Degree Course	
Bachelor	60.5
Master	0
5-years Course	39.5
Status	

(continued)

Table 1. (continued)

	%
In-Course	96.2
Outside-Course	3.8
Areas	
Arts	1.1
Linguistic	6.1
Professional	13.6
Scientific	4.7
Technical	15.1
Humanities	59.6
Types of dwelling	
City Apartment	48.8
Country or Beach House	9.2
Flat with a garden home in cities with < 60,000 citizens	10.1
Apartments in cities with < 60,000 citizens	26.0
Townhouse with garden home	4.3
Country or Beach Apartment	1.6

Psychological Assessment

All participants were assessed using the following psychological measures:

General Self-efficacy Scale (Italian version) [18]

The scale is a self-report measure of self-efficacy. It is a ten-item scale with good internal reliability (Cronbach's alphas between .76 and .90) and validity. It positively correlates with emotion, optimism, and work satisfaction and negatively with depression, stress, health complaints, burnout, and anxiety. Each item is rated on a 4-point scale with anchors 1: Not at all true and 4: Exactly true. The total score was computed for each scale by finding the sum of all items. For general self-efficacy, the total score ranges between 10 and 40, with a higher score indicating a more general self-efficacy. In the present study, the standardized Cronbach's α coefficient of general self-efficacy was .842, in line with the literature [18].

Academic Motivation Scale (AMS- Italian version) [16]

The AMS measures intrinsic, extrinsic motivation, and amotivation across many academic disciplines as defined in the light of Self-Determination Theory [19]. In the present study, the Italian version of the AMS, provided by [20] was used, consisting of five subscales, each of four items rated on a 4-point scale with anchors 1: Not at all true and 4: Exactly true, and measuring Amotivation (e.g., *Honestly, I don't know; I really feel that I am wasting my time in school*; Cronbach's $\alpha = .86$), External Regulation (e.g., *To obtain a more prestigious job later on*; Cronbach's $\alpha = .83$), Introjected Regulation (e.g., *Because when I succeed in school, I feel necessary*; Cronbach's $\alpha = .85$), Identified regulation (e.g., *Because I think that a high-school education will help me better prepare for the career I have chosen*; Cronbach's $\alpha = .81$), and Intrinsic Regulation (e.g., *Because*

I experience pleasure and satisfaction while learning new things; Cronbach's $\alpha = .87$). Following the indication provided by a recent meta-analysis about the Academic Motivation Scale scoring method [21], it was computed the Relative Autonomy Index (RAI) to measure the person's overall motivational orientation. RAI positive scores represent more autonomous regulation, and negative scores define more controlling regulation. Different weights to each Academic Motivation Scale subscale's score were assigned, computing the following formula:

$$\text{RAI} = (+2 * \text{Intrinsic Motivation subscale score}) + (+1 * \text{Identified Regulation subscale score}) + (-1 * \text{External Regulation subscale score}) + (-2 * \text{Amotivation subscale score}).$$

According to [22], the Introjected Motivation subscale was not considered in computing the RAI.

The final RAI measure served as an indicator of a person's overall motivational orientation, with positive scores representing more autonomous regulation and negative scores representing more controlling regulation.

Spielberger State/Trait Anxiety Inventory (Short Italian form) [23]

It consists of 10 items in two subscales. Five of these measure state anxiety (STAIS) (e.g., *I feel that difficulties are piling up so that I cannot overcome them*), and the other five items assess trait anxiety (STAIT) (e.g., *I feel confused*). Each item is rated on a 4-point scale (1: Not at all, 2: Somewhat, 3: Moderately so, 4: Very much so). Both subscales are assessed separately. A higher score indicates higher anxiety. Cronbach's alpha coefficients of STAI were .84 for STAIT and .88 for STAIS.

The COVID-19 Online Learning Scale

After the psychological assessment, all participants filled out an online questionnaire named COVID-19 Online Learning Scale (COLS-19), developed ad-hoc for the present study exploring the following variables:

Learning habits and strategies before/during the COVID-19 pandemic

These variables were assessed by asking participants to rate on a 5-point scale with anchors 1: Never and 5: Always, a series of learning habits and strategies measuring the grade in which students complete a task more effectively and efficiently in an academic setting. Exemplars of learning habits were: having scheduled time for studying; having a fixed time for studying; studying solo; studying with colleagues; studying at home or university (e.g., bibliotheca); Exemplars of learning strategies were: creating conceptual maps; using keywords; self-examination by carrying out exercises/questionnaires on topics studied or summary tests.

Academic achievement

The academic achievement was assessed by asking students to indicate their average exam scores.

Mental Health and Help Requests

Finally, the OL's impact on student mental health was measured by exploring to whom they ask for help.

Specifically, *mental health problems* were assessed with a direct question – i.e., Do you have Physical and Mental Health problems during the COVID-19 pandemic? Moreover, with a question in which participants might specify the physical and mental health problems such as organic and functional problems (e.g., gastro/intestinal problems, respiratory problems, headaches), anxiety, insomnia, mood alteration, inappetence, and asthenia they had during the COVID-19 pandemic.

As well, *help requests* were assessed, asking participants to indicate first if they ask for help or not (i.e., Do you ask someone for help during the COVID-19 pandemic?) and then to specify who (i.e., Whom you ask for help?) choosing from different categories of people such for instance partner, relatives, friends, psychologists, doctors, spiritual guide, or priests.

Procedure

Participants were recruited by adopting a snowballing procedure. The link to the survey was posted on the online classrooms of the researchers' university courses and social media of students' associations over twelve weeks during the COVID-19 s-wave Italian lockdown phase (March-May 2021).

All participants completed the survey during their online classrooms with an average of about 30 min. Data were collected automatically by MS Forms. According to the Declaration of Helsinki, all participants gave written consent about the anonymity of data handling and were not compensated financially or through additional university credits. The Bioethics Committee of the University of Palermo has approved the current study (n. 38/2021).

Data Analysis

This study was explorative and used a quantitative design with structured scales. Thus, firstly it was calculated descriptive statistics and Pearson's linear correlations were used to analyze the impact of psychological variables on OL activities. Then, participants were into two groups having HIGH vs. LOW scores in each of the psychological questionnaires (i.e., General Self-Efficacy Scale, Academic Motivation Scale, Spielberger State-Trait Anxiety Inventory) by the median value.

Finally, a series of factorial two \times two repeated measures multivariate analysis of variance (RM-MANOVA) were performed on scores obtained by participants on the COLS-19 scale.

All data analyses applied the IBM SPSS 26.0 software package (IBM Corp. Released 2011, IBM SPSS Statistics for Macintosh, Version 20.0. Armonk, NY: IBM Corp).

3 Results

Table 2 reports Pearson's linear correlation among all the study variables.

On average, participants show high levels of general self-efficacy ($M = 28.02$, $SD = 4.55$); their orientation toward academic motivation is an autonomous regulation even if the levels are not so high ($M = 19.51$, $SD = 8.71$), and they present high levels of trait anxiety ($M = 12.87$, $SD = 3.62$).

As regards Pearson's linear correlations, results show a significant positive association between self-efficacy and academic motivation ($r = .26$). In contrast, a significant

negative association between self-efficacy and trait anxiety ($r = -.34$) as well as between academic motivation and trait anxiety ($r = -.19$) was found.

Table 2. Pearson's correlations for Self-Efficacy, Academic Motivation, and Trait Anxiety (N = 1028)

	1	2	3
1. Self-Efficacy	-		
2. Academic motivation	.26**	-	
3. Trait Anxiety	-.34**	-.19**	-
M	28.02	19.51	12.87
SD	4.55	8.70	3.62
Skewness	-.026	-1.24	-.237
Kurtosis	.268	2.12	-.582

3.1 The Effect of OL on Learning Habits

A first factorial RM-MANOVA was performed on each item of the COLS-19 Learning habits subscale considering the HIGH/LOW scores for psychological measures (i.e., self-efficacy, academic motivation, and trait anxiety) as between-subjects factors and the BEFORE/AFTER the COVID-19 pandemic as a within-subjects factor.

Results show a significant main effect for the between-subject factor HIGH/LOW scores related to Self-Efficacy, $F(7, 1020) = 8.85, p < .001$, Academic Motivation, $F(7, 1020) = 9.91, p < .001$, and Anxiety, $F(7, 1020) = 4.31, p < .001$.

There was also a significant main effect for the within-subject factor BEFORE/AFTER for Self-Efficacy, $F(7, 1020) = 99.8, p < .001$, Academic Motivation, $F(7, 1020) = 99.7, p < .001$, and Anxiety $F(7, 1020) = 5.38, p < .001$.

However, a significant interaction HIGH/LOW scores \times BEFORE/AFTER has emerged only for Motivation $F(7, 1020) = 99.7, p < .001$, and Anxiety, $F(7, 1020) = 3.40, p < .001$, but not for Self-Efficacy, $F(7, 1020) = 1.27, n.s.$

Table 3 shows the univariate interaction effects for each COLS-19 Learning Habits subscale item.

To this respect, it was found that during the OL activities due to the COVID-19 pandemic, individuals with lower scores on self-efficacy reduced the scheduled time for studying more than those with higher scores, $F(1, 1026) = 4.64, p = .03$.

Undergraduates with lower scores on the RAI index, having a controlling regulation for their academic motivation, decreased their time scheduling during their study activities in the switching before and during the COVID-19 pandemic, $F(1, 1026) = 3.91, p = .05$, and their learning habit of taking notes during the OL lectures, $F(1, 1026) = 9.21, p < .01$. As predictable, considering the pandemic social restriction measures, the habit of studying with colleagues also diminished in students with a controlling regulation for

Table 3. Univariate interaction effects at the RM-MANOVA for Self-Efficacy, Motivation, and Trait Anxiety on COLS-19 Learning Habits (N = 1028)

Items	Self-Efficacy			Motivation			Trait Anxiety		
	F	<i>p</i>	$\eta^2 p$	F	<i>p</i>	$\eta^2 p$	F	<i>p</i>	$\eta^2 p$
Scheduled study time	4.64	.03	.005	3.91	.05	.004	25.52	< .001	.026
Flexible study time	.284	.59	.000	.71	.40	.001	.41	.52	.000
Taking notes	2.77	.09	.003	9.21	.002	.009	16.44	< .001	.016
Studying solo	.17	.68	.000	.54	.46	.001	2.94	.09	.003
Studying with colleagues	.88	.35	.001	4.52	.03	.004	2.14	.14	.002
Studying at home	.91	.34	.001	1.19	.27	.001	5.96	.01	.006
Studying at university	1.89	.17	.002	.26	.61	.000	4.57	.03	.004

their academic motivation more than those with a more autonomous one, $F(1, 1026) = 4.52, p = .03$.

With concerns to trait anxiety, results show that students with higher levels of trait anxiety display reduced learning habits in scheduling time for studying, $F(1, 1026) = 25.52, p < .001$, taking notes during OL lectures, $F(1, 1026) = 16.44, p < .001$, and contrarily increased their habits to studying both at home, $F(1, 1026) = 5.96, p = .01$, and at university, $F(1, 1026) = 4.57, p = .03$, more than their colleagues with lower anxiety levels.

3.2 The Effect of OL on Learning Strategies

A second factorial RM-MANOVA was performed considering the HIGH/LOW scores for psychological measures (i.e., self-efficacy, academic motivation, and trait anxiety) as between-subjects factors and the answers to the COLS-19 Learning strategies subscale as the within-subjects factor.

RM-MANOVAs display a significant main effect for the between-subject factor HIGH/LOW scores related to Self-Efficacy, $F(12, 1015) = 7.44, p < .001$, and Academic Motivation, $F(12, 1015) = 11.35, p < .001$.

There was also a significant main effect for the within-subject factor BEFORE/AFTER Anxiety $F(12, 1015) = 8.88, p < .001$.

Moreover, a significant interaction BEFORE/AFTER \times HIGH/LOW scores has emerged for all studied variables, Self-Efficacy, $F(12, 1015) = 3.31, p < .001$, Motivation, $F(12, 1015) = 2.09, p = .01$, and Anxiety, $F(12, 1015) = 3.49, p < .001$. Table 4

Table 4. Univariate interaction effects at the RM-MANOVA for Self-Efficacy, Motivation, and Trait Anxiety at COLS-19 Learning Strategies

Items	Self-Efficacy			Motivation			Trait Anxiety		
	F	<i>p</i>	$\eta^2 p$	F	<i>p</i>	$\eta^2 p$	F	<i>p</i>	$\eta^2 p$
Summarize	9.10	.003	.009	.01	.90	.000	5.15	.02	.005
Create conceptual maps	14.79	< .001	.014	.66	.42	.001	1.84	.17	.002
Highlight crucial argument	4.16	.04	.004	3.22	.07	.003	1.77	.18	.002
Identify keywords	2.81	.09	.003	2.77	.09	.003	3.17	.07	.003
Re-reading an argument	.07	.78	.000	.61	.44	.001	7.53	.01	.007
Use a studying timetable	.06	.79	.000	4.85	.03	.005	5.55	.02	.005
Self-reflection on the content through questions	.18	.67	.000	4.36	.04	.004	.98	.32	.001
Intersperse different subjects in the same study session	8.87	.003	.009	7.53	.01	.007	20.31	< .001	.019
Self-examination by carrying out exercises or tests	7.96	.005	.008	8.85	.003	.009	1.38	.24	.001
Giving explanations or formulating hypotheses on the causes of the studied phenomena	11.67	.001	.011	12.06	.001	.012	11.65	.001	.011
Creating mental images of the studied content	2.95	.08	.003	12.11	.001	.012	10.41	.001	.010
Verbal repetition	1.31	.25	.001	.28	.59	.000	12.51	< .001	.012

shows the univariate interaction effects for each COLS-19 Learning Strategies subscale item.

Findings show that during the OL activities due to the COVID-19 pandemic, students with lower scores on self-efficacy significantly reduced the strategy of summarizing, $F(1, 1026) = 9.10, p = .003$ and o, $F(1, 1026) = 8.87, p = .003$. *Vice versa*, university students with higher levels of self-efficacy significantly increased the use of learning strategies such as creating conceptual maps, $F(1, 1026) = 14.79, p < .001$, becoming able to use self-examinations by carrying out exercises, $F(1, 1026) = 7.96, p = .005$ and to apply the strategy of explaining the causes of studied phenomena, $F(1, 1026) = 11.67, p = .001$. The two groups' results about highlighting important arguments are not well defined even if a moderately significant interaction effect has emerged, $F(1, 1026) = 4.16, p = .04$.

Results display that university students with high academic motivation or having an autonomous regulation increased study strategies, as studying following a timetable, $F(1, 1026) = 4.85, p = .03$, using self-reflection on the content just studied through questions formulated by oneself or proposed by the book, $F(1, 1026) = 4.36, p = .04$, using self-examination by carrying out exercises or questionnaires on the studied

topics, $F(1, 1026) = 8.85, p = .003$, giving explanations on the causes of the studied phenomena, $F(1, 1026) = 12.06, p = .001$, and creating mental images of the studied content, $F(1, 1026) = 12.11, p = .001$. In contrast, students with low RAI scores of controlling regulation in their academic motivation reduced the strategy of interspersing different subjects in the same study session, $F(1, 1026) = 7.53, p = .01$.

Data also showed that during the OL classrooms, people with high trait anxiety decreased the use of learning strategies such as summarizing, $F(1, 1026) = 3.3, p < .05$, to space out the different subjects in the same study session, $F(1, 1026) = 20.31, p < .001$, and to give explanations of formulating hypotheses on the causes of studied phenomena, $F(1, 1026) = 11.65, p = .001$.

On the contrary, students with low trait anxiety increased learning strategies as re-reading time and argument, $F(1, 1026) = 7.53, p = .01$, studying following a fixed timetable, $F(1, 1026) = 5.55, p = .02$, creating mental images of the studied contents, $F(1, 1026) = 10.41, p = .001$, and repeating verbally, $F(1, 1026) = 12.51, p < .001$.

3.3 The Effect of OL on Academic Achievement

A univariate ANOVA was performed considering the HIGH/ LOW scores for psychological measures (i.e., self-efficacy, academic motivation, and trait anxiety) on academic achievement scores.

Results display that Self-Efficacy, $F(1, 978) = 10.03, p = .002$, Academic Motivation, $F(1, 978) = 23.77, p < .001$, and Trait Anxiety, $F(1, 978) = 8.47, p = .004$, have a significant effect on academic achievement in university students (Table 5).

Table 5. Univariate ANOVA for Self-Efficacy, Motivation and Trait Anxiety on academic achievement

	F	<i>p</i>	η^2p
Self-Efficacy	10.04	.002	.010
Academic Motivation	23.78	.000	.024
Trait Anxiety	8.47	.004	.009

3.4 The Effect of OL on Academic Achievement

Finally, results on the OL's impact on students' physical and mental health display a consistent prevalence of students reporting mental health problems (64%) in a spectrum of organic and/or mental diseases (see Table 6).

Moreover, more than half of the sample (61.3%) affirmed that they requested help, especially from partners (19.7%), friends (14.9%), relatives (13.1%), health professionals like psychologists or medical doctors (9.7%), and spiritual directors (0.4%).

Table 6. Percentage of physical and mental health problems for all participants (N = 1060)

	%
Organic diseases	16.0
Anxiety	46.1
Insomnia	35.0
Altered mood	43.5
Inappetence	8.3
Asthenia	4.7
Other problems	9.4
No health problems	36.0

4 Conclusion and Discussion

The present study, in line with literature underscoring the impact of stress appraisals on the mental health of students navigating the COVID-19 pandemic [24], shows a strong interrelation between psychological variables such as self-efficacy, academic motivation and trait anxiety, and the OL activities during the COVID-19 pandemic.

Indeed, self-efficacy was crucial for managing more learning strategies than habits. For example, the OL activities impact scheduling time for studying and managing cognitive learning strategies helpful in acquiring study materials, such as summarizing or elaborating and combining different subjects during the same study session for students low on self-efficacy. A similar trend has also emerged for students with a controlling regulation, more characterized by extrinsic academic motivation, and with a high level of trait anxiety.

Furthermore, the results of the current study evidenced that university students increased their physical and mental health problems during the switching between traditional and OL classrooms due to the COVID-19 pandemic. Such results are coherent with studies demonstrating that the COVID-19 pandemic has a significant psychological impact. For instance, the result of the incapacity of college students with low self-efficacy skills, less autonomous in pursuing learning goals, and very anxious to actively regulate fixed time scheduling for study activities could be interpreted in the light of a recent study demonstrating how the lockdown state imposed by the COVID-19 has significantly changed people's rhythms of life. According to [25], the loosening of daily official timing routines during the lockdown impacted the perceived control of the time that, in turn, has a mediator effect on time management behaviors on the self-reported job or academic performance [26]. This altered subjective perception of time control could be responsible for higher psychological distress and mental health issues [27].

Thus, psychologists and educators might deliver autonomy-supportive programs that teach students to cope with anxiety from attending OL classes. Previous studies [28, 29] on the psychological and emotional impact of the COVID-19 pandemic reported higher anxiety levels in university students. They highlighted the need for support mechanisms

that education institutions should establish to guarantee students' well-being and help them cope with psycho-emotional factors linked to global crises [30].

Moreover, educators might also help students to reach better academic outcomes using OL since it provides a more flexible, self-paced, and informal learning environment for students [31]. In any crisis, there is also an opportunity. The use of technology and digital devices highlighted some advantages that are likely to be considered for the future of education, particularly those related to the benefits of educational technology [30].

The increasing of mobile technologies represents an excellent way to access the learning process [32], which can revolutionize education by combining mobile and game-based learning approaches [33]. An example is Mobile Game-based Learning, which combines learning with playing, providing an environment where students can learn using gaming through smartphones. Previous studies on using Mobile Game-based Learning highlight improvement in students' motivation and academic outcomes.

Results of the present study need to consider some limitations: 1) the cross-sectional design applied in this work does not allow us to make cause-and-effect inferences. Thus, future research could replicate the study with other methodologies, such as longitudinal studies, to monitor better the learning strategies applied by undergraduates; 2) the convenience sample, even if it plays a valuable role in social science research [22], is not balanced by gender; still, it is hoped to replicate the work by balancing the male-female ratio; 3) a non-random population sample was applied. Thus, generalization cannot be made to the entire population of university students; so future cross-cultural studies on more representative samples from different universities are needed to corroborate this study's results.

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