

# Development and Validation of a questionnaire addressing Online Learning Experience of University Students during the COVID-19 Pandemic Quarantine, in Greece

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## Abstract

**Objective:** Our study aimed to develop and validate an instrument exploring undergraduate students' online learning experience during COVID-19 pandemic in Greece, and to investigate socio-demographic characteristics associated with students' online learning experience.

**Methods:** A 15 item questionnaire was developed and administered to undergraduate students at Universities of West Attica and Ioannina during 2021. Analysis was performed in 2 steps: a) Pilot testing: The responses of 15 participants were compared in two different time points to assess the stability of the tool (Test-retest reliability). Factor analysis, reliability, convergent and discriminant validity of the identified underlying factors, were estimated in a sample of 100 participants b) Main study: Univariable and multivariable linear regression analyses were performed to investigate socio-demographic characteristics associated with online learning experience in a sample of 1103 participants.

**Results:** The estimated correlation between the test and retest scores for all 15 items was 0.71 (p-value =0.003). The coefficient of reliability for all 15 items was very high (Cronbach's  $\alpha = 0.885$ ). Factor analysis identified 2 underlying factors, interpreted as "beliefs" and "skills" of online learning experience. The Cronbach's alpha coefficients for the 2 factors were also very high (0.879 and 0.820 respectively). The corrected item-total correlation was  $>0.30$  for all items of each factor indicating a satisfactory convergent validity. The correlation of the 2 factors ( $r_s = 0.45$ , p-value  $< 0.001$ ) indicated an adequate discriminant validity. Multivariable regression analysis showed that males, students aged  $>21$  years old, and participants who were very satisfied with their living conditions during quarantine, reported having more necessary skills and positive beliefs about online learning.

**Conclusion:** As online education is developing rapidly around the world, our study may help decision-makers understand students' attitudes and perceptions of online learning in order to improve their constructive participation in online courses.

**Keywords:** COVID-19; Distance Learning; Online Learning; E-Learning, Factor Analysis; Quarantine; University Students

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## Introduction

Due to the COVID-19 pandemic universities around the globe were forced to fundamentally change their teaching and learning environment [1]. To prevent or at least limit further spread of the virus, synchronous and asynchronous online teaching has been widely implemented since early 2020 [2].

Higher education institutions had to face the challenge of providing continuity to the educational process remotely due to the COVID-19 pandemic [3]. This scenario implied a drastic transformation without the possibility of preparation, having both teachers and students quickly develop online education competencies [4].

University students continued their education during the

pandemic through online learning platforms. However, online learning outcomes varied in different countries. They were affected by online learning infrastructures like internet accessibility and speed and the availability of electronics and computers. Several techniques were used to evaluate the online learning platforms during the COVID-19 pandemic [5].

Rapid shift from face-to-face to online-learning without enough time to plan and prepare students and teachers as well as hardware and software facilities caused a lot of problems in the learning process [6]. Student's experiences related to online education services are considered as an important factor in the continuity and maintenance of universities as well as the ability of institutions to attract students [7]. A student's experience is a complex structure that depends on special conditions and factors that exist in the community during the pandemic.

It is crucial to gain a better understanding of whether students are prepared for online learning and in which areas they will need additional support. Given how technology and access to technology have advanced, it is easy to assume that most students are ready for an online learning environment, even one that is fully online.

This research aimed: a) to develop and validate an instrument for exploring the impact of quarantine practices on students' life, and on students' experience about the online learning that they received during the pandemic using an online structured questionnaire., and b) to investigate the sociodemographic characteristics associated with students' experience about online learning during the COVID-19 pandemic Quarantine in Greece.

It is expected that the outcomes of this study will help decision-makers understand students' attitudes and motivation toward online learning and how this will affect their plans and decisions. In these circumstances, students' perceptions of online courses could be a crucial predictor of the ultimate effectiveness of online learning and could thus have implications for improving ongoing online courses.

## Materials and Methods

This cross-sectional study was conducted at the University of West Attica and University of Ioannina between June and October 2021. Undergraduate students were recruited using the convenience sampling method. The invitation emails included background information on the study and the importance of student participation, the names of the researchers, and a link to complete the survey. The email also stated that by clicking the link to complete the survey, they were providing informed consent. The survey was filled out anonymously on a voluntary basis.

The study was approved by the Ethics Committee of the University of West Attica (approval code: 42768/01-06-2021) and University of Ioannina (approval code: 25852/01-06-2021).

The first page of the questionnaire included introductory information. The introduction explained the study's purpose and domains. It also involved informed consent statements regarding participation in the study and confidentiality of the

data. Students were explicitly informed that they were free to participate in the study. Additionally, they were informed that their participation will be anonymous. Moreover, their answers would be confidential and would not affect their academic marks or their relationships with their instructors. Students were also informed that the survey would take 10–15 minutes to be filled based on the surveyor's comments.

## Research tool

This survey consisted of 52 questions in total. The first group of questions covered socio-demographic information. It included questions about students' gender, age, academic field, academic year, and place of residence during the Quarantine. Family economic status and parental education were used as proxy measures of socio-economic status. Four educational categories were created (primary, secondary, tertiary, and post-tertiary educational level) based on the highest qualification earned by each parent.

The second group of questions explored students' experience about online learning during COVID-19 pandemic and Quarantine. This part of the questionnaire was derived following a literature search on current online education. We developed a 15-item questionnaire focused on the learned skills related to electronics that enriched students' learning processes and the students' beliefs about online learning during the COVID-19 Quarantine. The items were in the form of a 5-point Likert scale ranging from "absolutely disagree" to "absolutely agree."

In the third group, the General Health Questionnaire (GHQ-12) [8] was used for the assessment of participants' psychological symptoms and social functioning adapted in Greek by Garyfallos et al. [9]. And its internal consistency factor structure assessed by Kokkinis et al. [10]. The fourth group of questions accessed the elements of participants' well-being [11] that is: positive emotions, engagement, positive relationships, meaning, and accomplishment, using the Flourishing Scale [12] adapted and validated in Greek by Leontopoulou et al [13].

In the context of the current study, we focused in the second group of questions that explored students' experience about online learning during COVID-19 pandemic and Quarantine.

## Statistical analysis

Analysis was carried out in two steps. In the first step, pilot testing was conducted to validate the online learning experience questionnaire. Specifically, a factor analysis was performed and the reliability and validity of the underlying factors identified were estimated on the responses of 100 participants enrolled in the study. In addition, test-retest reliability was estimated on the responses of 15 participants on two different time points during the first month of the study period. In the context of the main study (second step of the analysis), Univariable and multivariable linear regression analyses were used to investigate socio-demographic characteristics associated with participants' acquisition of skills and general beliefs about online learning.

## Descriptive statistics

Categorical variables were described using frequencies and

percentages and continuous variables using mean and standard deviation (SD). Kolmogorov-Smirnov test was performed to test for normality. All statistical analyses were carried out with the use of Stata 13.1 program [14] apart from factor analysis that was performed using the SPSS 23.0 program [15]. A significance level of 0.05 was applied.

### Factor analysis

Factor analysis was used to reduce the number of variables reflecting the items by grouping them into factors. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett's test of Sphericity were used to check if the data were appropriate for factor analysis and if the interitem correlations were sufficient (cut-off for the KMO =0.50). The principal components method using the covariance matrix and the varimax and promax rotation methods with Kaiser Normalization were applied. Factors were identified among the intercorrelation of a set of variables. The number of factors was based on the eigenvalue (>1.0), the screen test, and interpretability criteria. In addition, only factors with at least 3 items with loading >0.40 were retained. Important contributors to a factor were considered items with loadings >0.40. Items that best define each factor were considered those with the highest factor loadings (highest absolute scoring) [16,17].

### Reliability and validity of factors

Cronbach's alpha coefficient was used as an indicator of reliability using as criterion the cut-off of 0.60 [18]. Factors' convergent validity was tested by obtaining the correlations between the item-score and the score of the factor to which the item belonged after deleting this item (corrected item-total correlation). The score of a factor was the average of the item-scores defining this factor. Discriminant validity of the factors was tested by estimating the correlation between them and comparing the correlation coefficient with the factors' alpha coefficients. Spearman's correlation coefficient was used to measure the degree of correlation.

### Linear regression analysis

Two new variables were generated to reflect the factors by adding the scores of the items defining each factor. Linear regression analysis was performed separately for each factor. Specifically, Univariable and multivariable linear regression models were fitted using factor as the dependent variable. Only variables with a significant p-value ( $p < 0.05$ ) in the Univariable analysis were included in the final model for each factor. Age, gender, nationality, education level, decision concerning the participants' place of residence during quarantine, satisfaction of the participants' living conditions and maternal educational level, were chosen as possible explanatory variables in the final model used to identify variables associated with the factor interpreted as "skills". In the final model used to identify variables associated with the factor interpreted as "beliefs", we controlled for age, gender, department, education level, decision concerning the participants' place of residence during quarantine, satisfaction of the participants' living conditions and maternal educational level (independent variables). Coefficients and 95% confidence intervals (95% CI) were reported.

## Results

### Pilot testing

As we mentioned in the methods section, in the first step of the analysis, pilot testing was conducted. In the context of pilot testing, we analyzed the responses of the first 100 participants enrolled to examine the reliability and validity of the instrument at the early phase of the study.

### Factor analysis and factors' reliability and validity

Factor analysis was performed to establish potential underlying factors in our data. There were no missing values in the data. The KMO measure (0.805 >0.50) and the Bartlett's test of Sphericity (p-value <0.001) verified the appropriateness of the data for factor analysis. Factor analysis indicated that all communalities were >0.20 so no item removal was required. Due to the small sample size (100 <300), we checked the average communality of the items and because it was found between 0.50 and 0.60 (i.e., 0.54), it was considered acceptable. The examination of eigenvalues, the screen test, and the other criteria used (described in detail in the methods section) indicated the retention of 2 factors. These factors were interpreted as "skills" and "beliefs", and the total variance explained by them was 54% (>50%). All items had factor loadings >0.40 [Table 1]. Items 35 had almost equal loading in both factors, but it was included in the factor reflecting participant's beliefs in which it had the highest absolute scoring [Table 1]. Except for two items (i.e., 21 and 22), all item-total correlations and corrected item-total correlations were well above the recommended value of 0.30 [Table 1]. Items 21, 22 and 35 were not deleted because: 1) the re-computed KMO measure after the exclusion of these items negligibly changed, 2) by removing each one of these items we wouldn't have a considerable improvement in the Cronbach's alpha (i.e., reliability), and 3) all three items were addressing important elements that were not addressed in another items.

The coefficient of reliability (Cronbach's alpha) for all items was very high (0.885 >0.60) [Table 1]. The alpha coefficients of both factors, interpreted as "skills" and "beliefs", were also very high and equal to 0.820 and 0.879, respectively [Table 2]. The corrected item-total correlation was >0.30 for all items of the two factors indicating a satisfactory convergent validity of the factors [Table 2]. Even though items 21 and 22 of the factor interpreted as "skills" had lower corrected item-total correlation compared to other items of this factor, by removing each one of them we wouldn't have an improvement in the factor's alpha coefficient (i.e., factor's reliability) (0.816 and 0.813 compared to 0.820) [Table 2]. The correlation of the two factors ( $r_s = 0.45$ , p-value <0.001) was much lower than the factors' alpha coefficients demonstrating an adequate discriminant validity [Table 3].

### Test-retest reliability

At the early phase of the study, we estimated the test-retest reliability to check the stability of the tool. In the context of this analysis, we compared the responses of 15 participants in two different time points during June, 2021. The time interval

**Table 1:** Pilot testing. The items of the questionnaire to measure online learning experience.

Q	Item	Descriptives			Factor Loadings			
		mean	SD	item-total <sup>1</sup>	corrected item-total <sup>2</sup>	F1-Skills	F2-Beliefs	FA in all items
21	I have the ability to easily access the Internet as required to conduct online learning.	4.52	0.611	0.29	0.23	0.546	-0.100	F1-Skills
22	I have the skills to effectively use online learning tools.	4.37	0.747	0.29	0.21	0.611	-0.146	F1-Skills
23	I feel generally comfortable with the online learning process	3.76	0.976	0.71	0.66	0.723	0.367	F1-Skills
24	I feel comfortable with written electronic communication during online learning process.	3.56	1.076	0.66	0.58	0.671	0.340	F1-Skills
25	I feel comfortable using a camera during online learning.	2.74	1.050	0.66	0.59	0.630	0.372	F1-Skills
26	I feel comfortable to actively communicate with my fellow students during online learning	3.61	0.973	0.53	0.46	0.712	0.139	F1-Skills
27	I feel comfortable to actively communicate with my professors during online learning.	3.48	0.979	0.59	0.52	0.652	0.257	F1-Skills
28	I believe that online communication with my fellow students is as effective and efficient as communicating in person.	2.29	1.104	0.73	0.67	0.307	0.681	F2-Beliefs
29	I believe that online communication with my professors is as effective and efficient as communicating in person.	2.30	1.124	0.72	0.65	0.232	0.723	F2-Beliefs
30	I believe that my ability to concentrate is the same. both in the traditional classroom and during online learning.	2.25	1.158	0.76	0.70	0.079	0.892	F2-Beliefs
31	I believe that I am just as disciplined in the classroom as I am during online learning.	2.52	1.202	0.58	0.49	-0.164	0.825	F2-Beliefs
32	I believe that a theoretical course can be taught online without difficulty.	3.45	1.104	0.67	0.60	0.243	0.670	F2-Beliefs
33	I believe that a lab course can be taught online without difficulty.	1.74	1.001	0.59	0.52	0.065	0.665	F2-Beliefs
34	I believe that I am just as disciplined in organizing my study during online learning as I am in the traditional classroom.	2.98	1.172	0.71	0.64	0.159	0.772	F2-Beliefs
35	I believe that I can work effectively and efficiently with my fellow students in online group assignments	3.35	1.123	0.61	0.52	0.424	0.440	F2-Beliefs
<sup>1</sup> Correlation of item with overall score (sum of all 15 variables used)					<sup>4</sup> alpha = 0.885			
<sup>2</sup> Correlation of item with overall score excluding the item (corrected for overlap; sum of the remaining 14 items used)								
<sup>3</sup> Cronbach's alpha for all items (15 items)								

between the two points was 14 days and the ratio of sample size to number of tool's items was 1:1. The test-retest reliability for all items was high. Specifically, the estimated correlation between the test and retest scores for all items was strong and equal to 0.71 (p-value =0.003) [Table 4]. The mean of the test scores was 46.7 (SD =11.1) and of the retest scores was 43.7 (SD =10.6) [Table 4]. The test-retest reliability was also estimated for the two factors. A very strong correlation between the test and retest scores was estimated for the factor interpreted as "skills" (rs = 0.93; p-value <0.001) indicating a very high test-retest reliability [Table 4]. The test-retest reliability for the factor interpreted as "beliefs" was also high since a strong correlation between the test and retest scores was detected (rs = 0.59, p-value = 0.021) [Table 4].

### Main study

At the second step of the analysis (main study), the aim was to investigate socio-demographic characteristics associated with participants' acquisition of skills and general beliefs about online learning.

### Participants' socio-demographic characteristics and responses to the online learning experience questionnaire

In total, 1103 students responded to the survey. The characteristics of the study participants are described in detail in [Table 5]. The study population included 73.6% female students and 26% male students. 626 (56.8%) were 18-21 years old, 282 (25.6%) were between 22 and 25 years old, 48 (4.3%) were between 26 and 29 years old and 147 (13.3%) were over 30 years old. In most cases (94.3%) the participants declared that they were born in Greece and 95.9% have Greek nationality. The largest category of the surveyors was studying general sciences (609, 55.2%) followed by health sciences (491, 44.5%). A greater number of the respondents included second-year students (287; 26.0%), followed by over fourth-year students (254; 23.0%). 73.2% of the surveyors reported living in the place of their studies during the quarantine while 80.5 % of them were living with their families, 9.4% reported living alone, 1% with roommates, and 1.7% with relatives. 27,8% of the participants reported that

**Table 2:** Pilot testing - Item analysis and reliability statistics for each factor.

Factor	Item-total correlation	Corrected item-total correlation*	Cronbach's alpha if item deleted	Factor's cronbach's alpha
<b>Skills</b>				<b>0.820</b>
I have the ability to easily access the Internet as required to conduct online learning.	0.55	0.44	0.816	
I have the skills to effectively use online learning tools.	0.58	0.45	0.813	
I feel generally comfortable with the online learning process	0.79	0.68	0.775	
I feel comfortable with written electronic communication during online learning process.	0.74	0.60	0.789	
I feel comfortable using a camera during online learning.	0.71	0.57	0.796	
I feel comfortable to actively communicate with my fellow students during online learning	0.74	0.61	0.787	
I feel comfortable to actively communicate with my professors during online learning.	0.73	0.60	0.790	
<b>Beliefs</b>				<b>0.879</b>
I believe that online communication with my fellow students is as effective and efficient as communicating in person.	0.76	0.67	0.861	
I believe that online communication with my professors is as effective and efficient as communicating in person.	0.77	0.68	0.860	
I believe that my ability to concentrate is the same both in the traditional classroom and during online learning.	0.85	0.79	0.848	
I believe that I am just as disciplined in the classroom as I am during online learning.	0.73	0.62	0.866	
I believe that a theoretical course can be taught online without difficulty.	0.72	0.62	0.866	
I believe that a lab course can be taught online without difficulty.	0.70	0.61	0.868	
I believe that I am just as disciplined in organizing my study during online learning as I am in the traditional classroom.	0.77	0.68	0.860	
I believe that I can work effectively and efficiently with my fellow students in online group assignments	0.60	0.47	0.881	

\* Correlation of an item with its scale corrected for overlap (correlated with the sum of the other items in the scale if item deleted)

**Table 3:** Pilot testing - Spearman Correlation coefficients among the factors.

Factor	Mean	SD	Skills	Beliefs
Skills	3.72	0.645	1	0.45*
Beliefs	2.61	0.828		1

\*Statistically significant correlation at the 0.001 level of significance

**Table 4:** Test - Retest reliability of all items and the two factors.

Factor	Time point	mean	SD	rs
All items	1	46.7	11.1	0.71*
	2	43.7	10.6	
Skills	1	24.5	6.2	0.93**
	2	23.3	5.7	
Beliefs	1	22.3	6.8	0.59*
	2	20.4	5.9	

\* Statistically significant correlation at the 0.05 level of significance  
\*\* Statistically significant correlation at the 0.001 level of significance

decision concerning their place of residence was influenced mainly by financial reasons. Most students were very (54.2%) and moderately (35.8%) satisfied with their living situation during quarantine, a further 6.7% were rather satisfied, and 3.3% were

dissatisfied. Finally, a greater number of the respondents (77.6%) described their family's socio-economic status as medium and reported that their maternal (38.8%) or paternal (35.6%) educational level was in "higher education".

**Table 5:** Characteristics of the study population.

Characteristic		Number (1.103)	Percentage (%)
Gender	Male	287	26.0
	Female	<b>812</b>	<b>73.6</b>
	Other	4	0.4
Age (years)	18-21	<b>626</b>	<b>56.8</b>
	22-25	282	25.6
	26-29	48	4.3
	> 30	147	13.3
Born in Greece	Yes	<b>1.040</b>	<b>94.3</b>
	No	63	5.7
Nationality	Greek	<b>1.058</b>	<b>95.9</b>
	Other	45	4.1
University of studies	University of West Attica	<b>1.005</b>	<b>91.1</b>
	University of Ioannina	98	8.9
Department	Health sciences	491	44.5
	Other	<b>609</b>	<b>55.2</b>
	Unknown	3	0.3
Education level	1 <sup>st</sup>	86	7.8
	2 <sup>nd</sup>	<b>287</b>	<b>26.0</b>
	3 <sup>rd</sup>	237	21.5
	4 <sup>th</sup>	239	21.7
	>4 <sup>th</sup>	<b>254</b>	<b>23.0</b>
In your Department of study. the courses take place:	Online	<b>698</b>	<b>63.3</b>
	Both	130	11.8
Are you staying at your place of study during the quarantine;	Yes	<b>808</b>	<b>73.2</b>
	no	295	26.8
If YES (you live at your place of study during the quarantine). you are staying:(N=808)	With family	<b>650</b>	<b>80.5</b>
	Alone	76	9.4
	With roommate(s)	8	1.0
	With relatives	14	1.7
	In a student residence	2	0.2
	with your partner	50	6.2
	other	6	0.8
	unknown	2	0.2
If NOT (you do not live at your place of study during the quarantine) you are staying:(N=295)	With family	<b>253</b>	<b>85.8</b>
	Alone	13	4.4
	With roommate(s)	2	0.7
	With relatives	1	0.3
	In a student residence	1	0.3
	with your partner	16	5.4
other	3	1.0	

	unknown	6	2.1
This semester the decision concerning your place of residence is mainly influenced by:			
	educational/academic reasons	227	20.6
	health reasons (related to the pandemic)	83	7.5
	financial reasons	307	27.8
	social reasons	46	4.2
	personal reasons	249	22.6
	other	191	17.3
Are you satisfied with your living conditions;			
	Not at all	36	3.3
	A little	74	6.7
	Moderately	395	35.8
	Very	598	54.2
If you are a 2 <sup>nd</sup> year student or above. did you live at your place of study before the lockdown? N=1.017			
	Yes	808	79.5
	No	101	9.9
	unknown	108	10.6
How would you describe your family's socio-economic status?			
	High	43	3.9
	Medium	856	77.6
	Low	130	11.8
	I 'd prefer not to answer	74	6.7
Maternal educational level:			
	Primary education	204	18.5
	Secondary education	387	35.1
	Higher education	428	38.8
	Master's/Ph.D	84	7.6
Paternal educational level:			
	Primary education	254	23.1
	Secondary education	385	34.9
	Higher education	393	35.6
	Master's/Ph.D	71	6.4

Students' responses to the online learning experience questionnaire are presented in detail in Supplementary table. Cumulative percentages for "agree" and "absolutely agree" exceeding 50% in Q.21, Q.22, Q.23 and Q.24 reveal students' technological self-efficacy and positive online learning experience. 57.8% of the participants reported not feeling comfortable using a camera during online learning (Q.25). 48.4% of the students can easily interact ("agree" and "absolutely agree") with teachers (Q.27) and 45.2% with classmates (Q.26) which indicates that they gradually adapt to online education as cognitive interactions seem to be facilitated. Low percentages were recorded for "agree" and "absolutely agree" regarding online communication effectiveness and efficacy with teachers (Q.29) and classmates (Q.28) compared face-to-face ones. Low percentages were recorded for "agree" and "absolutely agree" in Q.30 and Q.31 regarding students' ability to concentrate and being disciplined during the course, both in the traditional classroom and during online learning. 55.7% of the participants reported their belief that a theoretical course can be taught online without difficulty

(Q.32). On the other hand, very low percentages were recorded for "agree" and "absolutely agree" regarding their belief that a lab course can be taught online without difficulty (Q.33). In addition, very low percentages were recorded for "agree" and "absolutely agree" regarding their belief that they have the same discipline in organizing their study both in the traditional classroom and during online learning (Q.34). Furthermore, 44.7% of the participants reported that they can work effectively and efficiently with their fellow students in online group assignments (Q.35).

To conclude, five items were shown to affect online experience negatively: a) students' online communication effectiveness and efficacy with teachers (Q.29) and classmates (Q.28), b) students' ability to concentrate (Q.30) and being disciplined (Q.31) during online course, and c) their belief that a lab course can be taught online without difficulty (Q.33). Two items had the higher impact: students' technological self-efficacy (Q.21), and their positive feelings about online learning process (Q.22). All other items had a moderate positive impact [Supplementary Table 1].

**Table 6:** Multivariable linear regression analysis using the factor “skills” as dependent variable.

Explanatory variable	b	t	95% CI		p-value
Gender					
* Female					
Male	1.70	4.81	1.01	2.38	<0.001
Other	1.45	0.57	-3.55	6.46	0.569
Age (years)					
*18-21					
22-25	1.70	3.48	0.74	2.66	0.001
26-29	2.76	3.34	1.14	4.39	0.001
≥30	3.90	7.31	2.85	4.94	<0.001
Nationality					
*Greek					
Other	-2.42	-3.10	-3.95	-0.89	0.002
Education level					
*1					
2	0.19	0.31	-1.03	1.41	0.759
3	0.38	0.59	-0.88	1.63	0.554
4	0.83	1.26	-0.46	2.12	0.207
>4	0.87	1.18	-0.58	2.31	0.241
This semester, the decision concerning your place of residence is mainly influenced by:					
* educational/academic reasons					
financial reasons	0.48	1.06	-0.41	1.35	0.292
health reasons (related to the pandemic)	0.65	0.99	-0.64	1.93	0.321
other	0.06	0.11	-0.95	1.06	0.911
personal reasons	-0.16	-0.34	-1.09	0.77	0.733
social reasons	-0.45	-0.55	-2.07	1.16	0.583
Are you satisfied with your living conditions;					
*Moderately					
A little	-2.26	-3.51	-3.53	-0.99	<0.001
Very	2.30	6.84	1.64	2.95	<0.001
Not at all	-3.31	-3.69	-5.06	-1.54	<0.001
Maternal educational level:					
* Primary education					
Secondary education	0.14	0.30	-0.75	1.02	0.764
Higher education/ Master's/Ph.D	-0.25	-0.56	-1.12	0.62	0.577
<b>R<sup>2</sup> = 0.197; Adjusted R<sup>2</sup> = 0.182; F (20, 1082) = 13.23 (p &lt; 0.001); N=1103</b>					
*reference category					

### Socio-demographic characteristics associated with participants’ skills and beliefs about online learning

Multivariable linear regression analysis [Table 6], using the factor interpreted as “skills” as the dependent variable, showed that males reported a greater comfort with basic skills on online learning than females ( $p < 0.001$ ). In addition to gender, age and nationality were also found to be associated with acquisition of skills. Specifically, participants aged >21 years old and those with Greek nationality reported having more confidence in skills. Moreover, students who were very satisfied with their living conditions during quarantine also reported having more confidence in skills than those who were moderately satisfied ( $p < 0.001$ ). In contrast, those who reported a little satisfied

or completely dissatisfied with their living conditions during quarantine had a lower comfort with basic skills on online learning.

Using the factor interpreted as “beliefs” as the dependent variable in the multivariable linear regression analysis [Table 7] we found that age and satisfaction with living condition during quarantine were also associated with participants’ beliefs about online learning. Specifically, participants aged >21 years old ( $p < 0.001$ ) and students who were very satisfied with their living conditions ( $p < 0.001$ ) had more positive beliefs about online learning. On the contrary, those who reported a little satisfied ( $p < 0.004$ ) or not at all satisfied ( $p < 0.031$ ) with their living conditions during quarantine had less positive beliefs about online learning than those who were moderately satisfied. Students studying

**Table 7:** Multivariable linear regression analysis using the factor “beliefs” as dependent variable.

Explanatory variable	b	t	95% CI		p-value
Gender					
* Female					
Male	0.85	1.55	-0.23	1.93	0.122
Other	-1.78	-0.46	-9.40	5.84	0.647
Age (years)					
*18-21					
22-25	4.16	5.59	2.70	5.62	<0.001
26-29	4.80	3.82	2.33	7.26	<0.001
≥30	7.32	9.02	5.72	8.90	<0.001
Department					
* Health sciences					
Other	2.01	4.02	1.02	2.97	<0.001
Unknown	-7.21	-1.61	-16.01	1.58	0.108
Education level					
*1					
2	0.51	0.53	-1.35	2.37	0.593
3	0.80	0.82	-1.12	2.72	0.414
4	1.11	1.10	-0.86	3.09	0.271
>4	1.18	1.03	-1.07	3.42	0.304
This semester, the decision concerning your place of residence is mainly influenced by:					
* educational/academic reasons					
financial reasons	1.54	2.25	0.20	2.88	0.025
health reasons (related to the pandemic)	2.69	2.70	0.74	4.64	0.007
other	0.78	1.00	-0.75	2.30	0.318
personal reasons	0.48	0.67	-0.93	1.89	0.505
social reasons	-0.84	-0.67	-3.30	1.61	0.502
Are you satisfied with your living conditions;					
* Moderately					
A little	-2.83	-2.88	-4.75	-0.90	0.004
Very	2.44	4.76	1.43	3.44	<0.001
Not at all	-2.95	-2.16	-5.62	-0.28	0.031
Maternal educational level:					
* Primary education					
Secondary education	-0.39	-0.57	-1.74	0.96	0.568
Higher education/ Master's/Ph.D	-1.25	-1.85	-2.56	0.07	0.064
<b>R<sup>2</sup> = 0.210; Adjusted R<sup>2</sup> = 0.195; F (21.1081) = 13.69 (p &lt;0.001); N=1103</b>					
*reference category					

other sciences were found to have more positive beliefs about online learning compared to those studying health sciences ( $p < 0.001$ ). Additionally, students whose decision concerning their place of residence was influenced by health reasons related to the pandemic ( $p < 0.007$ ) and financial reasons ( $p < 0.025$ ) had more positive beliefs about online learning than students who have chosen their place of residence influenced by educational/academic reasons.

## Discussion

This study aimed to develop and validate an online structured

questionnaire to address the need for an instrument measuring the impact of quarantine practices on students' skills and beliefs about online learning that they received during the pandemic. To the best of our knowledge, no published study assessing the learning skills and beliefs of students enrolled in online course during quarantine among Greek students is available. The transition from traditional to online courses was the result of the nationwide lockdown due to the Covid-19. In Greece, all schools' and academic institutions' closure was announced on March 10<sup>th</sup> of 2020 [19] and the Greek educational system was abruptly confronted to online education. The majority of

the Greek students, lacking relevant previous experience, were unprepared and this was expected to have an impact on their adjustment to online courses. This research aimed to explore the impact of quarantine practices on students' life, and students' skills and beliefs about the online learning that they received during the pandemic using an online structured questionnaire. Our study provides evidence toward the reliability and validity of the instrument. Cronbach's alpha of the instrument was 0.885 indicating high reliability and an acceptable measure of self-regulation in the online learning environment as well. Nunnally [20] has suggested that score reliability of 0.70 or better is acceptable when used in basic social science research such as in this study. When examining the reliability of each subscale (factor), values for Cronbach's alpha ranged from 0.820 to 0.879 revealing sufficient score reliability on the subscale level.

One distinguishing characteristic of online learning is the autonomy students experience in the learning environment. As such, online instruction eliminates the limitations of place, time, and physical materials and to a great degree gives students the control over when, what, and how to study [21]. As the online learning environment is characterized by autonomy, "skills" and "beliefs" become a critical factor for success in online learning [22-25]. Students lacking positive beliefs about online learning and acquisition of learning skills, may not accomplish learning tasks they are expected in online courses. However, the role of skills in the online learning environment during quarantine or other kind of distance education, should receive the appropriate attention as it does in the traditional face-to-face learning environment.

This study highlights the positive and negative points of the students' attitude towards online learning. There are several findings. The first one is that the developed tool was appropriate to evaluate the original literature-based dimensions of online learning. This does not say, of course, that these are the only dimensions that might be identified. Specifically, two predominant factors (dimensions) were identified in our data reflecting participants perceptions about the skills and their beliefs about online learning.

The second finding is that males reported a greater comfort with basic skills than females. With regards to the use of the internet or online learning facilities among university students, gender difference has been identified by researchers interested in students' abilities and attitudes toward the computer or web-based learning itself. Yang, et al. [26] found male students expend more effort than females in online courses. Hong had also found gender as one of the critical factors that affects learners' satisfaction on the internet. Gender difference was also found in the students' confidence about computers and stereotypical views of computer users [27-30]. On the other hand, there are studies indicating few or no gender differences for students' attitudes toward internet or web-based learning [26]. Specifically, Yukselturk and Bulut [31] have shown that there was no statistically significant mean difference among motivational beliefs, self-regulated learning, and achievement with respect to gender. Although previous research is contradictory, gender difference is a worthwhile factor that needs to be considered when designing the students' online learning.

The third finding indicates that participants aged >21 years old reported having more confidence in skills and had more positive beliefs about online learning than younger participants, suggesting that older students had better adjustment to online courses. Consistent evidence from university samples has shown that older students have more confidence than younger ones in computer proficiency and learning skills [32]. In addition, younger age has already been shown to predict students' need to have support in online education process [22,29,30,32-35].

Similarly, to previous reports documenting that ethnicity influences students' perceptions of online learning [28,35], our results suggest that participants with non-Greek nationality reported having less confidence in skills than Greeks. Previous research identified culturally related differences in students' online learning experiences. The cultural norms and language difficulties related to students' ethnic groups, could explain differences between online learning skills [36-38].

Interestingly, our findings indicated that students who were very satisfied with their living conditions during quarantine had more confidence in skills and more positive beliefs than those who were moderately satisfied while those who reported a little or not at all satisfied had less confidence in skills and less positive beliefs. Place of residence also has played an important role in level of academic acceptance and satisfaction before the pandemic [39,40]. In addition, there is evidence that a familiar and comfortable environment may promote the online education experiences and can help overcome negative emotions during the pandemic, so students in more familiar surroundings are more likely to cope with online learning difficulties better [41,42]. Some studies have found that location of current residence significantly influenced the online education competencies and satisfaction [40]. Furthermore, prior research suggested that the accessibility of students towards digital technologies and online learning depends on socio-economic factors such as family or personal income [43]. Similarly to previous reports, this study indicated that students whose decision concerning their place of residence was influenced by financial reasons had more positive beliefs about online learning compared to students who had chosen their place of residence influenced by educational/academic reasons. Finally, participants who were studying health sciences were found to have less positive beliefs about online learning than those who were studying other sciences. However, all the above findings are, indeed, a puzzling outcome of this study which warrants further research attention.

Our study was conducted in two Universities in Greece and included a sizable number of students of all academic years. In addition, it is one of the few studies that evaluated and used an online learning instrument to assess students' skills and beliefs about online learning experience during pandemic and investigated socio-demographic characteristics associated with them. Furthermore, due to the anonymity of self-reporting data, selection and reporting biases are substantially limited. Nevertheless, the present research has certain limitations. The participants were mainly students from two Universities located in big urban cities of Greece, which raises issues of generalization. Future research may include more educational institutions in Greece.

## Conclusions

The overall results suggest that this instrument has high reliability and satisfactory validity for use as a screening tool for detection of students' skills and beliefs towards online learning. In addition, our study provides new information in respect of the students' skills and beliefs towards online education during COVID-19 pandemic in Greece, on the basis of gender, age, and satisfaction of place of residence. Currently, online courses are expanding beyond the traditional face-to-face educational environment and becoming more and more incorporated into academic institutions interested in enhancing the participants' academic skill level and abilities. We expect that the outcomes of our study will help decision-makers understand students' attitudes and perceptions of online learning in order to improve their constructive participation in online courses that are nowadays an important part of academic education.

## Author Contributions

A.K.E, contributed to data collection, methodology, writing and original draft preparation, E.G.K contributed to methodology, conducted statistical analysis, interpretation of the data and contributed to writing and manuscript review, E.S contributed to data collection, conceptualization, methodology and review, S.L contributed to conceptualization, methodology and data acquisition, A.L contributed to methodology, supervision, project administration and review. All authors have read and agreed to the published version of the manuscript.

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## Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of the University of West Attica (approval code: 42768/01-06-2021) and University of Ioannina (approval code: 25852/01-06-2021).

## Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

## Data Availability

Data Availability Anonymized data that support the findings of this study are available upon reasonable request from the corresponding author, (ING). The data are not publicly available due to their containing information that could compromise the privacy of research participants.

## Competing Interests

The authors have no competing interests to declare.

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**Supplementary Table 1:** Online learning experience questions.

Q21:I have the ability to easily access the Internet as required to conduct online learning.			
	I absolutely agree	675	61.2
	I agree	333	30.2
	I neither agree nor disagree	70	6.4
	I disagree	21	1.9
	I absolutely disagree	4	0.3
Q22:I have the skills to effectively use online learning tools.			
	I absolutely agree	602	54.6
	I agree	403	36.5
	I neither agree nor disagree	67	6.1
	I disagree	27	2.4
	I absolutely disagree	4	0.4
Q23:I feel generally comfortable with the online learning process.			
	I absolutely agree	378	34.3
	I agree	286	25.9
	I neither agree nor disagree	254	23.0
	I disagree	134	12.2
	I absolutely disagree	51	4.6
Q24:I feel comfortable with written electronic communication during online learning process.			
	I absolutely agree	307	27.8
	I agree	306	27.8
	I neither agree nor disagree	265	24.0
	I disagree	171	15.5
	I absolutely disagree	54	4.9
Q25:I feel comfortable using a camera during online learning.			
	I absolutely agree	135	12.3
	I agree	183	16.6
	I neither agree nor disagree	320	29.0
	I disagree	318	28.8
	I absolutely disagree	147	13.3
Q26 : I feel comfortable to actively communicate with my fellow students during online learning.			
	I absolutely agree	213	19.3
	I agree	286	25.9
	I neither agree nor disagree	282	25.6
	I disagree	241	21.9
	I absolutely disagree	81	7.3
Q27:I feel comfortable to actively communicate with my professors during online learning.			
	I absolutely agree	219	19.9
	I agree	315	28.5
	I neither agree nor disagree	278	25.2
	I disagree	215	19.5

	I absolutely disagree	76	6.9
Q28 :I believe that online communication with my fellow students is as effective and efficient as communicating in person			
	I absolutely agree	106	9.6
	I agree	124	11.2
	I neither agree nor disagree	178	16.2
	I disagree	328	29.7
	I absolutely disagree	367	33.3
Q29:I believe that online communication with my professors is as effective and efficient as communicating in person			
	I absolutely agree	126	11.4
	I agree	140	12.7
	I neither agree nor disagree	195	17.7
	I disagree	310	28.1
	I absolutely disagree	332	30.1
Q30: I believe that my ability to concentrate is the same, both in the traditional classroom and during online learning.			
	I absolutely agree	155	14.1
	I agree	149	13.5
	I neither agree nor disagree	153	13.9
	I disagree	319	28.9
	I absolutely disagree	327	29.6
Q31:I believe that I am just as disciplined in the classroom as I am during online learning.			
	I absolutely agree	184	16.7
	I agree	190	17.2
	I neither agree nor disagree	169	15.3
	I disagree	301	27.3
	I absolutely disagree	259	23.5
Q32:I believe that a theoretical course can be taught online without difficulty.			
	I absolutely agree	329	29.8
	I agree	286	25.9
	I neither agree nor disagree	247	22.4
	I disagree	161	14.6
	I absolutely disagree	80	7.3
Q33:I believe that a lab course can be taught online without difficulty.			
	I absolutely agree	79	7.2
	I agree	77	7.0
	I neither agree nor disagree	123	11.1
	I disagree	289	26.2
	I absolutely disagree	535	48.5
Q34:I believe that I am just as disciplined in organizing my study during online learning as I am in the traditional classroom.			
	I absolutely agree	256	23.2
	I agree	256	23.2
	I neither agree nor disagree	215	19.5
	I disagree	246	22.3
	I absolutely disagree	130	11.8
Q35:I believe that I can work effectively and efficiently with my fellow students in online group assignments.			
	I absolutely agree	180	16.3
	I agree	313	28.4
	I neither agree nor disagree	281	25.5
	I disagree	196	17.8
	I absolutely disagree	133	12.0