Research article

The impact of the COVID-19 pandemic on students' future online education behaviour

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A B S T R A C T

Background: The COVID-19-related pandemic has affected education hugely, particularly in terms of the massive shift towards online teaching and learning. Higher education students and professors have faced new challenges, which might improve future online education behaviour, based on online education experience and learning, and pedagogical strategies during the COVID-19 pandemic.
Objective/Aim: The aim of this paper is to explore the views of Romanian students towards a possible future online education, highlighting their perceptions regarding the efficacy of digital online learning/pedagogical strategies and of the technological infrastructure, using as support theory the Input-Environment-Outcomes (I-E-O) model.
Methods/Instruments: An empirical quantitative-based investigation was implemented; data being collected from almost 800 students in business and economics. Based on the proposed conceptual model, data were analysed with structural equations modelling via SmartPLS 3.0.
Results: The novelty of the paper is that it tries to address students' perceptions regarding the future of online education, by using a few constructs, some of them validated in the literature, in order to establish pertinent links between these and the future of digital education. Results reveal that Romanian students prefer face-to-face teaching rather than online courses.
Conclusions/implications: In crisis situations, digital education might be the proper solution for future education, as it ensures effective education through efficient teaching-learning strategies and an advanced technological infrastructure.

1. Introduction

The COVID-19 pandemic that hit the world at the end of 2019 has brought significant changes for organisations and people, redefining boundaries, and forcing everyone to cope with the new situation [1]. Education had to change overnight due to the numerous lockdowns between 2020 and 2022 [2], switching almost instantly from face-to-face to hybrid or online education [3], as universities had to take rapidly efficient measures to protect their students and professors from the infectious disease [4].

The transition from a traditional, teacher-centred education to a digital, student-centred online education has generated stress, frustration, anxiety, and fear among all the involved participants [5–7]. Although online education has been practised since the mid-1950s by the University of London [8], this non-traditional study approach has grown and developed massively, mainly due to the

social distancing restrictions encountered in the recent COVID-19 pandemic [9]. Technological advancement indubitably helped to improve the speed and accessibility of distance and online education courses [10], as teaching and learning became dependent on a variety of media platforms and/or programmes (Zoom, Skype, Google Meets, Moodle, or other open sources developed in-house by universities). Teachers and students had to master these new platforms and learn how to use and interact with them [11], and also to conduct administrative and/or online scientific research activities [12]. The transition to digital education was difficult, especially as it was not clear how long such online activities would last within the universities, or the extent to which digital education would be accepted or assimilated, primarily by students [4,13]. Even today, it is not known whether fully digital education will remain a thing of the past or is a product of the future. If the future of higher education remains digital, one might ask to what extent will students identify with this new type of education?

Recent literature has paid little attention to students' future online education behaviour, the author's findings being different and subjective. Researchers revealed that students had positive or negative perceptions about online teaching and learning during the pandemic, some wanting to continue with online education [14], some of them not [15,16]. Literature [17] analysed Chinese students' habits, establishing a direct link between the acceptance of digital education and student satisfaction. A digitalized education, able to offer a better learning environment was, during the pandemic, a guarantee of student satisfaction. A satisfied student will switch, without difficulty, from offline to online education, having a higher intention to follow digital education. However, future online behaviour in the post-pandemic period was not the purpose of the research of [17]. German students found difficult the need to adapt to online education (teaching and learning), leading some of them to dropout from school [15]. Russian students did not agree with online education [18], but Chinese students showed positive online future behaviour based on the past experience gained through the need to study from home during the COVID-19 pandemic [19]. Because it is expected that online education will continue to grow worldwide, higher education institutions must rethink their online strategies and digital pedagogy in the post-pandemic period [20, 21].

Literature is quite scarce about the future of digital education. To cover this research gap, taking stock of the online learning and pedagogical strategies experienced during the COVID-19 pandemic, and exploring the Romanian students' future online education behaviour based on the experience gained during the numerous COVID-19 lockdowns an empirical quantitative based investigation was implemented. The emergence of the pandemic and the obligation to switch to online education meant for students from all over the world, a complete reversal of the situation compared to the classical way of teaching. In the pre-pandemic period, online education was only an exception, but due to COVID-19, universities were forced to resort to online education [13]. This implied not only a sudden transition of teachers from the usual teaching method to the online one, but also the obligation of the universities to develop technical capacities and specific platforms to support this new type of education [9]. Universities have invested massively in the workforce to generate and strengthen the competences of teaching staff, so that they can face this new type of education. Administrative services within universities, which support the educational service, were forced to switch to remote work, to preserve and increase the quality of the education system [10].

As the research scope is to explore Romanians students perspectives towards a possible future online education, highlighting their perceptions regarding the efficacy of digital online learning/pedagogical strategies and of the technological infrastructure, it must emphasized the fact that, due to the pandemic, many universities continue to use the advantages of online education and implicitly the technical resources, but only as a complement or support for traditional education. It must be also highlight the fact that in certain situations, online teaching-learning activities are still allowed, e.g. the teaching staff is away for a certain period of time and there is no substitute; the teaching staff is on medical leave and teaches online; there is no staff at location X of the university and then a substitute from another campus is used, who teaches online; the need to participate in the defence of a doctoral thesis by a commission from very distant geographical locations etc. Therefore, it is necessary to study both, the availability of students to participate in online courses especially in the conditions where online education does not allow direct socialization, as well as their perception regarding the future of online education.

The authors decided to choose Romania because it is a relevant country for the research context, due to the high-quality digital infrastructure and internet connectivity, Romanians being heavy internet users and new technology adopters [22]. The contribution of the analysis is, first of all, that it deals with an evaluation of Romanian business and economics students' perceptions on the effectiveness of online education during the COVID-19 pandemic; secondly, it deals with a new topic for this emerging country: students' future online education behaviour. Furthermore, the way in which the constructs are placed in the research model, the links between them and the proposed relationships, are a novelty for Romania, and a substantial contribution to the literature. The constructs from the conceptual model are grouped into the three components of the I-E-O (Input-Environment-Outcomes) theory, as follows: online education risks, pandemic fear, digital skills and technological infrastructure are the inputs, online learning and pedagogical strategies are the environment, while the present, but mostly the future of online education behaviour are the outcomes.

The paper is structured as follows: after the introduction, Section 2 contains a review of the literature on the relevant concepts regarding online education during the COVID-19 pandemic in the context of the I-E-O theory, as well as the hypotheses and the conceptual model. Section 3 presents the research methodology employed, while Section 4 continues with the presentation of the results, and Section 5 with the discussion. The paper ends with the conclusions, consisting of the theoretical and managerial implications, as well as limitations and future research perspectives.

2. Literature review: founding theory, hypotheses and conceptual model development

2.1. The input-environment-outcomes (I-E-O) theory

Since the official end of the COVID-19 pandemic (2022), quite many researchers have approached in their papers the impact of the health crisis within a higher education context [23–26], but only a few are based on the Input-Environment-Outcomes (I-E-O) theory. In 1984, Astin [27,28] developed a theory regarding the student's involvement in higher education, based on several principles: how academic environment influences students' development, being able to embrace principles from different sources, such as psychoanalysis and classical learning theory. By students' involvement the author means how much energy students use to devote to academic experience [27]. For example, a highly involved student spent a lot of time and energy in online learning during the lockdowns of the COVID-19 pandemic, while an uninvolved student neglected the studies and the whole online teaching-learning activity. Astin's I-E-O (Input-Environment-Outcome) model used to evaluate academic success, implicitly students' satisfaction, highlighting the effectiveness of educational policies and strategies [28]. In Astin's opinion the inputs are the student-related characteristics, the environment consists of the institutional experience and the outcomes refers to satisfaction and academic achievement. The purpose of this theory is to ensure the increase of student satisfaction through different ways and means. Since the appearance of this conceptual model, it has been used in numerous studies seeking to improve students learning outcomes in higher education [29]. Literature [30] built the model as follows: as inputs were considered the students characteristics such as personal expectations and knowledge value, the environment was made up of all the experiences, interactions, programs, and other aspects of the e-learning climate that students were exposed to, and finally the outcomes were students' satisfaction. The results of the research are useful recommendations for the implementation of e-learning classes in the post-pandemic period. Furthermore, the study approves the importance of Astin's I-E-O model, showing that the online learning environment can generate student's satisfaction, if all involved parties converge in this direction [30]. Recent research [31] conducted a similar study in Indonesian Universities, concluding that great attention must be paid on student's motivation, student's previous achievements, learning facilities and class size, as major inputs able to improve the students' accounting competencies. The environment represented by student engagement is also of great importance [31].

Literature [32] outlines the student's involvement in university inside and outside of the classroom during the 19-COVID pandemic, behaviour which confirms the results of Astin's research. The findings showed how much student's behaviour changed during the COVID-19 pandemic due to the numerous lockdowns negatively impacted student's participation in the classroom; their behaviour changed in a negative sense, hindering their life development as individuals because of the lack of social connections, of inappropriate housing conditions for home office activities, and of the decrease in enthusiasm and concentration. Another research based on Astin's I-E-O model [33] considered as inputs the students high school preparation, as environment the academic and the institutional support available to new students, and as outcomes the students' performance in tests and examinations. The results reveal that student's involvement in academic activities can be measured quantitative and qualitative. The quality of the students input, associated with their academic and family background have a major positive or negative impact on their outcomes. Combining students input, output and environment variables makes easier to predict students' performance in their learning environment [33].

This research draws up on the implementation of Astin's I-E-O model in the Romanian academic environment during the COVID-19 pandemic with the aid of different hypotheses, the inputs being online education risks, students pandemic fear, digital skills and technological infrastructure, the environment is reflected by the online learning and pedagogical strategies, while the outcomes are the students present and future online education behaviour.

2.2. Hypotheses and conceptual model development

Online education is based on a high rate of self-taught learning, displaying numerous advantages, and also challenges, with the potential to generate more in-depth discussions between participants, improving the quality of learning, encouraging wider student involvement, allowing better time management, a more effective, creative, and flexible modern way of teaching, and also the possibility of having access to recorded and/or teaching materials on learning platforms [34]. However, there are also some problems with digital education. Some students have adaptation difficulties and may feel isolated; they perceive behavioural and emotional obstacles in accepting technical innovations, e.g., teaching and learning platforms, or may be hindered by poor internet services or an inadequate family environment for studying at home. Some of them lament the lack of communication with colleagues and professors, or feel anxious, stressed, depressed, etc. [35]. These difficulties are considered as online education risks. Due to these risks and to other subjective factors faced by some students, student dropout rates have increased dramatically in recent years [36].

Among the risks, there are limitations to online education; for example, it fosters, to some extent, the anonymity of students, engendering a certain complexity in teaching materials preparation, and facilitating exam cheating [37–40]. For some students, online education represents a strong impediment to efficient teaching [10,41] as they quickly become tired, or suffer from concentration difficulties during online classes [42], thus necessitating more and intensive involvement [43]. To a certain extent, online education includes a degree of superficiality of teaching/learning and the alienation of students from school [44–47]. Online teaching and learning strategies must be effective, and designed to reduce the risks; otherwise, such risks will have a negative impact on the quality and success of digital education, which depends on how pedagogical strategies are implemented [48]. In Romania, students hope that online teaching and learning strategies are just a compromise solution that will only remain during or in the aftermath of the pandemic [49]. Therefore, the following hypotheses are to be stated:

H1. The risks of online education positively impact online learning and pedagogical strategies.

H2. The risks of online education positively influence students' online education behaviour.

Romanian students reacted differently to online education [50], depending on their level of proficiency in using online tools and platforms, their technical abilities to access online courses, and the manner in which educational activities are conducted. To be efficient recipients of online education, students need, in addition to technical skills and intuition, a good command of English, as different platforms are usually provided in the English language. They also need good time management and endurance to be able to post feedback and/or questions if content is unclear, or if the student-teacher interaction is not sufficient [51]. Students familiar with digitalization will have good e-learning abilities [52,53], although technical ability is sometimes challenging for professors [54,55].

When considering the technological background of online education, several advantages must be highlighted: quick access to "school from home" [45], improvement of digital skills [46], and fast interaction between students and teachers [47,48]. However, the quality of education students receive from online teaching is mainly dependent on their access to digital learning resources [34,49]. One big challenge is the ability of all stakeholders in online education to accept and manage advanced technology. Therefore, it is assumed that:

H3. Students' digital skills have a favourable impact on online learning and pedagogical strategies.

H4. Students' digital skills have a positive impact on online education behaviour.

Face-to-face teaching has numerous advantages compared to online classes, being more beneficial for knowledge transfer, for student-teacher interaction, as well as for getting rapid feedback to any questions raised [50]. Teachers can also assess by the gestures/facial expression of students whether they have understood the content, or if more explanation is necessary [51]. Face-to-face teaching also allows the implementation of boot camps and/or of workshops with company representatives, thus enabling knowledge co-creation and a just-in-time assessment of ideas and arguments [52]. Of course, online teaching and learning are heavily dependent on technology and the Internet [53], the existence of proper equipment, practice in digitalization, support and motivation, disruptions in this process leading to the lowering of participants' interest [54]. Through the use of the Internet and different digitalized teaching methods, various online platforms have seen an unprecedented development. Technology and technological infrastructure ultimately saved the continuity of higher education during the COVID-19 pandemic, all over the world [55].

When the pandemic broke out, the technological infrastructure was not developed in most countries, teachers and students merely having the necessary skills and abilities to resort to the digital requirements. In many cases, the closure of universities found them largely unprepared; therefore, students became interested in the effectiveness of the technological infrastructure and platforms, and also in the pedagogical and psychological skills of the lecturers [67,68]. So, it can be postulated that:

H5. Technological infrastructure has a favourable impact on online learning and pedagogical strategies.

H6. Technological infrastructure has a favourable impact on online education behaviour.

The virus, lack of precise and sure treatment, and inexistence of any vaccinations in the first months of the COVID-19 pandemic generated not only a lot of stress, but also increased pandemic fear in populations [49,69]. Being relatively young and healthy, students' COVID-19-related fear was less intense [70,71], but, of course, generated distress and discomfort [73], increasing their uncertainty level and perceived risk towards unknown situations [73]. On this basis, the following hypotheses are proposed:

H7. Pandemic fear had a positive influence on online learning and pedagogical strategies.

H8. Pandemic fear positively influenced online education behaviour.

H9. Pandemic fear positively influenced students' future online education behaviour.

The main disadvantages of online education refer to difficulties in learning content based on experimental or practical activities [74], lack of social interaction, and social isolation [75,76]. During the pandemic, students worldwide experienced adverse educational conditions, often having difficulty in keeping up with teaching staff or administrative requirements, or properly understanding and using synchronous teaching and learning [45]. In certain cases, this led to educational stress, exclusion, and social marginalisation [77].

Online degrees were traditionally more likely to be an option for the untypical students: mature, with multiple caring responsibilities, working lives etc., with the dropout rate being at least 20 % higher compared to on-campus students [54]. Besides the students' problem of combining work and/or other activities with online teaching and learning, the high dropout rates are also explained by the fact that professors tended to disregard the importance of online teaching, being less involved in its delivery. It was also found that teaching staff often lacked online skills and experience in using different online platforms, not being able to properly design online courses or simply trying to use the same pedagogical approach for online teaching as for face-to-face teaching [54].

Are students motivated to continue studying if online teaching and learning will be the future of university education? University students' perception regarding the future of online education and how far they could adapt to digital education are controversial discussion topics [78], the results of the research in that vein being subjective. Even if it is difficult to look at online education as the education of the future, students nowadays are more satisfied with online teaching and learning [79]. Due to the pandemic experience, post-pandemic higher education has the possibility of following a hybrid arrangement [80]. In the opinion of [18] however, students do not agree with online education because of the difficulty in adapting, feeling the need for more complex, attractive, and socially appropriate online teaching strategies for students and professors. The COVID-19 pandemic accentuated the social risk raised by online education, leading to the intention to dropout and/or increasing students' difficulty in coping with this educational form [15]. The

following hypotheses are assumed:

H10. Online education behaviour has an impact on students' future online behaviour.

H11. Online learning and pedagogical strategies exert an impact on students' online education behaviour.

H12. Online learning and pedagogical strategies have an impact on future online education behaviour.

Based on these arguments, the conceptual model from Fig. 1 is proposed. This shows the connection between the studied constructs, being relevant in explaining students' present and future online behaviour.

In order to establish logical links between the effectiveness of online learning and teaching strategies and students' future online education behaviour, the authors chose representative determinants, many already validated in the literature, but in different contexts (pandemic fear, digital skills, technological infrastructure, online education risks, and online educational strategies). Grouping the constructs in the figure below into the three elements of the I-E-O model, it can be highlighted that the inputs are given by online education risks, pandemic fear, digital skills and technological infrastructure, the environment is reflected by the online learning and pedagogical strategies, while the outcomes are the present and future online education behaviour.

3. Research methodology

3.1. Research context

In Romania, the first major lockdown completely shut down the traditional education system on March 17, 2020 [81], leading to an overnight transition, without prior digital education training. Adapting to the new conditions, both students and teaching staff had to deal with stress and underdeveloped infrastructure, but also to find solutions so that education was not lost entirely. Because a general fear of infection persisted, with no clear treatment against the virus, restrictions in the education sector remained until the Fall of 2020, educational institutions having to decide on their own how they would continue in the new academic year. Although hard sciences, including engineering and medicine, remained hybrid to some extent, soft sciences preferred online teaching and learning until March 2022, when overall restrictions were lifted [81].

The purpose of this research was to assess the future of digital education based on online education behaviour, online learning, and pedagogical strategies during the COVID-19 pandemic. In this respect, the authors resorted to an empirical investigation by means of a survey, using an online questionnaire addressed to Romanian business and economics students. Students from various Romanian higher education institutions took part in the online survey. Therefore, convenience sampling was preferred. The survey was carried out between April and July 2022, when all COVID-19-related restrictions were officially dropped [82]. The research respected the Ethical and Deontological Code of the Babeş-Bolyai University approved by the University Senate (Approval 632, 2013) [95], but also the Ethical Visa of the Babeş-Bolyai University (Ethical Visa, 2023) [96]. Furthermore, the data was collected under the framework of the project CNCS–UEFISCDI, Number PN-III-P4-PCE2021-0366. All respondents participated upon a voluntary basis, without offering any information that could trace their identity.

The questionnaire was based on the theoretical concepts depicted in Fig. 1. All theoretical concepts were reflectively measured: online education risks, digital skills, technological infrastructure, online education behaviour, online learning and pedagogical strategies, future online education behaviour, and pandemic fear. Respondents had to assess on a five-point Likert scale the different statements that belonged to each of the studied concepts (see Table 1).

The theoretical model from Fig. 1 was analysed by means of structural equations using SmartPLS. In this vein, the measurement
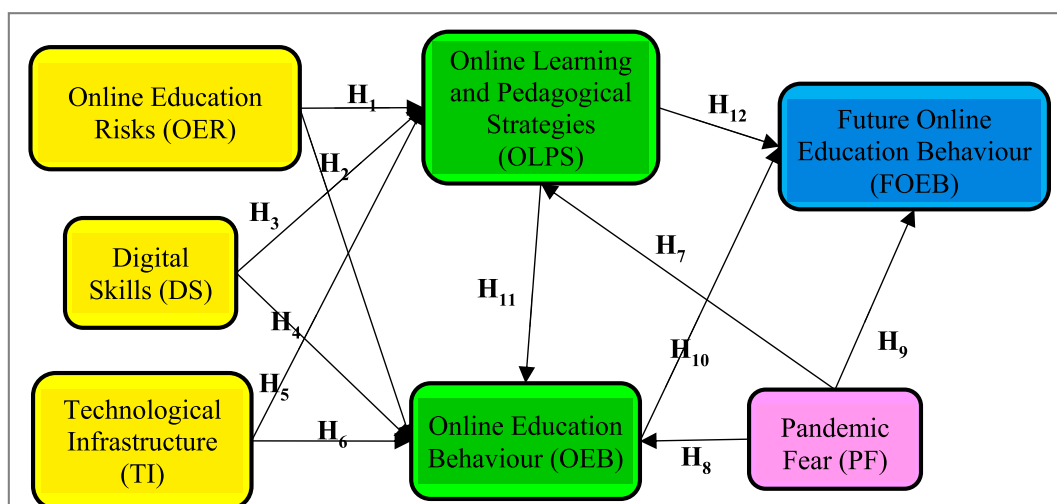

Fig. 1. Conceptual model: Generating future online education behaviour during the COVID-19 pandemic.

Table 1
Scales and items.

Item	Measure	Item Loading
Online Education Risks (OER) adapted after [10,21,35,41,42,44,45,50].		
	Online education …	
OER1	… makes difficult for me to understand the concepts taught.	0.902
OER2	… makes me shallow.	0.914
OER3	… took me away from school.	0.890
Digital Skills (DS) adapted after [18,52,53,55–59].		
	The digital skills and abilities that I possess …	
DS1	… make my online learning easier.	0.774
DS2	… make it easier for me to use different educational platforms.	0.811
DS3	… are unique; therefore, they give me a competitive advantage.	0.797
DS4	… will make it easier for me to find a job.	0.819
Technological infrastructure (TI) adapted after [60–64,68].		
	To benefit from online education …	
TI1	… I have high-speed Internet access.	0.752
TI2	… I have access to devices (laptop/tablet) that facilitate my online learning.	0.810
TI3	… I have easy access to educational platforms.	0.951
TI4	… I use the resources made available by the faculty.	0.707
Online Education Behaviour (OEB) adapted after [5,6,77].		
	Online education …	
OEB1	… gives me a feeling of anxiety.	0.887
OEB2	… is very tiring.	0.892
OEB3	… makes me depressed.	0.867
OEB4	… makes me feel overwhelmed.	0.882
OEB5	… distances me from my colleagues.	0.797
Online Learning and Pedagogical Strategies (OLPS) adapted after [48,54,83].		
	Learning-teaching assessment strategies used during online activities …	
OLPS1	… make me active in class.	0.872
OLPS2	… help me spend more time learning.	0.826
OLPS3	… are easier than in the classical learning system.	0.825
OLPS4	… are easy for those who work.	0.759
OLPS5	… are innovative.	0.832
Future online education behaviour (FOEB) adapted after [13,18–20].		
	For the future …	
FOEB1	… I will prefer online courses to face-to-face ones.	0.902
FOEB2	… I will be more active in online courses.	0.921
FOEB3	… I will also attend other online learning/training activities.	0.897
Pandemic fear (PF) adapted after [4,7,49,69,71].		
	In the context of the COVID-19 pandemic, I am very afraid …	
PF1	… to attend face-to-face classes.	0.805
PF2	… to socialise with others.	0.896
PF3	… to meet colleagues.	0.808
PF4	… to participate in events, which involves the participation of a large number of people.	0.855
PF5	… to travel to school.	0.856

Note: Factor loading >0.7 [84].

Table 2
The socio-demographic profile of respondents.

Gender	n	%	Net monthly income	n	%
Male	204	25.6	Under 400 EUR	119	14.9
Female	593	74.4	400-600 EUR	177	22.2
Total	**797**	**100.0**	600-800 EUR	143	17.9
Domicile	**n**	**%**	800-1000 EUR	102	12.8
Urban area	562	70.5	Over 1000 EUR	256	32.12
Rural area	235	29.5	**Total**	**797**	**100.0**
Total	**797**	**100.0**	**Marital status**	**n**	**%**
Generation	**n**	**%**	Single	575	72.1
Millennials/Y	187	23.5	Married/cohabiting	222	27.9
Z	610	76.5	**Total**	**797**	**100.0**
Total	**797**	**100.0**	**Type of studying place**	**n**	**%**
Enrolment	**n**	**%**	Tuition covered	398	49.8
Undergraduates	431	54.1	Tuition paying	399	50.1
Master studies	351	44.0	**Total**	**797**	**100.0**
Doctoral studies	15	1.9			
Total	**797**	**100.0**			

model was assessed, followed by the structural model and the relations between the concepts.

3.2. Sampling and data collecting

The study draws on empirical online quantitative research implemented through an online questionnaire distributed on various social media and learning platforms among student groups, through student organisations, and also by the authors themselves, during the COVID-19 pandemic. Sampling was done through convenience sample, with the aim of attracting as many students as possible. All questions had to be answered; otherwise, the online questionnaire could not be submitted. Participating in the research was voluntary, the respondents having the possibility of dropping completion of the questionnaire. The authors contacted more than 1,200 students, but only 854 responded. 57 questionnaires were incomplete, so in the end 797 responses were kept for further analysis. This leads to a response rate of about 66.4 %.

From a total of 797 people, 562 (70.5 %) were from urban areas, while 235 (29.5 %) lived in rural areas. While 187 people (23.5 %) belonged to Generation Y or Millennials (born between 1980 and 1994), 610 (76.5 %) belonged to Generation Z (born between 1995 and 2004). The average net monthly income declared by respondents was relatively variable. 119 people (14.9 %) declared a monthly net income of below 2000 lei (400 euros), 177 (22.2 %) had a net income of 400–600 euros, 143 (17.9 %) between 600 and 800 euros, 102 (12.8 %) between 800 and 1000 euros, while the remaining 256 (32.12 %) had a net income of over 1000 euros (see Table 2).

During the COVID-19 pandemic, 274 respondents (34.4 %) had no job, 112 respondents (14.1 %) worked part-time, while 411 people (51.6 %) had an 8-h daily work schedule. Of the 797 respondents, 204 were men (25.6 %) and 593 were women (74.4 %). Most respondents were single (575 persons: 72.1 %), the rest being legally married, cohabiting, or divorced. 222 respondents (27.9 %) declared that at the beginning of the COVID-19 pandemic in their study programme, teaching had taken place classically (face-to-face) - less during the period of initial restrictions; 225 people (28.2 %) were taught in a hybrid system, that is, courses were taught online, with seminars and lab workface-to-face, while 350 (43.9 %) had integral online education. Of the total of 797 respondents participating in the research, 431 (54.1 %) were enrolled in the undergraduate cycle, 351 (44 %) in master's studies, and only 15 (1.9 %) in Doctoral studies. 398 students (49.9 %) followed courses on a publicly financed place (tuition is covered by the Ministry of Education), while 399 (50.1 %) were registered as fully tuition-paying students. The overwhelming majority of respondents (762 people: 95.6 %) were studying for regular degrees, while only 35 (4.4 %) attended distance learning degrees.

3.3. Evaluation of the measurement models

Through SmartPLS 3.0., the authors resorted to an analysis with structural equation modelling (SEM) of the conceptual model (see Fig. 1). Furthermore, as recommended by the literature [73], the authors checked for item loadings (see item values in Table 1), data validity and reliability, average variance extracted (AVE) (see Table 3), discriminant validity with Fornell-Larcker (Table 4) and the Hetertrait-Monotrait criterion (Table 4). As all recommended minimum and/or maximum thresholds are fulfilled [84,85], the analysis model is correct, and the constructs depict convergent validity [86].

In the next step of the procedure suggested by the literature [87], a collinearity check of the measurement model had to be assessed. In this regard, the VIF values were considered, which must be for all variables below 5 otherwise the items would be collinear. The analysis computed a VIF of 3.241 for the variable PF2, so the sample does not contain multicollinearity. After that, a bootstrap analysis was performed. This allowed to test the hypotheses and the relationships between the constructs, with t-statistics testing twelve hypotheses.

3.4. The evaluation of the structural models

Next, a collinearity check of the constructs was performed, revealing that the highest VIF between OLPS and OEB for the inner model is 1.795 < 5 [87], but also 3.3 [88], meaning that there is no construct multicollinearity. The goodness-of-fit of the saturated model was also assessed. With a value of SRMR = 0.061 < 0.08, the model is correct. The variance of Future Online Education Behaviour is explained at 56.8 % ($R^2 = 0.568$) by the Online Learning and Pedagogical Strategies, Online Education Behaviour and COVID-19 Pandemic Fear, which enabled us to highlight that the prediction power of the model is strong (see Fig. 2).

Table 3
Validity and reliability.

Constructs	Cronbach Alpha	CR	AVE
Online Education Risks	0.886	0.929	0.814
Digital Skills	0.815	0.877	0.641
Technological Infrastructure	0.838	0.883	0.656
Online Education Behaviour	0.916	0.937	0.749
Online Learning and Pedagogical Strategies	0.881	0.913	0.678
Future Online Education Behaviour	0.892	0.933	0.823
Pandemic Fear	0.899	0.924	0.710

Note: Cronbach's Alpha>0.7; AVE>0.5; CR > 0.7 [84–86].

Table 4

Discriminant validity analyses.

Construct	DS	FOEB	OEB	OER	OLPS	PF	TI
	Fornell-Larcker criterion						
DS	0.800						
FOEB	0.490	**0.907**					
OEB	−0.249	−0.497	**0.866**				
OER	−0.263	−0.506	0.721	**0.902**			
OLPS	0.541	0.732	−0.504	−0.494	**0.824**		
PF	−0.037	0.055	0.292	0.192	0.012	**0.843**	
TI	0.514	0.268	−0.082	−0.102	0.334	−0.024	**0.820**
	Heterotrait-Monotrait criterion (HTMT)						
DS							
FOEB	0.569						
OEB	0.281	0.549					
OER	0.302	0.568	0.801				
OLPS	0.631	0.824	0.560	0.557			
PF	0.088	0.093	0.306	0.201	0.091		
TI	0.630	0.294	0.098	0.111	0.373	0.073	

Note: DS: Digital Skills; FOEB: Future Online Education Behaviour; OER: Online Education Risk; OEB: Online Education Behaviour; OLPS: Online Learning and Pedagogical Strategies; PF: Pandemic Fear; TI: Technological infrastructure. HTMT<0.9 weak; HTMT<0.8 strong [85].

3.5. Findings

The path coefficient analysis based on the *t*-test statistics is displayed in Table 5. Hypothesis 1 presumed that the perceived risks associated with online education positively influence the online pedagogical and learning strategies. The results ($\beta = -0.402$; T = 11.247; $p < 0.001$) highlight a strong but significant negative influence, which means that perceived risks diminish the efficiency of pedagogical and learning strategies, maybe because students were not satisfied with online education during the COVID-19 pandemic, confirming the previous findings [21,42,44,45]. The relationship between the two constructs allows us to accept H_1.

The second hypothesis assumed that the perceived risks associated with online education positively influence student online education behaviour. In this case, the results ($\beta = 0.571$; T = 15.511; $p < 0.001$) confirm the strong positive and significant influence, opposite to Ref. [41], who finds a negative influence between the perceived risks and human behaviour, but a positive one between risk and the intention of an individual to engage in a behaviour. The literature pinpoints that uncertainty in the teaching/learning online environment did not meet the students' educational expectations; despite making huge efforts to safeguard their students' identity, the feeling was that they were exposed to a lot of risks [35]. The observations mentioned above allow us to accept H_2.

The third hypothesis asserted that digital skills have a favourable impact on online learning and pedagogical strategies. The results ($\beta = 0.390$; T = 9.231; $p < 0.001$) show a strong positive and significant relation between the two constructs, confirming previous research [50,52,53]. Many university students/teachers had no experience of digitalization [54,55]. This is why it was necessary to increase online technological competencies for both parties [18] and to create pedagogical scenarios that varied according to the available components: technological tools, pedagogical treatment, navigational tools, study tools and supervision methods [48]. Thus, H_3 can be accepted.

H_4 analysed the influence of students' digital skills on their online education behaviour. This relation ($\beta = 0.015$; T = 0.435; $p = 0.663$) was found to be of very low influence and non-significant, in opposition to the relationship between the two constructs analysed in the literature [89–91], which highlighted that students were not technically prepared for digital education, improving digital competencies being of high importance. Students reacted differently to online education, their reactions being based on their proficiency in using online tools and their ability to technically access online courses [50]. Thus, H_4 was rejected.

Hypothesis H_5 investigated the impact of the available technological infrastructure on the used pedagogical and online learning strategies. In this case, the influence ($\beta = 0.095$; T = 2.484; $p = 0.013$) was also of very low impact and of low significance. But the hypothesis is in accordance with Tsolou's [45] conclusion that the quality of education students received from online teaching and the efficiency of online pedagogical strategies were mainly dependent on their access to digital learning resources [45]. Attractive and innovative pedagogical strategies would strengthen the student-teacher relationship and communication in online education, providing emotional support at the same time [90,92]. H_5 could be accepted.

H_6 assumed that the available technological infrastructure exerts a positive influence on students' online education behaviour. The results ($\beta = 0.057$; T = 2.115; $p = 0.035$) suggest a low influence, of low significance, which confirms the literature findings [64,65], underlining a strong dependence between the digital infrastructure and the students' position towards online education. Without motivation and the necessary technological equipment, students' interest towards online education would decrease. Furthermore, students who easily browsed the Internet would have a positive attitude towards online education [50]. So, the sixth hypothesis can be accepted.

As research was carried out during the COVID-19 pandemic, pandemic fear was included as a construct, and its impact on the propensity towards the online learning and pedagogical strategies was analysed. In the international literature, to define the construct "pandemic fear" authors use expressions such as "the high uncertainty and risk toward unexpected and unknown situation" [64,66,71,
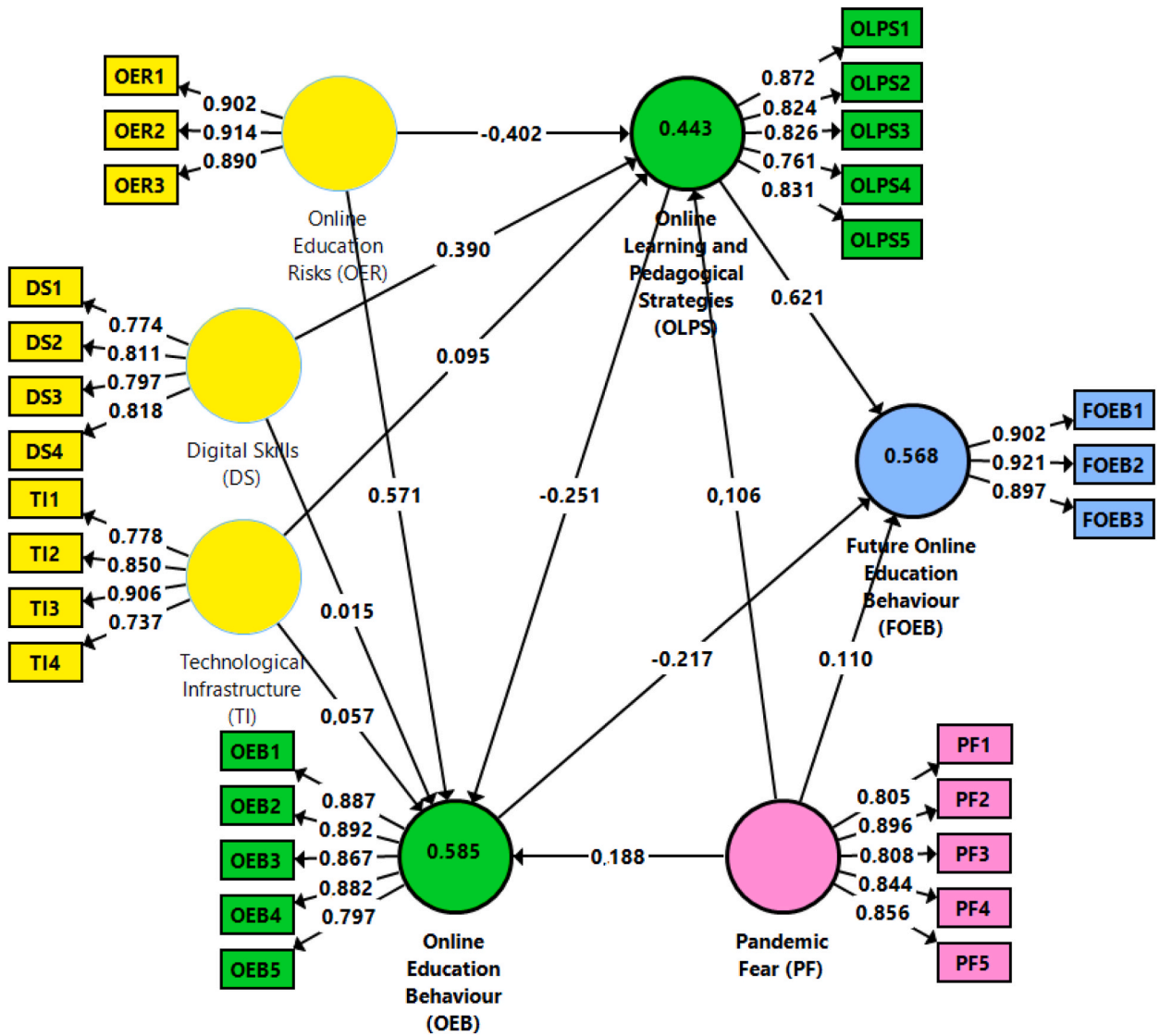
Fig. 2. Structural model.

Table 5
Path coefficients of the structural equation model.

Paths	Path Coefficients	Standard Deviation	T-Value	P-Value	Hypotheses
OER→OLPS	−0.402	0.036	11.247	0.000**	H_1-Confirmed
OER→OEB	0.571	0.037	15.511	0.000**	H_2-Confirmed
DS→OLPS	0.390	0.042	9.231	0.000**	H_3-Confirmed
DS→OEB	0.015	0.033	0.435	0.663[n.s.]	H_4-Rejected
TI→OLPS	0.095	0.038	2.484	0.013*	H_5-Confirmed
TI→OEB	0.057	0.027	2.115	0.035*	H_6-Confirmed
PF→OLPS	0.106	0.031	3.386	0.001**	H_7-Confirmed
PF→OEB	0.188	0.029	6.403	0.000**	H_8-Confirmed
PF→FOEB	0.110	0.029	3.485	0.000**	H_9-Confirmed
OEB→FOEB	−0.217	0.035	6.232	0.000**	H_{10}-Confirmed
OLPS→OEB	−0.251	0.041	6.052	0.000**	H_{11}-Confirmed
OLPS→FOEB	0.621	0.031	20.130	0.000**	H_{12}-Confirmed

Note:[n.s.] – non-significant; *$p < 0.05$; **$p < 0.001$; DS: Digital Skills; FOEB: Future Online Education Behaviour; OER: Online Education Risk; OEB: Online Education Behaviour; OLPS: Online Learning and Pedagogical Strategies; PF: Pandemic Fear; TI: Technological infrastructure.

73], "the stressful and uncomfortable teaching environment" [72] or "pandemic stress" [21]. The results ($\beta = 0.106$; T = 3.386; $p <$ 0.001) depict a low influence of high significance, so **H$_7$** is to be accepted.

Hypothesis eight theorised that pandemic fear positively impacts students' online education behaviour. In this case, the relations between the two constructs were of moderate impact ($\beta = 0.188$; T = 6.403; $p < 0.001$), but highly significant, similar to previous findings [4,7,49,69,70]. Thus, **H$_8$** could be accepted.

The ninth hypothesis ascertained that pandemic fear positively impacts students' future online education behaviour. The results pinpoint ($\beta = 0.110$; T = 3.485; $p < 0.001$) a moderate but significant influence, which is opposite to previous findings [13,18], who concluded that most students would prefer face-to-face education in the future, some of them being fearful that online learning would be prolonged. Thus, **H$_9$** is confirmed.

Hypothesis ten studied the influence of online education behaviour on the students' future online behaviour. Contrary to the expectations, the results ($\beta = -0.217$; T = 6.232; $p < 0.001$) depict a decrease in the phenomenon, thus highlighting that online education was not desired in the future, confirming previous findings [15,18,45,77]. Students were worried for the future because they were afraid of the re-definition of teaching and learning through online instruments [16]. However, **H$_{10}$** could be accepted.

The next element investigated the influence of online learning and pedagogical strategies on students' behaviour in online education. The results ($\beta = -0.251$; T = 6.052; $p < 0.001$) also show a negative but significant influence. The highest difficulties encountered by students regarding the pedagogical strategies were in the case of practical activities, due to the impossibility of keeping up with the information provided, and often feeling socially marginalized [45,74–76]. Because the results confirm previous findings, **H$_{11}$** could be accepted.

The last hypothesis (**H$_{12}$**) presumed that online learning and pedagogical strategies exert a positive influence on future online education behaviour. This assumption is confirmed by the results ($\beta = 0.621$; T = 20.130; $p < 0.001$), as the influence was of high and positive significance. Some students agreed that online pedagogical strategies were efficient, considering that online teaching could be the future of higher education [93], while others considered online education to be a problem, and not feasible to adopt for a long time [80,93], so opinions were subjective [80]. validated this hypothesis, underlining that efficient online learning and pedagogical strategies may create the conditions for a hybrid education. So **H$_{12}$** was accepted.

4. Discussions

Analysis of the future behaviour towards digital education has an extremely subjective character, the research carried out so far worldwide indicating that the opinions of young people differ from one university to another, from one country to another and from one geographical region to another [79,80,93]. Online learning and pedagogical strategies and students' online education behaviour are influenced by perceived risks associated with digital education [10,41]. The personal characteristics of students and their learning strategies have a high impact on diminishing the negative perceptions of online education, and on avoiding dropout intention [48]. Furthermore, online strategies must be improved by additional features, such as the attractiveness of a presentation, a good network interaction between all the implied sections, and the presentation of lessons as if online teaching itself were a game (suggested by Ref. [18]). These two influences were confirmed by the analysis, even if the results were checked with the help of negation items, which are in opposition to similar findings obtained by other researchers [41].

Students' digital skills have a positive impact on teaching and learning strategies, without having an impact on their online behaviour. The first supposition validates previous findings [18,37], whereas the second assumption is in opposition to the literature [50,89,90] as the impact of Romanian students' digital skills on their online behaviour is insignificant. The available technological infrastructure has a major impact on both teaching and learning strategies, and students' online behaviour, assumptions confirmed previously [45,50,64,92].

Pandemic fear is the latest name of the constructs, often used in the literature, that highlight unknown or uncertain situations, or pandemic stress. Such risky conjunctures may influence students' current online education behaviour, future online education strategies, and also teaching and learning strategies [7,64,69,71]. With the specification that the intensity of pandemic fear differs from one geographical place to another or from a person to another, the concrete impact on students' online behaviour is also subjective, depending on each student's perceptions towards the pandemic. For this reason, different results on the impact of pandemic fear on student future online behaviour were obtained; these findings are similar to previous research [13,18]. The results show that pandemic fear is stronger compared to fear of online education.

The results of many studies in the field of education worldwide are similar in terms of student reluctance towards the future of online education [16,18,45]. Most students are not motivated to continue studying online if this is likely to be the education of the future. The study validates this conclusion, which is applicable in the situation of Romanian students' online behaviour. Online pedagogical teaching and learning strategies have an important impact on students' online behaviour, and on their future online education behaviour. These determinants have already been validated in various scientific works [80,93], but are of a subjective character, generating different concepts, depending on the profile of the establishment where the young people study [45,75]. The difference comes from the difficulty in understanding the applied courses or exact disciplines compared to the more theoretical ones.

The findings are in opposition to similar results from developing countries, where universities introduced a complex online environment that was quickly adopted by both students and teachers during lockdowns, without difficulty. There are huge differences, not only between students' desire to use online learning and pedagogical strategies in developed countries, compared to developing countries, but also when comparing several emerging countries [94].

5. Conclusions

The originality of this approach consists in including in the study those variables or constructs which, in the authors opinion, have a major impact on the future of online higher economic education in an emerging country like Romania. The authors formulated new items, while establishing and testing new correlations between the chosen constructs. Independent of the fact that the name of the constructs is or is not the same as that in the literature, the correlations between them are, in most cases, new or slightly modified. The way in which the links between the constructs in the research model were established is due to the vision of the authors, as well as their grouping into the three elements of the I-E-O theory.

The effect of attitudes to the COVID-19 pandemic on Romanian students concerning future online teaching and learning is major, being influenced by many determinants such as teaching strategies, digital skills, available technology, pandemic fear, and a lot of online education risks. The experience they had during the pandemic related to online education causing future economists to feel dissatisfied with it, primarily because digitalization carries with it a lot of risks: lack of socialization, stress, isolation, depression, difficulty in understanding the taught courses, etc. However, if professors in the higher education institutions have efficient online teaching and pedagogical strategies and easy access to technological infrastructure (platforms, programmes), the above-mentioned risks can be diminished, encouraging teachers to adapt their teaching-learning methods according to the needs of a high-performance digital education. This suggests that universities should continue investing in their own digital infrastructure. Even if the majority of students are reluctant to fully embrace a future online education, or teachers feel uncomfortable in adapting to the changes, it is recommended that all higher education institutions should be prepared, from the technical infrastructure point of view for such a scenario. This will be possible if institutions have a budget for crisis situations, when, either because of a new pandemic, or other emergency situation, they are forced to migrate to online education. Furthermore, it is recommended that Romanian universities enrol professors in online education training courses, so that they can familiarize themselves with this new working environment and the new technological infrastructure. In this way, in the event of a crisis, they will no longer be surprised by any changes that may appear overnight.

All hypotheses were confirmed expect for one, students' digital skills have a positive influence on online learning and pedagogical strategies, but not on their online behaviour. The quality of education received by students during the pandemic was strongly dependent on their access to technology but did not change their perceptions concerning online teaching. Students need to involve their professors in online communication to feel emotionally comfortable. A student's attitude towards the future of online education, however, does not depend on their level of technological proficiency. The result of the study highlights the relevance of the Input-Environment-Outcomes (I-E-O) theory proposed by Astin [28] and its implementation during the pandemic and even post-pandemic period, suggesting that the COVID-19 pandemic has a non-negligible influence on the future of online education in Romania, even if it is not a positive one. This research showed that Romanian students would not prefer purely digital education in the future, and hope that online teaching and learning will not be the higher education of tomorrow. However, if huge changes occur in education, they need efficient online learning and pedagogical strategies to influence their perceptions regarding the future of online education. The efficiency of the technological infrastructure of Romanian universities and the improvement of digital teaching methods through easy-to-manipulate platforms must be a future guarantee for the education of an emerging country in the event of unfavourable circumstances for classical education.

The main limitation of the research is that the answers to the questionnaire were collected only from students of economic sciences faculties in Romania, and not from other areas of study. At the same time even if the respondents were from different study cycles (Bachelor, Master, and Doctorate) it would be almost impossible to do a generational analysis, due to the age gaps and social status of the young people. Furthermore, if future analysis could be implemented taking into consideration a sampling of students from economics faculties, of students who do paid work during their studies, and those who do not work, it might be possible to obtain different results, because their perception of time management is different. For this reason, future research could be extended to other fields of study and could be deepened depending on the level of studies, or according to the criteria of student typology (untypical mature students with working lives, or young students), in order to analyse if there is a possible generational difference in students' perceptions towards the future of economic digital higher education.

CRediT authorship contribution statement

Luiela Magdalena Csorba: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Investigation, Formal analysis, Data curation, Conceptualization. **Dan-Cristian Dabija:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Data availability statement

Data will be made available on request.

Additional information

No additional information is available for this paper.

Funding statement

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:I am a member of the Editorial Advisory Board of Heliyon, section Tourism Hospitality https://www.cell.com/heliyon/tourism-hospitality/editors If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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