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Finnish university students' satisfaction with e-learning outcomes during the COVID-19 pandemic

Students' satisfaction with e-learning

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Abstract

Purpose – Students' satisfaction with e-learning outcomes is a vital component in determining the adoption of e-learning systems. Understanding the antecedent factors impacting students' satisfaction with e-learning outcomes helps decision-makers at the higher education to take the necessary actions to enhance the quality of students' performance, especially during the exceptional times, such as the COVID-19 pandemic.

Design/methodology/approach – This paper aims to determine and analyse the antecedent factors influencing students' satisfaction with e-learning outcomes during the pandemic. Structural equation modelling (SEM) is used to analysis a proposed research model.

Findings – The SEM results show that digital communities in e-learning, information technology (quality and accessibility) and the online course design quality directly influence students' satisfaction with e-learning outcomes. More interestingly, results show that the COVID-19-related factors (1) awareness of the COVID-19, (2) perceived challenges (negatively) and (3) the educational institutions' preparedness also influence e-learning outcomes.

Research limitations/implications – The results suggest that the decision-makers at the educational institutions should consider adopting a blended learning system approach to deliver e-learning during the emergency, such as the COVID-19 outbreak situation.

Originality/value – This is one of the first studies in higher education context, which seek to identify the antecedent factors that influence students' satisfaction with e-learning outcomes during the COVID-19 pandemic.

Keywords COVID-19, e-learning, Distance learning, Higher education, Information communications technology

Paper type Research paper

1. Introduction

Higher-education institutions have been affected by the recent COVID-19 pandemic worldwide. Many countries implemented a national lockdown, banning much of students' face-to-face interaction and physical presence at higher-education institutions. Even though the initial outbreak of the pandemic was first reported in December 2019, it remains an enormous challenge for higher education until now (Adedoyin and Soykan, 2020; Basir *et al.*, 2021; de Boer, 2021). This situation prompted higher-education institutions to adapt to the



abrupt shift to distance and online learning to support the provision of seamless and sustainable teaching and learning online (Almaiah *et al.*, 2020).

Higher-education institutions rely on information and communications technology (ICT) to deliver their core services: teaching and learning, in exclusive distant and hybrid settings (Sun *et al.*, 2008). However, recent literature (e.g. Evans *et al.*, 2021) indicates many challenges in delivering e-learning effectively, specifically during the current COVID-19 pandemic. For an efficient remote-only e-learning delivery, multiple obstacles and bottlenecks, such as availability of teaching and administrative resources, work under pressure, and more importantly, dependability on IT infrastructure, digital learning tools and other IT platforms play a role (Ebner *et al.*, 2020). Some recent studies, such as Nikou and Maslov (2021), found a potential difference in the intention to use e-learning between COVID-19 and non-COVID-19 contexts. Furthermore, a sudden shift to exclusive e-learning methods of instruction caused a significant negative impact on the university students' well-being, including a rise in depression and anxiety disorders (Fawaz and Samaha, 2021).

Besides, effective e-learning encompasses not just the online posting of content via a learning management system (hereafter LMS) but also actual teaching and mentoring. This suggests the difference between remote emergency teaching and effective/efficient online learning (Hodges *et al.*, 2020). Moreover, establishing an appropriate learning environment depends on having both online and offline learning infrastructures (Nortvig *et al.*, 2018), which, at the times of COVID-19, has been impaired due to the inability of most higher-education institutions to provide proper offline space for learning. As such, to meet the increasing demands for remote learning, LMSs have become increasingly popular again (Baber, 2020; Radha *et al.*, 2020). According to Sun *et al.* (2008, p. 1189), students' satisfaction with e-learning is "*the degree of perceived learner satisfaction with e-learning settings as a whole*", and the e-learners' perceived satisfaction with e-learning is considered a key indicator of e-learning system adoption (Arbaugh, 2000).

Students' satisfaction with e-learning outcomes in this research refers to the immediate result of a successful learning experience as well as their overall performance in their courses using e-learning systems (Baber, 2020; Gray and DiLoreto, 2016). Some authors, such as Richardson *et al.* (2016), found high correlation between students' overall perceived learning with students' satisfaction with e-learning systems. From an academic perspective, multiple factors have been used to measure the e-learning outcomes, especially concerning the research on perceived satisfaction with e-learning outcomes (Sun *et al.*, 2008). Some of these factors such as IT system quality, course design quality, students' engagement in an online class and course information and structure have been utilised in the recent studies to explore the impact of the COVID-19 pandemic on e-learning satisfaction.

Serenko (2011) argued that with respect to antecedent factors of perceived e-learning satisfaction, several factors (e.g. course grade and gender) and environmental aspects (e.g. actual classroom experience and education delivery modes) may affect students' satisfaction. More importantly, recent literature builds a solid argument to underline the importance of students' perceived satisfaction with e-learning outcomes in the COVID-19 context (Hamdan *et al.*, 2021). Some studies found that school closure had a potential negative impact on the students' academic performance and achievements (Kuhfeld *et al.*, 2020) or had an impact on the students' perceived satisfaction and psychological well-being due to the rapid shift to exclusive e-learning methods of instruction. Therefore, more research is required to examine the relationship between COVID-19-related factors and students' satisfaction with e-learning outcomes as well as the factors that may mediate these relationships (Baber, 2020; Fawaz and Samaha, 2021; Gopal *et al.*, 2021; Shahzad *et al.*, 2021).

This paper aims to identify the factors that directly influence or mediate the students' satisfaction with e-learning outcomes during the COVID-19 pandemic. In doing so, we develop an integrated theoretical model that draws on a range of factors in relation to,

e.g. COVID-19 pandemic, IT (quality and accessibility), course design quality and students' engagement in e-learning digital communities. These factors contribute to the students' satisfaction with e-learning outcomes. To evaluate the proposed model, we conducted this empirical research and collected data via an online survey during the school closures, focusing on only university students as the target group. The main criterion for participation in the study was to be an active student in higher education.

This study contributes to the body of knowledge by providing new insights. For example, the outcomes of this study demonstrate that it is now the ideal time for decision-makers at higher-education institutions to emphasise on blended learning systems using advanced technology for teaching and learning purposes. It is advised that the structure of the courses offered to students be reconsidered and that online teaching methods be adopted. The findings show that the educational institutions' preparedness and the availability of advanced IT infrastructure to provide distance learning during the challenging times play an important role in how students express their satisfactions with e-learning outcomes. Moreover, the study contributes to literature by demonstrating that academic staff at higher-education institutions should pay special attention in the design of online courses and the creation of digital communities where students can connect with their peers and teachers.

The rest of the article is organised as follows. [Section 2](#) presents the relevant literature. [Section 3](#) provides the theoretical framework and development of the research hypotheses. [Section 4](#) describes the methodology. [Section 5](#) provides the research results. [Section 6](#) provides discussions of the results. [Section 7](#) concludes the research, outlines the limitations and provides some recommendations for future research.

2. Literature review

2.1 E-learning

E-learning is widely defined as the emergent paradigm of making use of ICT to deliver the learning contents and information for the education and training of learners in a systematic way ([Sun et al., 2008](#)). The e-learning systems are based on the transmission of knowledge online, yet they may also entail concomitant concepts, like digital communication ([Liw and Huang, 2013](#)), the purpose of which may be motivated by objectives other than merely a transmission of knowledge online. Furthermore, there are slightly alternative views concerning e-learning not only as a method to deliver information for education and training but as, e.g. a means to improve personal career fulfilments, to allow for the integration of human resource management system, and to increase productivity and satisfaction of the e-learners ([Uden et al., 2007](#)). These views adopt a holistic, open systems view, whereby the purpose of e-learning is understood more broadly. In this research, we maintain a widely accepted e-learning definition provided by [Sun et al. \(2008\)](#). From this perspective, e-learning consists of two major phases (1) content development, and (2) content delivery and maintenance. Content development includes planning, design, creation, and evaluation, which in turn leads to content delivery and maintenance. The process of e-learning is considered iterative ([Khan, 2004](#)), and has its own pros and cons. On the one hand, e-learning provides learner-centred, self-paced, cost-effective learning, on the other hand, e-learning as a process lacks social interactions and has a risk for higher degrees of frustration and confusion, specifically in the pandemic situation. The e-learning also demands a significant chunk of time from instructors for the course preparation ([Zhang et al., 2012](#)). In addition, LMS is used in e-learning as a central information system. Such digital platforms enrich students' learning by providing an outlet for the course content and facilitating the teacher's work in education and training delivery ([Bansode and Kumbha, 2012](#)).

[Sun et al. \(2008\)](#) and [Nortvig et al. \(2018\)](#), have conceptualised satisfaction of e-learning outcomes as an outcome variable to measure the success of e-learning outcomes. [Sun et al. \(2008\)](#), has argued that satisfaction of e-learning outcomes is potentially reliant on

multiple factors, such as learner's computer anxiety, IT infrastructure (quality and accessibility) and digital learning management tools, instructor's attitude towards using e-learning, quality of e-learning courses and course content, among other factors. In addition, Fleming *et al.* (2017), concluded that e-learning satisfaction and future use depend on the low complexity of the e-learning outcomes, the perceived utility of the learning knowledge offered and the users' technical support. Nortvig *et al.* (2018), found that (1) digital learning community with positive and engaging interactions between teachers and students, (2) strong self-confidence in learning ability, (3) appropriate teaching environment (both online and offline) with a strong educator presence as a mentoring figure, and (4) a course design quality, all influence the learning outcome, in particular the satisfaction with e-learning.

2.2 Blended learning: boundaries between physical and virtual

In the COVID-19 context, where nearly a complete remote learning delivery was recommended and instructed, it is essential to consider the blended learning approach. Some authors, such as Ateş Çobanoğlu (2018, p. 139), argued that the widespread implementations of blended learning (b-learning) and online learning are promising for reshaping teaching and learning in higher education. E-learning is not a bounded activity to a specific time and place, which is done entirely online, but is increasingly more blended, with both digital and offline activities that both students and instructors partake in. Moreover, due to the extensive use of LMSs and other digital learning tools, boundaries between the physical and the virtual in the learning sphere have become less transparent and more permeable, with learners being able to use digital technologies to learn, discover, and construct meaningful knowledge (Ellis and Goodyear, 2016). Blended e-learning suggests that learning happens both online and offline, and learners not only sit behind the screen consuming the course content but also think and reflect to assess the received knowledge in the more traditional learning settings.

However, at the times of the COVID-19 pandemic, physical learning has been impacted negatively due to the inability of schools to provide the necessary "offline part" of studying, such as learning space on the campus. Students were forced to study remotely, which is closer to the self-directed unstructured learning. In this paper, e-learning refers to learning that relies on the ICT, which is a part of overarching teaching and learning done at the educational institutions. We also consider e-learning as a part of blended learning, and hence e-learning is fuzzy with hard-to-define borders of where it ends, and where traditional learning starts. Regardless of the drawbacks, the notion of blended learning is essential when we consider the COVID-19 situation, as the pandemic and quarantine seemingly have re-defined the previous blended approach and the measures of its success towards a learning approach that is increasingly more digital and self-directed (Ożadowicz, 2020).

2.3 COVID-19 and e-learning

The global quarantine imposed by the COVID-19 pandemic resulted in the closure of the higher education institutions. As a result, the learners' (students) physical presence and social interactions with the teachers have been affected (Karalis and Raikou, 2020). During the pandemic, higher education institutions have increasingly turned to e-learning as a key method of operation (Almaiah *et al.*, 2020; Ebner *et al.*, 2020). As such, distance education and course design have increasingly become important when evaluating an e-learning capability to deliver a high-quality outcome in the context of COVID-19 (Almaiah *et al.*, 2020).

From the survey of the teachers' perspective at the higher education institution, multiple challenges were found to impact the educational preparedness to deliver e-learning (Alea *et al.*, 2020). It was found that students may suffer significant psychological distress during the education in the pandemic (Hasan and Bao, 2020), and that they may also prefer

traditional face-to-face learning. However, due to the necessity of adapting to the education processes at the higher education environments, e-learning, and the development of e-learning related methods and technology have received massive attention (Ebner *et al.*, 2020). It has been argued that the availability of the ICT and Internet to design and deliver education has become a new challenge to satisfy a much higher data consumption with learning applications and tools used in e-learning (Favale *et al.*, 2020). As such, e-learning may face significant challenges concerning the technical (ICT reliability, availability of equipment), and social aspects (teachers' ability to deliver e-learning, students' distress).

3. Theoretical framework and hypothesis development

Literature shows various theoretical models that describe the relationship between e-learning and outcome variables; for instance, students' satisfaction in online learning environment, and perceived learning (Gray and DiLoreto, 2016). Due to the recency of the COVID-19 pandemic, and the imposed recommendations for online learning, this paper tries to theoretically explore and identify factors influencing students' satisfaction with e-learning outcomes during the COVID-19 pandemic and school closures. We start with COVID-19 related factors.

3.1 COVID-19 related factors

Recent studies have identified several challenges of e-learning systems adoption and usage during the COVID-19 pandemic (Kaisara and Bwalya, 2021). For example, Almaiah *et al.* (2020) have noticed that technological challenges, individual challenges, cultural challenges, and course challenges are the main obstacles faced by the higher education environments in the period of lockdown of the COVID-19 pandemic. Moreover, Aini *et al.* (2020), found that ICT connectivity, e-learning system supports, self-regulation and competency were the main challenges of e-learning during the global COVID-19.

According to WHO (2020), and Alahdal *et al.* (2020), individual's awareness towards COVID-19 positively impact their attitude toward facing the challenges of COVID-19, and their practices to reduce the spreading rate during the pandemic. Furthermore, educational institutions must be prepared and invest in distance education implementation, according to the Distance Education Models (Academy Administration Practice, 2011). During the COVID-19 pandemic, this issue has gained new prominence. Finally, Musingafi *et al.* (2015, p. 59) investigated the challenges of e-learning education and discovered that the most mentioned issues included lack of study time, access to and usage of ICT, inadequate feedback, and lack of study materials. Alea *et al.* (2020), have assessed these issues from teachers' perspectives, and investigated higher education institutions' preparedness and challenges in adopting e-learning during quarantine periods. The authors examined three factors, and conceptualised them as COVID-19 related constructs, (1) the awareness of the COVID-related situation, (2) the educational institutions' preparedness to conduct distance learning, and (3) perceived challenges during the COVID-19 in distance learning education.

In this paper, we adopt Alea *et al.* (2020) conceptualisation, and use all three COVID-19 related factors to examine students' satisfaction with e-learning outcomes. Furthermore, the COVID-19 impact on higher education is understood both as the factor associated with the context of the person, forcing one to participate solely in distant e-learning, and an intervening variable, which formulates how the process of e-learning is done. Thus, we include other factors such as (1) digital communities of e-learning, (2) IT (quality and accessibility), and (3) course design quality in our proposed model. In general, the proposed model was developed for the educational settings and augmented by several important

constructs that may influence students' satisfaction with e-learning outcomes. Hence, we hypothesise:

- H1.* Awareness of COVID-19 has a positive effect on the digital communities of e-learning.
- H1a.* Awareness of COVID-19 has a positive effect on the information technology (quality and accessibility).
- H1b.* Awareness of COVID-19 has a positive effect on the course design quality.
- H2.* Perceived challenges during the COVID-19 has a negative effect on the digital communities of e-learning.
- H2a.* Perceived challenges during the COVID-19 has a negative effect on information technology (quality and accessibility).
- H2b.* Perceived challenges during the COVID-19 has a negative effect on the course design quality.
- H3.* Perceived educational institutions' preparedness has a positive effect on the digital communities of e-learning.
- H3a.* Perceived educational institutions' preparedness has a positive effect on information technology (quality and accessibility).
- H3b.* Perceived educational institutions' preparedness has a positive effect on the course design quality.

3.2 Digital communities in e-learning

It has been argued that students' interaction and engagement in online communities enables them to develop knowledge and understanding (Koh and Kan, 2021). The students, through collaborative learning management systems, can create educational communities for knowledge generation, sharing, and discussion outside of the classroom or with members of larger learning communities (Shreeve *et al.*, 2009). Liaw and Huang (2013) stated that e-learning outcomes involve communication activities (e.g. the use of chat forums or e-mails), and exploration activities (e.g. use of browsers). Liaw and Huang (2013) outlined three types of interactions in e-learning, learning content, learner-learner, and learner-instructor. Thus, it is essential to outline digital communities and participatory culture to understand students' satisfaction with e-learning outcomes. Members of digital communities use a range of digital technologies to support their activities and sense of community, which allows for increasing the cohesion and engagement within the digital communities (Sillence and Baber, 2004). Organisational characteristics, socio-economic factors, IT, and digital literacy training programmes may further impact the digital communities in e-learning (Gil-Garcia and Luna-Reyes, 2009).

Moreover, in a participatory culture, members feel that their contributions matter and have a certain degree of responsiveness to others' opinions and feelings (Jenkins, 2009). In e-learning, it is vital to have a participatory culture if one is to engage in learning electronically. To do so, one should develop new skills, such as collective intelligence (pooling of knowledge to achieve the same goal), networking, and information literacy (the ability to search for, synthesise, and disseminate information) (Jenkins, 2009). For example, collective intelligence in the context of e-learning could be understood as the movement of all the members in the community (teachers and students alike) towards an improved ability to study and learn by pooling together individual's knowledge. During the pandemic situation,

digital communities may include interactions between students and teachers due to the limitation imposed by the quarantine situation. Hence, we hypothesise that:

H4. Digital communities in e-learning has a significant effect on the students' satisfaction with e-learning outcomes.

3.3 Information technology (quality and accessibility)

E-learning is essentially performed with the use of IT. As such, the limitation to access the needed IT resources potentially impact e-learning (Benigno and Trentin, 2000). Selim (2007) noted that the ease of Internet connectivity on campus and the effectiveness of IT infrastructure impact satisfaction with e-learning outcomes. It has been shown that students partaking in e-learning rely strongly on the IT infrastructure's quality to retrieve the required information (Alsabawy *et al.*, 2016). The quality of the experience of using an IT system (learning management system) may also impact the e-learning process (Maslov and Nikou, 2020). Nevertheless, we also argue that the current situation with COVID-19 may potentially limit the students' access and the use of IT infrastructures provided by the universities. Hence, we hypothesise that:

H5. Information technology (quality and accessibility) has a significant effect on the students' satisfaction with e-learning outcomes.

3.4 Course design quality

Course design quality relates to what constitutes the course, such as course information, instructional objectives, course layout and course output (Wright, 2003), which may impact the satisfaction with the e-learning outcomes (Martín-Rodríguez *et al.*, 2015). The course design quality is one of the information-quality measures and the course content quality (Lee *et al.*, 2009; Liu and Chu, 2010). According to Uppal *et al.* (2018), the supportiveness of the overall service, information quality and system quality are different aspects of e-learning quality. Characteristics of the instructional design of e-learning –content quality and learner support, feedback, and recognition– may also impact the use of and the satisfaction of e-learning outcomes (Garavan *et al.*, 2010). However, the pandemic situation may also impact the course design quality, mainly due to the limitation imposed by the quarantine situation, such as accessibility to the full potential of IT infrastructures and other IT-related tools and resources. Hence, we hypothesise that:

H6. Course design quality has a significant effect on the students' satisfaction with e-learning outcomes

3.5 E-learning satisfaction

As noted previously, we focus on the students' satisfaction with e-learning outcomes in the higher education context as the dependent variable. As such, there may be several different factors that could influence the students' satisfaction. Student satisfaction with e-learning outcomes has been studied earlier (Taghizadeh *et al.*, 2021), and is theoretically affected by student-student interaction, effective support, learning materials, and learning environment (Benigno and Trentin, 2000). Sun *et al.* (2008) suggested that perceived e-learning satisfaction is dependent on six dimensions (learner, instructor, course, technology, design and learning environment). Similarly, Liaw and Huang (2013) argued that perceived satisfaction could be affected by interactive learning environments, perceived self-efficacy, and perceived anxiety. Moreover, it has been argued that system quality, information quality, and service quality significantly impact users' satisfaction with using an e-learning system, which is significant in affecting users' intention to use an e-learning system (Ramayah and Lee, 2012). Thus, we conclude that many potential factors may affect e-learning satisfaction.

Furthermore, we use some of the individual characteristics as control variables. It has been argued that younger students are more willing to use IT for learning. Evidence; however, is divisive in this aspect. For example, [Fleming et al. \(2017\)](#), stated that age influences neither satisfaction nor the intention to use e-learning systems. Moreover, [Yakubu et al. \(2020\)](#) stated that the prior experience and the usage of LMS influence the acceptance of e-learning systems, Thus, we will use age and the length of using e-learning systems as control variables to assess if there would be any differences in the path relationships based on the individual characteristics, and their satisfaction with e-learning outcomes. Finally, we intend to run a mediation analysis. In the model, the effect of COVID-19 related factors (e.g. awareness of COVID-19 and perceived challenges during the COVID-19) on the satisfaction with e-learning outcomes may be mediated through the digital communities of e-learning, IT (quality and accessibility), and the course design quality (see [Figure 1](#)).

4. Methodology

The model measurement and assessment of the constructs were done using SmartPLS v. 3.2, guided by the procedures of Partial Least Squares Structural Equation Modelling (PLS-SEM).

4.1 Measures and data collection

All the survey for measuring six constructs predicting the students' satisfaction with e-learning outcomes during COVID-19 were adopted from previously validated studies. If required, the items have been slightly modified to fit the study context. Items for measuring the awareness of COVID-19 (three items), educational institutions preparedness to conduct distance learning (six items), and perceived challenges during COVID-19 (four items), all were derived from [Alea et al. \(2020\)](#), pp. 134–136). When constructing the survey and collecting the data, these items were among the few available theoretically validated survey items concerning the COVID-19 related factors in the broader context of e-learning. Survey items for measuring digital communities in e-learning (four items), IT (quality and accessibility) (four items), and course design quality (3 items), were derived from [Liaw and Huang \(2013: p. 23\)](#), [Selim \(2007\)](#), pp. 410–411) and [Wright \(2003\)](#), respectively. Finally, items for measuring students' satisfaction (four items), were derived from [Arbaugh \(2000\)](#), p. 41), see [Appendix](#). Perceived satisfaction with e-learning systems is a widely adopted concept as an outcome variable in the quantitative studies of e-learning (e.g. [Sun et al., 2008](#)). A 7-point Likert-type scale was used to measure the items.

As of March 2020, the Finnish government declared the closing of all educational institutions, higher education institutions included. The data collection was conducted via an online survey between August and October 2020. In six weeks, we collected data only from

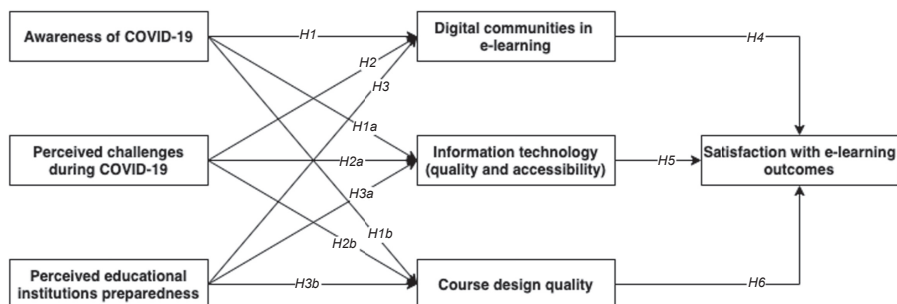


Figure 1.
Theoretical framework

university students. We sent over 350 invitations, but 153 responses were received. Upon further examination of the completeness of the data, and removing unengaged responses, in total, 131 responses were included in the final analysis. We also conducted a non-response bias test, which can be caused by the framing of a sample that may exclude a certain type of respondents in a non-homogeneous population. We compared the first and last quarters of responses through the *t*-test, by comparing the average scores for the main variables of the first quartile and the last quartile of the respondents (Lau *et al.*, 2010). The result did not show any significant differences between the mean scores of the two groups. Although, the SEM approach is sensitive to sample size, especially when SEM parameter estimates the parameters, we argue that the sample size used in this research is sufficient, as we have obtained fairly good results when calculating the chi-square and goodness of fit indices (Kyriazos, 2018).

5. Results

5.1 Descriptive statistics

Of the respondents, 73 (55.7%) were females, 56 (42.7%) were males, and two did not reveal their gender. The average age of the respondents was 25 years old (with standard dev. = 6.1). The highest academic degree of the respondents varies according to the following: high school diploma ($n = 63$), bachelor's degree ($n = 40$), master's degree ($N = 19$), and PhD or other ($n = 9$). We also asked respondents to indicate for how long in total they have been using e-learning systems. The following information was retrieved; less than a year ($n = 61$), between one to three years ($n = 37$), more than three years ($n = 32$), and only one respondent has never used such systems.

5.2 Measurement results

In the following, we report on the data analysis at the measurement model, which refers to assessing the measures' reliability and validity. In doing so, we computed: (1) item (indicator) loadings and internal consistency reliability, (2) convergent validity, and (3) discriminant validity (Hair *et al.*, 2019).

5.3 Item loadings and internal consistency reliability

PLS-SEM results were utilised for the item loadings in this study. Table 1 shows the detail of item loadings, and Table 2 show the correlation matrix. All item loadings (except two items: CVID3 and IT3), have satisfied the recommended loading values of 0.70 or higher (Hair *et al.*, 2019). Therefore, 27 items remained for the next step of the PLS-SEM analysis. Internal consistency reliability refers to the statistical consistency across survey items (indicators), and according to Hair *et al.* (2019), it should be reported through Cronbach's alpha (α) and Composite Reliability (CR). Therefore, we computed the two assessments, and the values achieved were all above the recommended threshold of 0.70 (Hair *et al.*, 2019), providing good internal consistencies.

5.4 Convergent validity and discriminant validity

Convergent validity refers to the degree to which two measures of constructs that theoretically should be related, are in fact, related. Regarding the convergent validity, the values of average variance extracted (AVE) were accounted for, and all the AVE values (see Table 1), were above the recommended threshold of 0.50.

Discriminant validity assessment refers to the extent to which a construct is different from other constructs (Hair *et al.*, 2019). To report the values, the Fornell Larcker criterion were used, and the AVE scores of a construct should be lower than the shared variance for all model constructs. As shown in Table 3, all the AVE scores satisfied this condition, and

Construct	Items	Loading	Mean	Std	α	CR	AVE
Awareness COVID-19 situation	CVID1	0.87	6.81	0.74	0.799	0.905	0.827
	CVID2	0.95	6.95	0.95			
Digital communities in e-learning	DCOM1	0.71	3.88	2.02	0.780	0.874	0.705
	DCOM2	0.93	3.61	1.92			
	DCOM3	0.92	3.71	2.11			
Course design quality	CDES1	0.81	4.82	1.74	0.807	0.886	0.721
	CDES2	0.90	4.63	1.64			
	CDES3	0.83	3.92	1.87			
Information technology (quality and accessibility)	IT1	0.71	3.92	1.62	0.771	0.855	0.600
	IT2	0.82	4.65	1.54			
	IT4	0.91	4.11	1.76			
Perceived challenges during COVID-19	PCHA1	0.83	5.66	1.83	0.847	0.896	0.684
	PCHA2	0.71	5.05	1.84			
	PCHA3	0.90	5.53	1.91			
	PCHA4	0.87	5.74	1.82			
Educational institutions preparedness to conduct distance learning	PEIP1	0.84	3.73	1.89	0.908	0.929	0.685
	PEIP2	0.90	4.29	1.84			
	PEIP3	0.87	4.85	1.80			
	PEIP4	0.75	4.82	1.82			
	PEIP5	0.77	4.86	1.86			
	PEIP6	0.83	4.61	1.89			
Satisfaction with e-learning outcomes	ESAT1	0.89	3.50	1.92	0.907	0.935	0.782
	ESAT2	0.93	3.78	2.05			
	ESAT3	0.86	3.24	2.06			
	ESAT4	0.86	3.02	2.20			

Table 1.
Reflective indicator loadings and internal consistency reliability

	CVID	DCOM	CDES	IT	PCHA	PEIP	ESAT
Awareness COVID-19 situation	–						
Digital communities in e-learning	0.201	–					
Course design	0.225	0.369	–				
Information technology (quality and accessibility)	0.14	0.493	0.616	–			
Perceived challenges during COVID-19	0.162	–0.3	–0.249	–0.31	–		
Educational institutions preparedness to conduct distance learning	0.154	0.179	0.594	0.529	–0.208	–	
Satisfaction with e-learning outcomes	0.203	0.629	0.509	0.608	–0.498	0.407	–

Table 2.
Correlation matrix

	CVID	DCOM	CDES	IT	PCHA	PEIP	ESAT
Awareness COVID-19 situation	<i>0.909</i>						
Digital communities in e-learning	0.201	<i>0.839</i>					
Course design	0.225	0.369	<i>0.849</i>				
Information technology (quality and accessibility)	0.140	0.493	0.616	<i>0.774</i>			
Perceived challenges during COVID-19	0.162	–0.300	–0.249	–0.309	<i>0.827</i>		
Educational institutions preparedness to conduct distance learning	0.154	0.179	0.594	0.529	–0.208	<i>0.828</i>	
Satisfaction with e-learning outcomes	0.203	0.629	0.509	0.608	–0.498	0.407	<i>0.884</i>

Table 3.
Discriminant validity

therefore, the discriminant validity was established based on the evaluation of the Fornell Larcker criterion (Fornell and Larcker, 1981).

We also assessed the discriminant validity through the heterotrait-monotrait ratio of correlations (HTMTs). Discriminant validity problems also appear when HTMT values are higher than 0.90. The construct can be similar if HTMT shows a value of > 0.90, which in this case, it indicates the lack of discriminant validity. Table 4 shows the HTMT values, and as shown, all values were lower than 0.90.

5.5 Structural results and discussion

The structural model assessment was performed following Hair *et al.* (2019) recommendation. To assess the path coefficients between endogenous and exogenous constructs, the sample was bootstrapped through 5.000 sub-sampling. The structural results showed that most of the hypotheses were supported (Table 5 and Figure 2). The outcome variable, i.e. students' satisfaction with e-learning outcomes, was explained by a

	CVID	DCOM	CDES	IT	PCHA	PEIP	ESAT
Awareness COVID-19 situation							
Digital communities in e-learning	0.257						
Course design	0.266	0.459					
Information technology (quality and accessibility)	0.207	0.622	0.774				
Perceived challenges during COVID-19	0.222	0.365	0.284	0.364			
Educational institutions preparedness to conduct distance learning	0.173	0.219	0.682	0.591	0.217		
Satisfaction with e-learning outcomes	0.224	0.732	0.583	0.709	0.534	0.438	

Table 4.
Discriminant validity (HTMT)

Hypothesis	β	t-statistics	Sig
H1: Awareness of COVID-19 → Digital communities in e-learning	0.242	3.092	0.001***
H1a: Awareness of COVID-19 → Information technology (quality and accessibility)	0.12	1.422	NS
H1b: Awareness of COVID-19 → Course design quality	0.170	2.579	0.01**
H2: Perceived challenges → Digital communities in e-learning	-0.323	3.916	0.001***
H2a: Perceived challenges → Information technology (quality and accessibility)	-0.229	2.881	0.001***
H2b: Perceived challenges → Course design quality	-0.166	2.214	0.05*
H3: Educational institutions preparedness to conduct distance learning → Digital communities in e-learning	0.075	0.829	NS
H3a: Educational institutions preparedness to conduct distance learning → Information technology (quality and accessibility)	0.465	6.022	0.001***
H3b: Educational institutions preparedness to conduct distance learning → Course design quality	0.534	7.070	0.001***
H4: Digital communities in e-learning → Satisfaction with e-learning outcomes	0.420	5.915	0.001***
H5: Information technology (quality and accessibility) → Satisfaction with e-learning outcomes	0.295	4.386	0.001***
H6: Course design quality → Satisfaction with e-learning outcomes	0.172	2.222	0.05*

Note(s): *p-value < 0.05; **p-value < 0.01; ***p-value < 0.001
NS: Not significant

Table 5.
Structural results

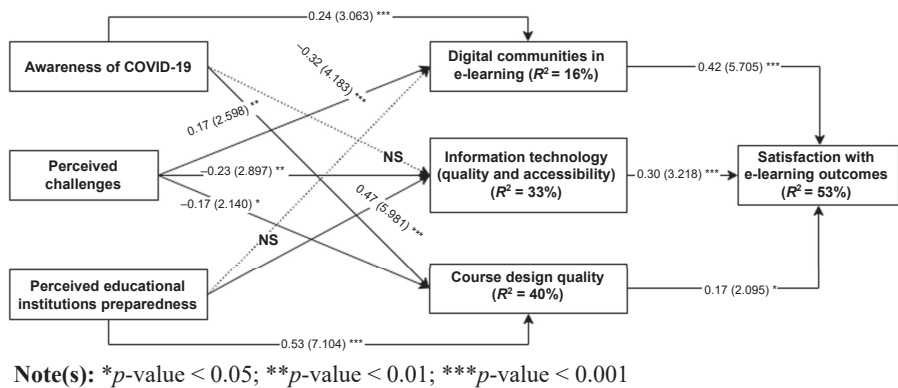


Figure 2.
Structural model
results

variance of 53%. Moreover, digital communities in e-learning, IT (quality and accessibility), and course design quality were explained by variance of 16, 33, and 40%, respectively.

Besides, the results showed that the paths between awareness of COVID-19 to digital communities in e-learning ($\beta = 0.24$; $t = 3.092$; $p = 0.001$), and to course design quality ($\beta = 0.17$; $t = 2.579$; $p = 0.01$), were significant and both **H1** and **H1b** were supported. But the path between awareness of COVID-19 to IT (quality and accessibility) was not significant; thus, **H1a** was rejected. The SEM results showed that the paths between perceived challenges during the COVID-19 to digital communities in e-learning ($\beta = -0.323$; $t = 3.916$; $p = 0.001$), IT (quality and accessibility) ($\beta = -0.119$; $t = 2.881$; $p = 0.001$), and course design quality ($\beta = -0.166$; $t = 2.214$; $p = 0.05$), were all negatively significant, and **H2**, **H2a**, and **H2b** were supported. In addition, the SEM results showed that the path between educational institutions' preparedness to conduct distance learning to digital communities in e-learning was not significant; therefore, **H3** was rejected. Furthermore, the results showed that the path between educational institutions' preparedness to conduct distance learning to IT (quality and accessibility) ($\beta = 0.465$; $t = 6.022$; $p = 0.001$), and course design quality ($\beta = 0.534$; $t = 7.070$; $p = 0.001$) were both significant; thus, **H3a** and **H3b** were supported. Finally, the paths from digital communities in e-learning ($\beta = 0.420$; $t = 5.915$; $p = 0.001$), IT (quality and accessibility) ($\beta = 0.295$; $t = 4.386$; $p = 0.001$), and course design quality ($\beta = 0.172$; $t = 2.222$; $p = 0.05$) to satisfaction with e-learning outcomes were all significant. Therefore, **H4**, **H5**, and **H6** were supported.

Moreover, we examined the mediating effects of (1) digital communities in e-learning, (2) IT (quality and accessibility), and (3) course design between the COVID-19 related factors, and satisfaction with e-learning outcomes. We first accounted for the results of total indirect effects and then examined the specific indirect effects values, as PLS-SEM procedures required. The mediation test results showed the total indirect effects for the paths between (1) awareness of COVID-19 ($\beta = 0.162$; $t = 2.559$; $p = 0.01$), (2) perceived challenges during the COVID-19 ($\beta = -0.232$; $t = 3.867$; $p = 0.001$), and (3) educational institutions' preparedness to conduct distance learning ($\beta = 0.261$; $t = 3.920$; $p = 0.001$), to satisfaction with e-learning outcomes were all significant. This indicates that there might be mediation effects in these path relationships. Therefore, we checked for the specific indirect effects values and found that the path between awareness of COVID-19 to the satisfaction with e-learning outcomes was only mediated through digital communities in e-learning ($\beta = 0.102$; $t = 2.800$; $p = 0.005$). Moreover, the mediation test results showed that the path between perceived challenges during COVID-19 to satisfaction with e-learning outcomes was only mediated through digital communities in e-learning ($\beta = -0.136$; $t = 2.871$; $p = 0.005$). Finally, we found that the IT

(quality and accessibility) ($\beta = 0.137$; $t = 2.845$; $p = 0.005$), and course design quality ($\beta = 0.092$; $t = 2.127$; $p = 0.05$), both mediate the relationship between educational institutions' preparedness to conduct distance learning and satisfaction with e-learning outcomes.

5.6 Multigroup analysis (MGA)

The proposed model was further analysed to see how the students' demographic characteristics influence path relationships in the model. The gender and the length of using e-learning systems were used as control variables. The multigroup analysis (MGA) was computed, and the results showed that students were different in some paths (see Table 5). For example, females and males were different in the path between perceived challenges during the COVID-19, and digital communities in e-learning. The result showed that this path was only significant for females. The MGA results also showed that females and males were different in the path relationship between course design quality and satisfaction with e-learning outcomes, such that this path was significant only for males. Moreover, the respondents were divided into two groups based on the number of years they were using e-learning systems. Group 1 includes respondents with less than a year ($n = 61$), and group two includes respondents with more than a year ($n = 70$). The MGA results showed that the difference between the two groups is only realised through the path between awareness of COVID-19 and course design quality, such that this path was only significant for those who have used the e-learning systems for more than a year (see Table 6).

6. Discussions and conclusions

Students' satisfaction with the e-learning outcomes can be used as one of the main indicators of the quality of education within the higher educational institutions. It could be speculated that a higher degree of satisfaction will be associated with a higher likelihood of success in the learning process, which translates to better study performance. The assessment and evaluation of the factors that influence students' satisfaction with e-learning outcomes can provide a novel understanding of fundamental problems to the core of successful instructional practices. This paper explored the satisfaction of students with e-learning outcomes during the COVID-19 pandemic by proposing a research model, which is a robust model, as it incorporates several constructs that capture various aspects of student's satisfaction with e-learning outcomes.

The findings of this research are important because they provide not only new theoretical insights but also provide some practical implications to decision-makers and policymakers at the educational environments. The findings demonstrate how the closure of universities has affected the students' education, providing recommendations to both long- and short-term planning in order address the challenges raised in the research. The findings indicate that the

Path relationships	β	t -statistics	p	Sig
<i>MGA results based on the gender</i>				
Perceived challenges during the COVID-19 → Digital communities in e-learning	-0.600	7.378	0.001	Female
Course design quality → Satisfaction with e-learning outcomes	0.422	3.569	0.001	Male
<i>MGA results based on the length of the use of e-learning systems</i>				
Awareness of COVID-19 → Course design quality	0.359	3.578	0.001	Group 2

Table 6. Multigroup analysis results

conceptual model proposed in this paper is applicable to the current COVID-19 pandemic situation and its application to analyse students' satisfaction with e-learning outcomes in higher education institutions.

Three key antecedent factors related to the COVID-19 situation were used in the model assessment: (1) awareness of the COVID-19 situation, (2) perceived challenges during COVID-19, and (3) the educational institutions' preparedness to conduct distance learning. In addition, we assessed the direct impact of (1) online course design, (2) creation of digital communities enabling students to interact with their peers during the schools' closures, and (3) the educational institution's IT infrastructures to students' satisfactions with e-learning outcomes. The results showed that students' attitudes towards the e-learning systems and, therefore, their satisfaction with e-learning outcomes rely on many factors associated with e-learning concept, such as COVID-19 related factors (Baber, 2020; Radha *et al.*, 2020).

We also found that other factors contribute to students' satisfaction and the exclusive use of e-learning mode for education (Fawaz and Samaha, 2021). For example, when nearly all university campuses were forced to close entirely during the COVID-19 pandemic, and the mode of learning was primarily via distant communication, digital communities where students could meet their peers and teachers remotely, campus IT infrastructures (accessibility and quality) and online course design quality could all affect students' satisfaction. As such, while we provide theoretical support for such importance, our findings may suggest that exclusive use of e-learning as the only mode of education in the context of a pandemic could impact the e-learners' satisfaction; therefore, a blended approach needs to be considered too. Another contribution of this study is shown by theoretical support that shows pandemic-related factors may indirectly impact students' satisfaction with e-learning outcomes. This research theoretically contributes to literature by showing that all factors relevant to COVID-19 indirectly influence students' satisfaction with e-learning outcomes, with perceived COVID-19 challenges having a negative impact. Previous studies also recognise that COVID-19 related factors indirectly influence students' intention to use e-learning tools and e-learning delivery (e.g. Alea *et al.*, 2020; Nikou and Maslov, 2021). Furthermore, the findings revealed that online course design and implementation have a direct impact on students' satisfaction with e-learning outcomes. As a result, when designing online courses, instructors should consider the challenges associated with the design and quality of distance learning courses. They should, for example, consider providing multiple ways for learners to participate, developing a consistent user interface experience, designing inclusive instructions, and developing clearly stated, relevant, and quantifiable outcomes (Lewis, 2021).

The final contribution of this paper is that gender is an influential factor for determining the e-learning satisfaction in the pandemic context. For example, we found that male students value the quality of the course design. The results of multigroup analysis (MGA) showed that the course design has a direct effect on the students' satisfaction with the outcomes of e-learning. For female students, we found that perceived challenges during COVID-19 have a direct but negative effect on their perceptions of digital communities in e-learning, supporting previous findings of Shahzad *et al.* (2021). This may be more related to female students who prefer face-to-face experiences with their peers and instructors, and thus do not anticipate any advantages of interaction in digital communities.

6.1 Practical implications

The findings of this research have several implications, which could be helpful for the higher education institutions to identify the factors that enhance student learning outcome and satisfaction level with e-learning during the COVID-19 pandemic, or similar other pandemic and emergency cases. For example, our findings showed that students appreciate the

potentials of using e-learning systems to support their learning and effectively solve potential barriers to the pandemic situation. This finding is in line with [Raza et al. \(2021\)](#), who found that students with a higher level of positive intention to use e-learning systems are more satisfied with e-learning outcome. We recommend that decision-makers and policymakers in higher education institutions focus on improving the students' satisfaction with e-learning by reinforcing the IT (accessibly and quality) infrastructure, and their ability to provide distance learning services. We also suggest that policymakers consider and develop both long- and short-term solutions to address the challenges raised due to school closures and pay attention when selecting and implementing e-learning applications and platforms ([Milic and Simeunovic, 2021](#)). If they manage to do so, we could expect that the students' satisfaction with e-learning outcomes will be enhanced, and that they will be more willing to use e-learning systems to achieve their study goals, especially when they are socially isolated due to the emergency situations.

Finally, we suggest that decision-makers at the educational institutions give a priority to developing a blended learning system. Because if students perceive their learning output is enhanced, they will be more likely to embrace technologies and digital learning tools that promote e-learning and distance learning. So, we recommend developing solid online digital portals through which teachers can teach without any barriers, and students could benefit from such opportunities. We recommend further teacher training courses assist teachers in developing their capability to conduct distance education. Similarly, investing in the necessary ICT equipment and infrastructure for distant learning is an effective way to enhance the institution's ability to provide e-learning education to students. Such implementation allows educational institutions to be well prepared in the future if similar pandemic or emergency closure happen.

6.2 Limitations

Like other studies, our paper is not without limitations. The first is the generalisability of the findings. While we have carefully selected the respondents and developed the proposed conceptual model within the recent literature, the factors found to affect students' satisfaction with the e-learning outcomes may only refer to the current research setting. In addition, although we had a relatively sufficient sample size to conduct a detailed statistical analysis, a larger sample size might provide different results, so the structural results and findings should be carefully interpreted. However, as we have carefully selected our sample to project the real situation in which the students are engaged during the COVID-19 pandemic, the low number of respondents might be less important in this circumstance. Furthermore, because this study was performed in a Finnish educational and cultural setting, the findings must be interpreted considering the settings of the current research and cultural characteristics associated with the Finnish educational system. Finally, literature on this topic suggests multiple antecedent factors that could potentially impact the perceived e-learning satisfaction among the students, which were not included in this study. Therefore, we suggest future studies employ other factors such as usability of e-learning, quality of the e-service, instructors attitude toward e-learning, quality of instructor and learner's computer self-efficacy to see if different insights could be gained.

This research has uncovered manifold insights about the impact of different COVID-19-related factors on students' satisfaction with e-learning outcomes. Future research may utilise the proposed model to see if additional findings in other contexts can be achieved. Future research is also suggested to explore further how, if possible, educational institutions should be prepared for future events, such as the one we are witnessing in the current pandemic situation.

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Further reading

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(The Appendix follows overleaf)

Awareness COVID-19 situation	<p>I am aware that COVID-19 is a global pandemic</p> <p>I am aware of the importance of social distancing to prevent the spread of COVID-19</p> <p>I am aware of the measures implemented at my university to conduct the distance learning during the quarantine</p>
Digital communities in e-learning	<p>I would like to share my e-learning experience in an e-learning community</p> <p>I believe e-learning can assist teacher–learner interaction</p> <p>I believe e-learning can assist learner–learner interaction</p> <p>I would like to share my e-learning experience in an e-learning community</p>
Course design quality	<p>The e-learning courses have adequate information about the courses, e.g. start dates, contact information of the instructor</p> <p>The e-learning courses have relevant, accurate and complete content, aligned to learning objectives of the courses</p> <p>The e-learning courses have attractive and consistent layout</p>
Information technology (quality and accessibility)	<p>I find the user interface design of websites with learning content pleasant</p> <p>Overall, websites with the learning content are easy to use</p> <p>There are no troubles with Internet connection when I study in distance learning</p> <p>Overall, the information technology infrastructure to support e-learning is efficient and reliable</p>
Perceived challenges during COVID-19	<p>There are challenges on managing the stress caused by the quarantine at home and in between online classes demands</p> <p>There are challenges on beating the homework deadlines and requirements set by the teachers</p> <p>There are challenges on the sudden shift from face to face to online classes</p> <p>There are challenges on establishing a proper emotional connection with instructors and other learners, required for distance learning</p>
Educational institutions preparedness to conduct distance learning	<p>Overall, teachers are well-equipped and ready to provide distance learning</p> <p>Teachers are capable of utilising e-learning systems, like Moodle, to provide distance learning</p> <p>Teachers are capable of utilising communication technology, digital tools and applications -like Zoom or e-mails to communicate with learners</p> <p>The school has a system of information dissemination to communicate with the learners during the quarantine</p> <p>The school has provided the regulations and policies on the use of distance learning during the quarantine</p> <p>The school has a well-working IT infrastructure to support distant learning during the quarantine</p>
Satisfaction with e-learning outcomes	<p>I am very satisfied with distance learning</p> <p>I feel that e-learning courses serve my needs well</p> <p>I feel the quality of the courses I took was largely unaffected by conducting it via the internet</p> <p>I would prefer online course to traditional course for my studies</p>

Table A1.
The list of survey questions

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