Changes in Online Distance Learning Behaviour of University Students during the Coronavirus Disease 2019 Outbreak, and development of the Model of Forced Distance Online Learning Preferences

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Abstract: Because of the Coronavirus Disease 2019 (COVID-19) outbreak, most universities were forced to choose Online Distance Learning (ODL). The study aimed to examine the response of university students to the new situation. A questionnaire was sent to the entire university student population. Based on responses from 606 students, it was revealed that use of all applications in ODL increased. However, only the use of MS Teams increased significantly, while the use of the other applications (email, Moodle, e-textbooks) increased in a range of low to medium in terms of effect sizes, and even nonsignificant for applications such as Padlet and Kahoot. Based on the replies of 414 respondents, a Model of Forced Distance Online Learning Preferences (MoFDOLP) based on Structural Equation Modeling was developed. With a chosen combination of predictors, we succeeded in predicting 95% of variance for Satisfaction, more than 50% for Continuance Preferences variance in MS Teams applications, and nearly 20% in the case of e-materials. Among hypothesized constructs, only Attitudes are a strong predictor of Satisfaction, while Organizational Support, Perceived Ease of Use and Learner Attitude toward Online Learning are not. Satisfaction is a good predictor of Continuance Preferences to use Information Technology after the lockdown ended.

Keywords: *Higher education, online distance learning, continuance preferences, COVID-19, outbreak.*

Introduction

The response of most Universities in the world to the Coronavirus Disease (COVID-19) outbreak, as a new playmaker in education (Usak et al., 2020) at the end of 2019 and the beginning of 2020, was the transition to online environments. Compared to the past, when online education was introduced in universities in the form of distance courses or online support for standard courses, this transition was not gradual but happened overnight, accompanied by a recognition that *"Universities will never be the same after the coronavirus crisis"* (Witze, 2020). With the exception of some courses where field and laboratory work could not be put online and were postponed, all courses at the University of Maribor went online. Prepared or not, teachers were overnight placed in a situation where they had to start online teaching with a lot of improvisation, a situation which was recognised by Hodges et al. 2020) as *"emergency remote teaching"*. The national isolation order forced instructors to think differently and act innovatively, at least on the personal level of educational provision. It has never happened before that entire school systems have been suspended and teaching activities transferred online, regardless of whether students, teachers and support staff were pedagogically and materially prepared for this transition. While the teachers have at least some freedom to adapt their teaching to Online Distance Education (Dolenc et al., 2021), the only choice students had was to follow their educators.

Distance education means that teachers and learners are physically separated, and it is not something that emerged only after the invention of the Internet but has existed in various forms for at least two centuries (Moore et al., 2011). The biggest difference is that in the earlier era of distance education, most interactions between teachers and students were asynchronous. With the introduction of the Internet, opportunities for synchronous work diversified in a range from chats to videoconferencing systems. Additionally, asynchronous exchange of materials was largely transferred to digital environments and paths of communication. Most recently, the boom in distance education was made possible by the fusion of the fast Internet, the transformation of paper texts and analogue photo and film material into digital

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formats, and interactive applications used for teaching and learning. This has allowed *"bricks and mortar"* universities to move parts of some courses or entire courses and even programmes to virtual environments. At the extreme end, advanced technologies allowed the establishment of fully online higher educational institutions. Where the transition is smooth and successive, traditional face-to-face learning can coexist or is blended with the forms of distance learning. In contrast to the established gradual methods for planning and implementation of courses (Suartama et al., 2020), the transition from face-to-face to online courses observed in the COVID-19 pandemic was driven by an external factor and not by the pedagogical desire to make courses or computer applications (Blumenthal & Blumenthal, 2020) user friendly.

For the current study, we adopted the term Online Distant Learning (ODL) (Cheawjindakarn et al., 2013), which is a student-centred approach where learning is a result of teaching and study activities. In this way, we seek to clearly distinguish ODL from other forms of and design options for distance education (Hodges et al., 2020) and flipped classrooms (Julia et al., 2020). Given the enforced nature of ODL, it was necessary to introduce the term Forced Online Distant Learning (FODL) when referring to learning activities during the closure of the university.

At the beginning of March when the COVID-19 crisis started, the University of Maribor already had all the tools, software and knowledge to go fully online. All staff and students had their digital identities, each course already had a Moodle page, and the software for distance teaching was MS Teams and available to everyone. Therefore, it is safe to say that the transition to emergency distance teaching, which took place in one day in most faculties, was well supported from the technical point of view by the available functional learning platforms and applications; however, it cannot be said that all teachers had adequate technological pedagogical content knowledge (Koehler & Mishra, 2008) because of the voluntary nature of online education before lock-down.

Aims and Scope

We were interested in investigating the response of students to the novel situation of being pushed into Forced Online Distant Learning – FODL, and in their preferences to continue with ODL after the reopening of the university and which factors were decisive in this decision. The objective of this study and previous work (Dolenc et al., 2021) is to develop an evidence-based theoretical and practical basis for the implementation of ODL. The final intention was to build and test the *Model of Forced Distance Online Learning Preferences (MoFDOLP)* to be applied in the case of new lockdowns, should this be necessary.

We therefore began our research with three primary research questions:

RQ1: In what way has the frequency of applications and programmes used for ODL changed among students?

RQ2: What are the continuance preferences of students towards applying the programmes and applications used during the closure once the university has reopened?

RQ3: Is it possible to create a model (MoFDOLP) to explain the preferences to continue ODL from theoretical constructs used in previous studies?

The study can be regarded as exploratory in the parts where we investigate student responses to a situation that has never happened before. In these parts, we did not guess the direction of the responses and form hypotheses based on such guesses, e.g., about the frequency of use of different applications. This can also be said for items used in the constructs building a model (Fig. 1). However, the second part of the study can be recognized as confirmatory analysis because a model (Fig. 1) based on theoretically predicted constructs borrowed from a number of theories was tested, and modified. The objective of these analyses was to explore the strength of the theoretically predicted paths (hypotheses) in the models. On the other hand, work toward models with better explanatory power can again be recognized as exploratory (Byrne, 2013).

Differences based on personal characteristics such as gender were not explored. The reason is not that such knowledge is unimportant, but because at this point, we are in a search of a robust model that can be used for the improvement of online education, regardless of personal characteristics or traits.

Research model and hypotheses

The intellectual framework of the instrument's adoption, adaptation and construction followed several theoretical predispositions mostly arising from a family of related theories. They comprised those connected with Information Systems Continuance Intention theory (Bhattacherjee, 2001). The models leading to the use and abandonment of technology follow a logic that, before actual behaviour, an individual must develop an intention to use technology, test it and either continue with use or abandon it. The models follow general theories such as those proposed by the theory of planned behaviour (Ajzen, 1991), self-determination theory (Ryan & Deci, 2000), and self-efficacy (Bandura, 1997). They were later incorporated into models (theories) such as the innovation diffusion theory (Rogers 1995), the technology acceptance model (TAM) (Davis, 1989; Davis et al. 1992), UTAUT (Venkatesh & Davis, 2000; Venkatesh et al., 2003) and a General Extended Technology Acceptance Model for e-learning (GETAMEL) (Abdullah & Ward, 2016).

For an overview of the technology adoption theories, see Chroustova et al. (2015), and for factors external to the TAM, consult Abdullah & Ward (2016). Once the technology has been accepted and tested, a user has two options: to continue using it or to abandon it, which is the content of Information systems Continuance Intention Theory (Bhattacherjee, 2001). All these theories have been tested and adapted many times, and constructs have been added to or removed from the original models; however, it seems that TAM with extensions is still the prevailing model (Schere et al. 2019; Šumak et al., 2011).

One of the assumptions behind these theories is the voluntary nature of acceptance and continuation of technology use. In our case, students were forced to migrate online; therefore, we have created a model named Model of Forced Distance Online Learning Preferences (MoFDOLP) (Fig 1). Compared to other models for online learning, the major change was the replacement of the construct Continuance Intentions (CI) with a new construct named Continuance Preference (CP). We made this replacement because students have only a limited influence on the instructor's choice of teaching method but can only have preferences. We evaluated several constructs used in previous studies on distance e-learning (e.g. Barbeite & Weiss, 2004; Bhuasiri et al., 2012; Gattiker & Hlavka, 1992; Park, 2009; Sun et al., 2006; Šumak et al., 2010) and reviews (Abdullah & Ward, 2016; Cheawjindakarn et al., 2013), aiming to strike a balance between the length of the questionnaire and the predictive power of the instruments. Studies based on UTAUT and modified UTAUT were considered, as well as consultation papers using selected constructs outside e-learning (e.g. Šumak & Šorgo, 2016; Šumak et al., 2017).
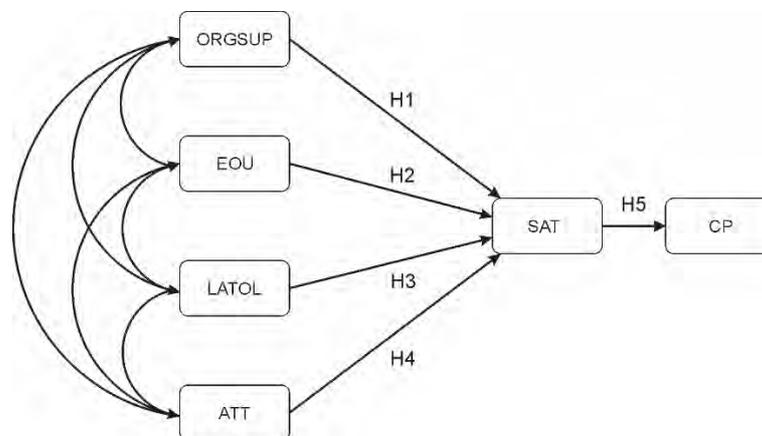
Note: ORGSUP – Organisational support; EOU – Perceived ease of use; LATOL- Learner attitude toward online learning; ATT – Attitudes, SAT - Satisfaction and CP- Continuance Preference to continue on-line learning.

Fig. 1 Model of Forced Distance Online Learning Preferences (MoFDOLP)

Predictor constructs (latent variables)

All predictor constructs and their constituent variables in our study should be understood in the context of Forced Online Distant Leaching (FODL).

Organisational support (ORGSUP)

Organisational support can be divided into management, technological, and pedagogical support. It can influence all phases of the technology adoption cycle as a promoter or repressor of technology use. Management and technology support, separately or in combination, are included in several models (e.g. Al-alak & Alnawas, 2011; Bandyopadhyay & Natarajan, 2008). For our study, we combined items from management support scales as adapted from Šumak et al. (2017) and technology support. To four items used previously, we added one item (ORGSUP 6) called pedagogical support and one item (ORGSUP 5) that can be recognised as technological support. Teachers in these circumstances can be regarded as part of the organization as well, providing support to their students outside the framework of the content of the lectures. Perceived teacher support was found to have a broad range of direct and mediated effects on student motivation for e-learning (Fryer & Bovee, 2016). The importance of pedagogical support was recognised by Hepp et al. (2004), which established that information and communication technology (ICT) in education is useless without *"well-trained and motivated teachers"*. The same can be said for students, who can benefit from ICT-delivered content only when they can proficiently use it and get help when needed. There are many differences between work inside the University buildings and from home. The most important difference is the access and quality of Internet services, where employees and students were both left to solve their own connection problems. We, therefore, advanced the following hypothesis:

H1: Organisational support (ORGSUP) will statistically significantly influence satisfaction (SAT).

Perceived Ease of Use (EOU) and Attitudes (ATT)

Constructs of Perceived Ease of Use (EOU) and Attitudes (ATT) were borrowed and adapted from TAM (Davis, 1989; Bagozzi et al., 1992). Based on a meta-review, Šumak et al. (2011) reported that the perceived ease of use tends to be a factor that can influence the attitudes of users toward using e-learning technology in equal measure for different user types and types of e-learning technology settings. Translations as applied in Šumak and Šorgo (2016) and Šumak et al. (2017) were used as a basis for adaptation, taking into account that in the case of our study, the difference between TAM and UTAUT is that students from our sample had actual (for some of them unwilling) experience with ODL; therefore, we applied these as predictors of satisfaction (SAT) (consult Fig. 1).

Briefly, and based on the work of Wu & Zhang (2014), we understood these as follows:

a) the perceived ease of use can be defined as the extent to which a person believes that using ODL will be free of effort;

b) the attitude towards ODL was regarded as the degree to which an individual perceived a positive or negative feeling related to ODL.

Combined with EOU, the attitude towards FODL would affect preferences toward actual technology use. The hypotheses were as follows:

H_2: Perceived Ease of Use (EOU) will statistically significantly influence satisfaction (SAT).

H_4: Attitudes (ATT) will statistically significantly influence satisfaction (SAT).

Learner attitude toward online learning (LATOL)

The construct Learner Attitude Toward Online Learning (LATOL) evolved from the Computer Attitude Scale developed by Gattiker and Hlavka (1992). They recognized that computer attitude can be separated into five factors: Complexity, Productivity, Health, Interesting work, and Consequences of computers. Many authors (e.g., Arbaugh, 2002; Arbaugh & Duray, 2002; Piccoli et al., 2001) indicate that learners' attitude toward computers is an important factor in online learning satisfaction. A more positive attitude towards ICT will result in more satisfied and effective learning (Piccoli et al., 2001). Sun et al. (2008) define learner's attitude as the learner's impression of participating in e-learning activities. Researchers Ho and Kuo (2010) indicate that learners' computer attitude plays a significant role in the recognition of the usability of online learning. According to the study of Liaw et al. (2007), there are three aspects of learner attitude linked to online learning environments: (1) Online learning as a self-paced learning environment; (2) the online learning environment provides learners with various assisted functions; (3) online learning provides a multimedia instruction environment.

Although the study by Gattiker and Hlavka (1992) recognizes the influence of five factors, we decided to include only Complexity and Productivity in our instrument considering online learning environments. Therefore, our prediction is that LATOL is an important factor in satisfaction (SAT), and the following hypothesis was formed:

H_3: Learner attitude toward online learning (LATOL) will statistically significantly influence Satisfaction (SAT).

Additionally, we predicted that predictor constructs will correlate between each other, however, no formal hypothesis was formed about this issue.

Outcome variables

Continuance preferences (CP)

Continuance preferences in the present study can be understood as the wish of the students to continue with ODL even after the restoration of regular face-to-face teaching. Continuance preferences are not a construct included in major technology acceptance theories such as TAM, UTAUT and their derivatives; however, there are studies exploring student perceptions of or preparedness for online learning/e-learning or comparisons between student perceptions of traditional and online learning (Parkes et al., 2015; Artino Jr, 2010; Otter et al., 2013; Almaghaslah et al., 2018; Soh et al., 2018).

Parkes et al. (2015) found that students may be reasonably prepared to deal with the technology of e-learning; however, they are not well prepared for activities such as reading and writing, being clear and concise in responses, synthesizing ideas, planning strategies, making arguments, and working with others. Otter et al. (2013) compared student perceptions of online and traditional courses. Their findings show that students see online courses as more self-directed and feel more disconnected when studying online. Almaghaslah et al. (2018), Soh et al. (2018), and Krishnan (2018) explored student perceptions of online learning tools. Pharmacy students expressed some interest in online learning methods within the pharmacy curriculum (Almaghaslah et al., 2018). The study among English Language practitioners showed that the use of online learning tools has the potential to promote more effective writing instruction (Soh et al., 2018). Results of an analysis of math students' preferences revealed that students preferred the

face-to-face learning mode for communication, discussion, and understanding of mathematics concepts and in improving their learning of mathematics. However, despite their inclination to the face-to-face learning mode, more than half the students believed that the mathematics courses should be taught in a hybrid mode. For these studies, we can conclude that students choose to study online only within certain limits. Nevertheless, student preferences are not a guarantee for their continuance preferences to use online study.

Based on a qualitative study, Al-Samarraie et al. (2018) defined 'e-learning continuance satisfaction'. They proposed that students must continually be satisfied with the e-learning systems offered by higher education institutions if they are to continue using them.

Continuance intention (CI) to use e-learning was explored by Rodríguez-Ardura and Meseguer-Artola (2016), who found that behavioural intention is determined by attitude and prompts actual e-learning continuance. However, students have no influence on which form of instruction their teachers choose; in our models, therefore, CI was changed to *Continuance Preferences towards on-line learning* (CP).

Satisfaction (SAT)

Satisfaction with a device or service can be recognized as a key factor in the continuation or discontinuation of use (Thong et al. 2006). It is based on personal experiences, and both positive and negative incidents can influence satisfaction. Satisfaction is a construct stemming from Expectation Confirmation Theory (Oliver, 1980) and is used in models as applied in Bhattacherjee (2001) as a predictor of *Continuance intention to use information systems.* The following hypothesis was formed:

H_5: *Satisfaction (SAT) will statistically significantly influence continuance preferences towards on-line learning (CP).*

Methodology

Sampling procedure

An online form was created by 1Ka the open-source application for web surveys. The link was announced to the University students through various access channels, like social networks and Faculty mailing lists. After two weeks, the data collection process ended. The instrument was anonymous, and response was considered as consent. An opt-out option was recognized in the fact that no fields were marked as obligatory and that no participant would be subject to abuse or benefits from the response. According to the University rules, such research does not need the approval of an ethical body, because no sensitive personal data was collected.

Research population and sample

The research population consisted of Slovene-speaking university students from the University of Maribor, Slovenia (hereinafter students). Based on the University of Maribor's annual 2019 program (UM, 2020), the total number of students was 13,337 in this year.

A total of 750 students started the online questionnaire, of which 448 answered completely (Table 1). Owing to the dropout of respondents at different parts of the questionnaire, we used a sample of 606 (80.8%) in analysing the first part and 414 (after deleting those with missing data) in analysing the second part of the research, where models are constructed. Because demographic questions were at the end of the questionnaire, we provide a structure for those who reached this point (Table 1).

Table 1: Sample characteristics of the students (n=448)

Demographic characteristics	Frequency	%
Gender		
Male	95	21.2
Female	352	78.6
Other	1	.2
Year of study (missing = 1)		
1	148	33.1
2	109	24.4
3	98	21.9
4	55	12.3
5	30	6.7
6	4	.9
not a student	3	.7

Table 1: Continued

Demographic characteristics	Frequency	%
Subject area you are studying		
Humanities (e.g. history, philosophy)	9	2.2
Social sciences without pedagogy (e.g. sociology. economics. law)	79	17.0
Social sciences - pedagogy (pedagogy, Didactics or subject didactics)	47	10.9
Natural sciences (e.g. biology, physics, chemistry)	136	30.7
Technology and Engineering (e.g. Mechanical Engineering, Engineering,	29	6.6
Biotechnology)	20	4.4
Mathematics	5	1.2
Mother tongue	11	2.7
Foreign Languages	110	23.8
Other	2	.5

Later items and constructs were not analysed based on demographic differences.

Description of the instrument

The questionnaire consisted of four parts.

The first part was devoted to the use of different types of ODL among the student population before and after the closure of the university. A 5-point scale was used, ranging from never (1), to rarely (2), occasionally (3), often (4), and whenever appropriate (5).

The second part of the questionnaire consisted of four sets of statements referring to the constructs described above: ORGSUP, EOU, LATOL, ATT and SAT. These statements asked for a response in a 7-point format in a range from completely disagree (1) to completely agree (7). No anchors between the extremes were provided, and number four was considered as the neutral position.

The third part was dedicated to the investigation of the respondents' preference to continue using ODL after the reopening of the university, the continuance preferences (CP). We provided an answer option: *"When classroom instruction is restored, I would prefer to use:"*. This partial sentence was followed by 7 items (see Appendix) in 7-point Likert format, from completely disagree (1) to completely agree (7). As in the previous case, no anchors between the extremes were provided, and number four was considered as the neutral position.

The content validity of the second and third parts of the instrument was assured with careful selection of the constructs, which, with exception of the CP, had been previously used in many Slovenian and international studies (see Research model and hypotheses section for details and references). In the case of CP, consent was sought within a community of researchers from the field. The fourth part was about the demographics of the respondents. We asked for gender, year of study, and the subject area of study.

Statistical analyses

Statistical analyses follow traditional methods as applied in the verification of the theoretically predicted models by use of Confirmatory Factorial Analysis (CFA) and Structural Equation Modelling (SEM) (e.g. Šumak & Šorgo, 2016; Šumak et al. 2017).

Beforehand, all items were checked for missing data, and descriptive statistics were used for investigation of frequency distribution and calculation of central tendencies (Mean, Standard Deviation, Mode and Median). With the application of Principal Component Analysis, all constructs were checked for unidimensionality, Cronbach's alphas, and Composite reliabilities were calculated to assess the reliability of constructs. As a threshold margin for Cronbach's alphas > .70 was set. All constructs used as predictors passed initial checking. The exception was CP, which split into two components; therefore, we proceed to CFA considering two models, the first for the MS Teams programme, and the second for e-materials.

To establish Fit Measures and Indices for CFA, a selection was made from options available in AMOS (Byrne, 2013; Hair et al., 1998, Kline, 1998). Among the absolute, incremental, and parsimonious indices on offer, our choices were as follows:

a) the likelihood-ratio Chi-square index (basic absolute fit measure), and the chi-square to degrees of freedom ratio (CMIDF or $\chi^2/df < 3$);

b) Incremental Fit Index (IFI), and a Comparative Fit Index (CFI), with values closer to one (1) indicating a better fitting model;

c)   Standardised Root Mean Square Residual (SRMR), and Root Mean Square Error of Approximation (RMSEA) with an acceptable range of .08 or less.

For improvement of the models, two procedures were used as proposed by Byrne (2013). The first was an inspection of the standardized residual covariance matrix. Based on the inspection, variables exceeding values greater than 2 were deleted. The second method was the application of the modification indices. Based on inspection of values, error terms were connected within some of the constructs.

The common method bias (Podsakoff et al., 2003; Podsakoff et al., 2012; Schwarz et al., 2017) can hamper results of this type of study; therefore, all measures were taken to prevent it in a range of recommendations from the references.

Results

The results are presented by section.

Part 1

Frequency of usage of ODL forms

Table 2: Descriptive statistics for different forms of distance learning (n = 606)

Q4: My distance learning usually takes place in the form of:	Frequency	%
Synchronous education (in real time, videoconferences, etc.)	201	33.2
Asynchronous education (saved pps/docs/pdf/recorded lectures/email, etc.)	40	6.6
A combination of both	365	60.2
Q5: The materials I get for distance learning are mostly: (missing = 12)	**Frequency**	**%**
Materials for lectures/exercises live via videoconference (synchronous)	456	76.8
Materials for lectures/exercises with recorded sound (asynchronous)	9	1.5
Recorded videos of lectures/exercises (asynchronous)	7	1.2
Materials for lectures/exercises published online (asynchronous)	122	20.5

From Table 2, it can be seen that most students experienced a combination of online video lectures and work with written materials posted in repositories. Pre-recorded lessons and materials with recorded sound were exceptional and provided only by a marginal minority of educators.

Descriptors of the usage of ODL applications before and after closure

Table 3: Comparing descriptive statistics for frequency of using various forms of online distance learning before interrupting the education process due to the COVID-19 and after three months of closure (n = 606)

	Q2: How often had you used various forms of online distance learning <u>before</u> interrupting the teaching process due to the COVID-19 virus?										Q3: How often do you use various forms of online distance learning <u>now</u>?										Cohen's *d*	Change of use in online learning before and after closure.
	Missing	Mean	SD	Mode	Median	Never 1	2	3	4	When ever appro priate 5	Missing	Mean	SD	Mode	Median	Never 1	2	3	4	When ever appro priate 5		
							f (%)										f (%)					
a) E-mail	0	3.68	1.15	4	4	5.1	11.4	22.9	31.8	28.7	4	4.23	.92	5	4	1.3	4.0	13.5	32.9	48.3	.53	⬆
b) Online classrooms (Moodle)	1	3.44	1.12	3	3	5.0	15.5	30.1	29.3	20.2	4	3.97	1.10	5	4	4.0	7.8	14.6	34.2	39.4	.48	⬆
c) Videoconferencing system (MS Teams)	2	1.7	1.38	1	1	75.5	6.1	3.5	3.0	11.9	7	4.54	.86	5	5	2.0	2.7	4.3	21.2	69.8	2.47	⬆
d) Online materials (e-materials, e-textbooks, etc.)	2	2.78	1.16	2	3	14.9	28.5	27.3	22.0	7.3	5	3.35	1.18	4	4	9.2	13.8	26.6	33.4	17.0	.49	⬆
e) Web applications (Padlet, Kahoot, etc.)	2	1.67	.83	1	1	53.0	28.8	16.6	1.2	.5	5	1.77	1.01	1	1	54.6	23.0	15.3	5.5	1.7	.11	⬆

From the results presented in Table 3, it is obvious that among all applications used to learn and communicate learning materials, the biggest jump occurred in the videoconferencing system, MS Teams, which was used during the lockdown by almost all students and regularly by only a few before that. Use of most of the other communication channels increased in terms of effect sizes on the border between small and intermediate. No effect is calculated for Web applications such as Padlet, Kahoot etc., which were being used, both before and after lockdown, probably by only a small community of users. Frequency of use rose only slightly in the case of e-mail, Moodle, and e-textbooks.

Part 2: Confirmatory Factorial Analysis

Continuance preferences

Continuance preferences (Cronbach's alpha: α = .74) to use various online applications and communication channels were assessed on a 7-point scale, with anchors set at completely disagree (1) and completely agree (7), with four as a middle point. Results ranked by decreasing mean are presented in Table 4. Frequencies of the items used in our model are provided in Table 5.

Table 4: Descriptive statistics for the items forming constructs of Continuance preferences (CP) (N = 446)

Items	Code	When classroom instruction is restored, I wish to use for learning:	Missing	Mean	SD	Mode	Med	PC1	PC2
CP6	Q10f	Online materials designed to supplement knowledge (e.g. e-materials, e-textbooks, PowerPoint audio presentations, etc.).	3	5.44	1.65	7	6.0	.715	
CP2	Q10b	Online learning platforms (e.g. Moodle, etc.).	1	5.24	1.67	7	6.0	.783	
CP5	Q10e	Online learning materials (e.g. e-learning materials, e-textbooks, PowerPoint presentation with audio, etc.).	1	5.11	1.83	7	5.0	.708	
CP1	Q10a	E-mail.	1	4.91	1.91	7	5.0	.690	
CP3	Q10c	Video conferencing system (e.g. MS Teams) for small groups of students or individual lessons.	1	4.67	2.24	7	5.0		-.881
CP4	Q10d	Video conferencing system (e.g. MS Teams) for large groups of students.	2	4.52	2.28	7	5.0		-.883
CP7	Q10g	Web applications (e.g. Padlet, Kahoot, etc.).	1	3.37	1.96	1	4.0	.512	

Note. CP3 and CP4 were included in CP-I, and CP2, CP5 and CP6 in CP-II. CP1 and CP7 were excluded.

After inspecting the results, we can recognize that online materials designed to supplement knowledge (e.g. e-materials, e-textbooks, PowerPoint audio presentations, etc.) occupy the highest position, along with Moodle, and online learning materials (e.g. e-learning materials, e-textbooks, PowerPoint presentation with audio, etc.). All these were already in use before the lockdown; continued use could therefore be expected. Among newcomers, videoconferencing systems fell above the midpoint; however, the mean is quite high. Web applications, which were not used by the majority before closure have even less chance of continued use.

After the PCA (component loadings are provided in Table 4), it was clear that these applications form two clearly separate components explaining 61% of the variance. The first component (Table 4), explaining an additional 20% of variance (Cronbach's alpha = .82; Eigenvalue = 1.4), comprises two MS Teams variables, and the second component consists of the five forms already in use before the lock-down, explaining 41.2% of variance (Cronbach's alpha = .76; Eigenvalue = 2.9).

Among competing models, there are two models as structural and final measurement models (Fig. 2 and 3) presented in the paper. The first model included the latent variable CP-I, with two MS Teams variables as an outcome, and in the second model, CP-II included three variables comprising management with e-materials (Cronbach's alpha = .67; and .87 if Moodle is deleted).

Based on the results, we decided to include the Model 1: CP-I for Videoconferencing system (MS Teams), for work in both small and big groups; and Model 2 CP-II for e-learning materials. From the models, e-mails and Web applications were excluded.

Descriptors of the constructs (latent variables) used in CFA

Results of descriptive statistics for all items included in the models are provided in Table 5. Items excluded from the final model (Fig. 3) are italicized. Detailed content for all items is provided in the Appendix.

Table 5: Descriptive statistics for the items forming constructs considered in the model (N = 414)

Items	Codes	Mean	SD	Mode	Median	f (%) 1	2	3	4	5	6	7
Organizational support (Cronbach's alphas: α_{M1} = .86; α_{M2} = .79; CR_{M1} = .87; CR_{M2} = .79)												
ORGSUP1	Q6a	5.92	1.19	7	6	.2	1.0	3.1	8.5	17.4	28.7	41.1
ORGSUP2	Q6b	4.84	1.57	6	5	2.7	6.5	9.9	20.8	21.5	22.2	16.4
ORGSUP3	*Q6c*	4.39	1.66	4	4	5.6	9.2	12.6	27.1	16.9	16.9	11.8
ORGSUP4	*Q6d*	4.53	1.63	4	5	5.1	7.7	10.9	24.9	20.5	18.4	12.6
ORGSUP5	Q6e	5.06	1.57	6	5	2.2	6.0	9.9	13.0	22.9	25.8	20.0
ORGSUP6	Q6f	5.00	1.47	5	5	2.2	5.1	7.7	16.2	29.0	23.9	15.9
Perceived ease of use (Cronbach's alphas: α_{M1} = .92; α_{M2} = .92; CR_{M1} = .92; CR_{M2} = .93)												
EOU1	*Q7e*	5.28	1.35	5	5	1.0	3.6	4.8	14.7	29.0	26.8	20.0
EOU2	Q7f	5.15	1.52	6	5	2.7	3.1	9.7	13.3	24.6	25.4	21.3
EOU3	Q7g	5.62	1.35	6	6	1.0	2.4	5.3	8.5	21.0	31.6	30.2
EOU4	Q7h	5.67	1.27	7	6	.5	1.7	4.6	9.9	21.5	30.4	31.4
EOU5	*Q7i*	5.45	1.27	6	6	.7	1.9	5.6	10.9	27.1	31.9	22.0
EOU6	*Q7j*	5.25	1.36	5	5	1.0	2.2	8.0	15.5	28.3	23.9	21.3
Learner attitude toward online learning (Cronbach's alphas: α_{M1} = .87; α_{M2} = .89; CR_{M1} = .88; CR_{M2} = .89)												
LATOL1	Q9a	3.02	1.78	2	3	23.9	24.4	16.2	13.8	10.4	6.0	5.3
LATOL2	Q9b	2.59	1.58	1	2	30.9	27.3	15.2	13.0	8.5	1.9	3.1
LATOL4	*Q9d*	3.09	1.95	1	3	29.5	18.6	13.3	13.0	11.4	6.3	8.0
LATOL6	*Q9f*	2.36	1.52	1	2	38.9	25.8	12.6	11.4	6.8	3.1	1.4
Attitude toward using technology (Cronbach's alphas: α_{M1} = α_{M2}= .94; CR_{M1} = .94; CR_{M2} = .94)												
ATT1	Q8f	5.36	1.74	7	6	6.0	3.9	3.9	10.1	21.3	20.0	34.8
ATT3	Q8h	4.87	2.04	7	5	11.4	6.8	6.3	11.4	18.1	15.9	30.2
ATT4	Q8i	5.01	1.77	7	5	6.0	4.8	8.5	14.0	22.7	16.9	27.1
ATT5	Q8j	4.69	1.77	4	5	7.2	6.3	7.5	23.9	19.1	16.2	19.8
Satisfaction (Cronbach's alphas: α_{M1} = .61; α_{M2} = .90; CR_{M1} = .90; CR_{M2} = .90)												
SAT1	Q8a	4.55	1.77	5	5	7.0	7.7	12.1	19.1	22.2	14.5	17.4
SAT2	Q8b	5.15	1.60	5	5	3.4	5.6	5.1	13.3	28.7	19.1	24.9
SAT3	*Q8cR*	3.24	1.61	3	3	16.2	20.0	23.7	16.7	13.5	7.0	2.9
SAT4	*Q8d*	5.31	1.28	5	5	1.2	1.9	4.3	15.0	31.2	27.5	18.8
SAT5	Q8e	5.19	1.64	7	5	4.6	3.6	7.0	12.3	22.9	24.4	25.1
Continuance preferences (Cronbach's alpha for CP-I: α_{M1} = α_{M2}= .82; Cronbach's alpha for CP-II: α_{M1} = α_{M2} = .76; CR_{M1} = .82; CR_{M2} = .76)												
CP-I	Q10c	4.73	2.22	7	5	15.5	8.2	5.8	9.7	12.8	15.7	32.4
	Q10d	4.57	2.28	7	5	18.4	7.2	6.5	11.4	11.1	14.3	31.2
CP-II	Q10e	5.14	1.80	7	5	5.8	6.0	6.3	11.8	21.0	18.4	30.7
	Q10b	5.25	1.67	7	6	3.6	5.8	6.0	11.8	20.5	23.7	28.5
	Q10f	5.44	1.65	7	6	4.1	3.4	5.3	9.7	22.7	18.4	36.5

Note: Cronbach's α_{M1} – Cronbach's of the hypothesized model. Cronbach's α_{M2} – Cronbach's of the final model, (deleted items are in italics). 7-point scale: strongly disagree (1) to strongly agree (7).; CR = Composite reliability

Inspection of the results as provided in Table 5 shows that most students agree with the statements provided, with the exception of LATOL (see Appendix), where disagreements reflect a lack of major problems with ODL. All constructs have appropriate alphas and are unidimensional, which qualifies them to be included in the models.

Table 6: Fit indices for hypothesized and final models (n = 447)

Model	NPAR	χ2	df	χ2/df	IFI	CFI	SRMR	RMSEA
Threshold values				**< 3**	**>.95**	**>.95**	**<.08**	**<.07**
Hypothesized model 1	65	1311	313	4.19	.89	.89	.08	.09
Hypothesized model 2	67	1335	339	3.94	.95	.90	.08	.08
Final model 1	48	306	123	2.49	.97	.97	.04	.06
Final model 2	50	332	140	2.37	.97	.97	.04	.06

From Table 6, it can be deduced that fit indices for both hypothesized models are close and, after interventions, the final models well above or below the thresholds suggested by relevant references.
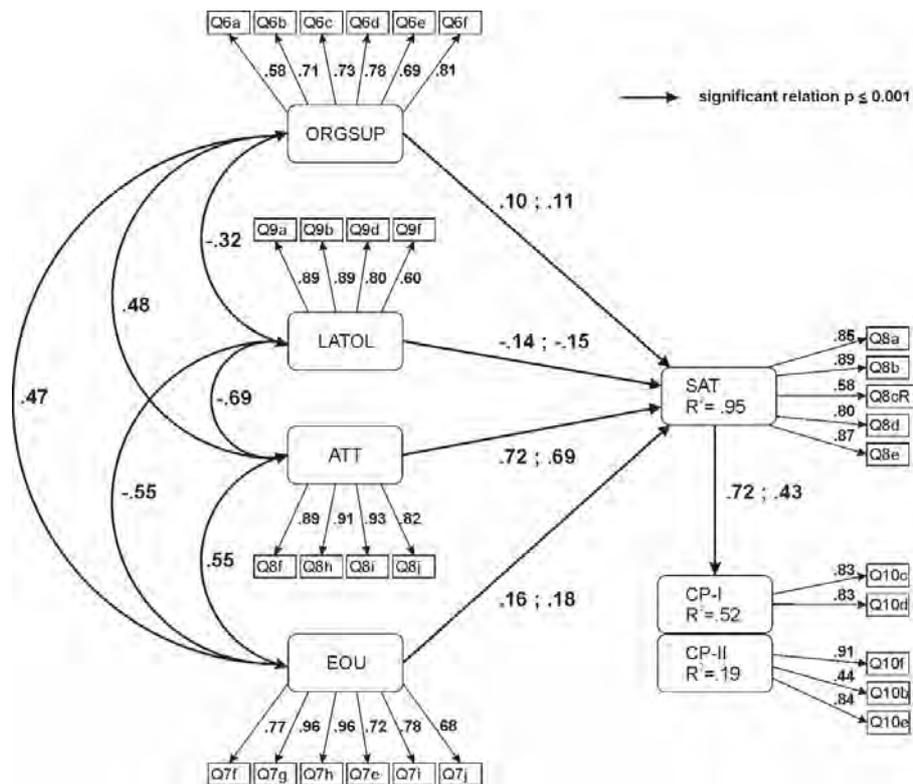
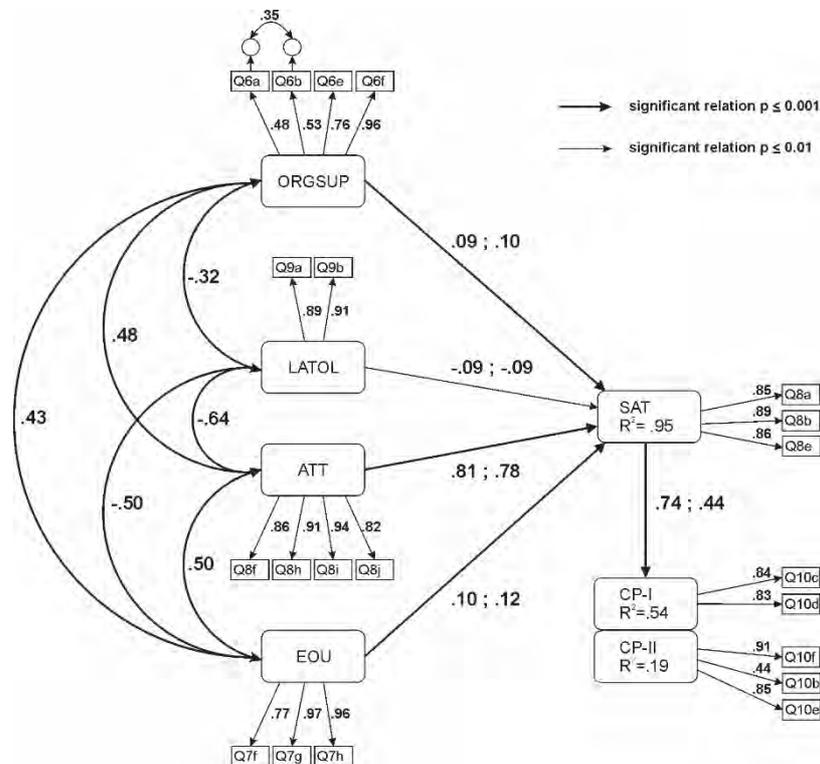*Figure 2. Hypothesized Models 1 and 2. Standardised path coefficients are given in the figure. On the left are coefficients for Model 1, and on the right for Model 2*

Inspection of the hypothesized Models 1 and 2 (Fig. 2) reveals that only ATT significantly loaded on SAT, and SAT on CP, as well. All correlations between constructs are in the moderate range. It is worth mentioning that all correlations with LATOL are negative.

Fit indices of both hypothesized Models were close to the acceptable values (Table 6), but below the values suggested in the references. Therefore, we proceeded to build the final Models by application of the step-by-step approach.

Figure 3. Final Models 1 and 2. Standardised path coefficients are given in the figure. On the left are coefficients for Model 1, and on the right for Model 2

After interventions made in the initial hypothesized models, all inspected fit indices fall in the good range (Table 6); the models can therefore be accepted. On inspection of the final Models 1 and 2, we note that all constructs included in the model are predictors of SAT (R^2 = .95) in the following order: ATT (.81) > EOU (.10) > ORGSUP (.09) > LATOL (-.09). The differences between path coefficients are small; however only ATT falls in the range of moderate or even strong predictors.

When, in the construct of CP, work with MS Teams (CP-I) was replaced by CP-II, paths coefficients and explained variance in SAT and CP changed in such a way that the path coefficient was lower and R^2 dropped from .54 to .19.

Discussion

Since we are commenting on behavioural changes related to a situation that occurred for the first time in education, equally for teachers and students, we do not have references with which to compare them. During the time of preparation for this paper, some opinion papers have appeared (e.g. Bao, 2020, Crawford et al., 2020, Toquero, 2020, Usak et al., 2020); however, no studies based on CFA were available. Therefore, in some cases, the conclusions can be considered speculative. Furthermore, we do not comment on laboratories or on practical work and fieldwork, where ODL is severely limited in the virtual environment, where learning manipulative skills and practical laboratory skills cannot be replaced by videos, animations or simulations (Kaup et al., 2020). Beyond the scope were also established online courses dedicated to different classes of participants who are not regular full-time students.

According to reported data (Table 2), transition to ODL cannot be recognized as a transition to study which can happen anyplace, anytime, and anywhere (Corbeil & Valdes-Corbeil, 2007). Because of the prevailing synchronous and blended forms, transformation was to a form of ODL with fixed schedules transferring traditional lectures to a form of broadcasting system, where groups of students were large and with the possibility to include conversation where groups were reasonably small. The support of lectures by various forms of teaching materials existed before and was prolonged. Pre-recorded lessons and materials with additional voice explanation were provided only to a minor group of students, once again ignoring the ideal of anyplace, anytime, and anywhere that is paramount in ODL. We do not have information about how many lectures were recorded by course participants and shared between them on alternative channels.

The results in Table 3 show that students reported an increase in the use of all applications used for ODT. All listed applications were already available and used before the closure in different quantities. The increase in the use of e-mail, Moodle and e-textbooks was small to medium in terms of effect size and even nonsignificant for applications such as Padlet and Kahoot. All these applications have in common that they were being used before and will continue to be used afterwards (Dolenc et al., 2021) as a communication channel or as a repository for teaching materials and reception point for assignments. Significant increases and a very large effect size applied only to MS Teams, reflecting that whenever possible, teachers transmitted traditional lectures online or combined them with asynchronous uploading of assignments and materials (Dolenc et al., 2021).

The results based on the second research question asking students about their continuance preferences to use online forms and applications based on experiences before and during the closure can hardly be compared with references, given the lack of these. With the application of PCA, it was possible to identify two main groups of applications. In the first group are applications that enable communication and ODL and were already in use before the lockdown (email, Moodle and shared teaching materials). These were used continuously during the lockdown, and it is obvious that teachers will use these in the future. Similarly, we can predict that if they experienced the inclusion of professional software (e.g. programming languages, Robotics, simulators and the like), they will be obliged to continue to use these. Some types of specialized software (e.g. Padlet, Kahoot) did not find their way into courses and will most probably not proliferate in the future.

Owing to the novelty of the *MoFDOLP* model, there is no literature enabling direct comparison of the model with other studies; however, it was possible to compare the paths between the constructs (latent variables), especially those used within Continuous Intention Theory (Bhattacherjee, 2001). All constructs of the model are unidimensional and have appropriate Cronbach's alphas. After corrections were made, the models had good or even excellent fit; therefore, we can suggest the model be tested by other authors. With a chosen combination of predictors, we succeeded in predicting 95% of the variance for SAT, more than 50% of CP variance in MS Teams applications, and nearly 20% in the case of e-materials.

Three of the five hypotheses should be rejected and two accepted, based on calculated path coefficients. As has been established, the novelty of the model means that some of the paths can be discussed from the standpoint of earlier models that served as a basis for constructing the model.

Hypothesis (H_1) that organisational support (ORGSUP) will statistically significantly influence satisfaction (SAT) was rejected because of insignificant path coefficients. This finding should be further investigated, especially because students positively evaluated the support they received from their faculties in a range from M = 4.33, SD = 1.67 to M = 5.87, SD = 1.28. Therefore, we can say that good improvement of organisational support will probably increase student

satisfaction and can speculate that given the ubiquitous use of digital devices in their daily routines, the expected support is not so much in teaching them digital skills but in the provision of learning environments and access to these.

The hypothesis (H_2) that EOU will influence SAT was rejected, and hypothesis (H_4) that ATT will influence SAT was accepted. Moreover, only the influence of ATT can be regarded in terms as large. To the best of our knowledge, there is no literature that would allow a comparison of the paths for Perceived Ease of Use (EOU) and Attitudes (ATT) towards satisfaction (SAT) to continuance preferences (CP). The hypothesis (H_3) about the influence of LATOL on SAT was rejected as well. Similar to the previous constructs, there is a lack of references for comparison.

The hypothesis (H_5) that satisfaction (SAT) will statistically significantly influence continuance preferences toward different forms of ODL is accepted. The same pattern, with the construct continuance intention instead of continuance preferences, has already been observed in studies by Bhattacherjee (2001), Benlian et al. (2011), Carillo et al. (2017), Deng et al. (2010), Dolenc et al. (2021), Lee (2010), Limayem and Cheung (2008), and Roca et al. (2006) where such connections were moderate. In a study by Zhou et al. (2012), the connection was weak.

Conclusion

Starting from the spring of 2020, the outbreak of COVID-19 caused the closure of universities around the world. Since this situation was occurring for the first time, it was a unique challenge for them: the emergency remote teaching caught the majority of educators and students unprepared at least in the use of the videoconferencing system, which almost overnight become the most important Forced Online Distance Learning (FODL) application. Although the situation was stressful, the University of Maribor as an institution had a rapid and organized reaction: the teachers and students became used to the new working environment within only one weekend. However, basic postulate of distant online education as anywhere and anytime was not achieved, and was transferred only to anywhere, because of prevailing synchronous lectures.

In contrast to previous studies, which measured various factors influencing the voluntary choice of online distance learning, the students in our study had no choice, which was the reason for the rapid transition to ODL. Teachers have adapted to the new environment by changing existing teaching methods to online mode (Dolenc et al., 2021), however, mostly to scheduled lectures supported by learning materials and only rarely offered filmed lectures or teaching materials accompanied by recorded explanations.

Findings from this study will be very helpful in case there is another wave of the COVID virus or any similar situation in the future. We can conclude that:

- among all applications used to learn and communicate learning materials, the biggest jump during the emergency remote teaching occurred in the videoconferencing system, MS Teams, which during the lockdown, was used by almost all students and regularly by only a few before it,

- there are major differences in teaching large groups of students compared to small groups. Working with small groups of students allows for more individualized teaching and learning experiences,

- asynchronous activities might be more reasonable than synchronous ones,

- student satisfaction with ODL statistically significantly influences their continuance preferences towards online learning; however, students' attitude toward online learning does not statistically significantly influence satisfaction with ODL.

At the end of the conclusion section, answers to the research questions are provided.

RQ1: In what way has the frequency of applications and programmes used for ODL changed among students?

There was a small to moderate rise in the use of all types of previously used applications, with the exception of MS Teams, where the rise was large.

RQ2: What are the continuance preferences of students towards applying the programmes and applications used during the closure once the university has reopened?

Continuance preferences differ between applications and are higher for those connected with asynchronous forms of ODL than the synchronous alternatives.

RQ3: Is it possible to create a model (MoFDOLP) to explain the preferences to continue ODL from theoretical constructs used in previous studies?

We succeeded in creating a model (MoFDOLP) with validated constructs and appropriate fits (Fig. 2, Fig. 3, Table 6).

Recommendations

Previous studies have examined the voluntary nature of acceptance, adoption and continued use of technology, which is generally not applicable under involuntary lockdown conditions. In the event of a lockdown, students were forced to migrate online, so we suggest that the Model of Forced Distance Online Learning Preferences (MoFDOLP) should be tested in a number of higher education institutions. The argument is to obtain authentic findings to strengthen online education in each course. Furthermore, we propose to test the model on samples of students with special needs. Based on the findings management of each institution should develop authentic recommendations to address cognitive, technological and structural problems caused by FDOL. The recommendations should be made available to prevent superficial knowledge and to increase the satisfaction of all stakeholders with a good education. Particular attention should be paid to the role of the institution in providing support and courses for students to make communication more effective. It seems that 'Ease of use' is no longer a problem due to the frequent use of digital technologies. Possible health problems, probably caused by the FDOL, require an immediate separate investigation.

Since different video conferencing and learning management systems are in use, these may be a source of differences to explore. The second area to be explored is differences between the use of the same applications and forms of learning, owing to technical and cultural influences on ODL. Therefore, comparative studies are recommended on differences between equal systems and similarities between the different synchronous and achynchronous systems used in ODL.

Limitations

The limitations relate to the research methodology, because the respondents were self-elected and because the invisible majority of students did not respond. We can only speculate that they had the same experiences and opinions and acted in accordance with those who responded. However, it is impossible to correct this possible weakness in the study design. We can only speculate about the transferability of the results to the global student population and students with special needs, as the preferences for continuation and satisfaction may vary depending on the university environment, the systems used, organisational support and similar factors. The issues with content validity could be a concern; however, we tried to prevent these by using tested instruments and careful examination of the constructs. The same aplies to issues connected with the on-line questionnaires; however, self- selection on the basis of proficiency in the use of on-line systems and digital competency due to the university level of the respondents cannot be regarded as a limitation. Because of the choice of language, foreign students were excluded from the study, although these might have had different opinions and experiences.

Declaration of Interest statement

The authors declare that they have no conflict of interest.

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Appendix:

Measurement items and scales

Item	Question number	Statement	Adapted from
Organisational support (*ORGSUP*)			
ORGSUP1	Q6a	The faculty encourages me to use ODL for learning.	Igbaria et al. (1996; 1997); Thompson et al. (1991)
ORGSUP2	Q6b	The faculty is aware of the benefits that can be achieved with the use of ODL in learning.	
ORGSUP3	Q6c	The faculty recognizes my efforts in using ODL for learning.	
ORGSUP4	Q6d	The faculty has a strong interest in my using ODL.	
ORGSUP5	Q6e	The faculty provides me with appropriate technical support for learning in ODL.	Our own
ORGSUP6	Q6f	The faculty offers me appropriate pedagogical support for learning in ODL.	
Perceived usefulness (PU)			
PU1	Q7a	Using the ODL improves my learning performance.	Liao C., Palvia P., & Chen JL. (2009)
PU2	Q7b	Using the ODL improves my learning productivity.	
PU3	Q7c	Using the ODL enhances my effectiveness in learning.	
PU4	Q7d	I find the ODL to be useful in my learning.	
Perceived ease of use (EOU)			
EOU1	Q7e	My interaction with ODL is clear and understandable.	Liao C., Palvia P., & Chen J.L. (2009)
EOU2	Q7f	Interaction with ODL does not require a lot of my mental effort.	
EOU3	Q7g	I find it easy to get ODL to do what I want it to do.	
EOU4	Q7h	I find ODL easy to use.	
EOU5	Q7i	ODL offers appropriate functionality.	Urbach et al. (2010)
EOU6	Q7j	ODL offers comfortable access to all the learning applications I need.	
Satisfaction (SAT)			
SAT1	Q8a	After trying ODL, I can describe the experience as fun.	Nijs, L., & Leman, M. (2014), Debevc, M., Weiss, J., Šorgo, A., & Kožuh, I. (2020)
SAT2	Q8b	After trying ODL, I can describe the experience as instructive.	
SAT3	Q8c	After trying ODL, I can describe the experience as difficult (reversed item).	
SAT4	Q8d	After trying ODL, I can describe the experience as understandable.	
SAT5	Q8e	After trying ODL, I can describe the experience as successful.	
Attitude toward using technology (ATT)			
ATT1	Q8f	Using ODL for teaching is a good idea.	Liao C., Palvia P., & Chen J.L. (2009)
ATT2	Q8g	Using ODL for teaching is a wise idea.	
ATT3	Q8h	I like the idea of using ODL for teaching.	
ATT4	Q8i	Using ODL is a pleasant experience.	
ATT5	Q8j	Since using ODL, I have changed my thoughts on using it in a positive direction.	Our own
Learner attitude toward online learning (LATOL)			
LATOL1	Q9a	I believe that working with ODL is very difficult	Gattiker & Hlavka (1992)
LATOL2	Q9b	I believe that working with ODL is very complicated	
LATOL3	Q9c	I believe that working with ODL requires technical ability	
LATOL4	Q9d	I believe that working with ODL led me to experience great psychological stress	
LATOL5	Q9e	I believe that working with ODL can be done only if one knows a programming language	
LATOL6	Q9f	I believe that working with ODL is only advisable for people with a lot of patience	
LATOL7	Q9g	I believe that working with ODL makes learning more productive	
LATOL8	Q9h	I believe that working with ODL is for young people only	
Continuance preferences (CP)			
When classroom instruction is restored, I would prefer to use:			
CP1	Q10a	E-mail.	Our own
CP2	Q10b	Online learning platforms (e.g. Moodle, etc.).	
CP3	Q10c	Video conferencing system (e.g. MS Teams) for small groups of students or individual lessons.	
CP4	Q10d	Video conferencing system (e.g. MS Teams) for large groups of students.	
CP5	Q10e	Online learning materials (e.g. e-learning materials, e-textbooks, PowerPoint presentation with audio, etc.).	
CP6	Q10f	Online materials designed to supplement knowledge (e.g. e-materials, e-textbooks, PowerPoint audio presentations, etc.).	
CP7	Q10g	Web applications (e.g. Padlet, Kahoot, etc.).	
CP8	Q10h	Nothing from the selection.	