Remote learning via video conferencing technologies: Implications for research and practice

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Abstract

Following the unprecedented outbreak of the Coronavirus pandemic (COVID-19), educators and students have shifted from conventional face-to-face lectures to fully virtual sessions that were delivered via video conferencing software. This research investigates the facilitating conditions and the students' perceptions toward using these interactive resources to continue their learning journey. The data was gathered through a structured questionnaire among 777 students in tertiary education. The survey instrument comprised valid measures that are frequently utilized in academia, to evaluate the individuals' acceptance of interactive educational technologies. A partial least squares (PLS) approach revealed that there were very significant factors that were predicting the students' dispositions to utilize synchronous learning programs. The findings underlined the importance of providing appropriate facilitating conditions to improve perceptions and attitudes toward interactive conferencing software. These results reflect the latest developments, as COVID-19 has inevitably accelerated the digital transformation in the realms of education. This contribution implies that students adapted well to a new normal. It confirmed that they are willing to participate and engage in virtual meetings through video conferencing programs.

Keywords: Video conferencing, Remote learning, Facilitating conditions, Perceived interactivity, Unified Theory of Acceptance and Use of Technology, Attitudes toward technology.

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1. Introduction

In the aftermath of COVID-19, education institutions including universities and colleges were required to follow their regulatory institutions' protocols to limit the outbreak of the Coronavirus pandemic (COVID-19) [1-5]. They had to adapt to a crisis that affected the delivery of traditional educational services in various contexts [6-9]. Policymakers introduced radical preventative measures in their institutions, including social distancing policies and hygienic procedures, to prevent contagion [10]. In many cases, they mandated institutions to resort to digital resources to continue delivering their educational services [11-14]. Education institutions including universities were expected to work remotely by using synchronous and asynchronous learning technologies during lockdown or partial lockdown situations [15].

In the first wave of COVID-19, education service providers shifted from conventional teaching approaches to fully remote course delivery [16]. Initially, this transition resulted in a number of challenges to students and instructors [17]. In many cases, educators were pressurized to utilize digital technologies including learning management systems (LMSs) as well as video conferencing programs [18]. Very often, they relied on their institutions' Moodle or virtual learning environment software to share digital resources including videos, power point presentations and links to online notes. During the pandemic, educators acquainted themselves with video-conferencing platforms [19].

Eventually, policy makers eased their preventative measures following the second and third waves of COVID-19, and educational institutions reopened their doors to students and employees. Yet, many academic members of staff, in various contexts, were (and are) still utilizing remote learning technologies including video conferencing programs to deliver their educational programs.

This research investigates the students' acceptance and utilization of video conferencing software. It uses constructs that were drawn from the technology acceptance model (TAM) [20-24], and from its related Unified Theory of Acceptance and Use of Technology (UTAUT / UTAUT2) [25-27]. It integrated them with perceived interactivity construct [28-30] to comprehend the students' readiness to use synchronous conferencing technologies. Specifically, this study explores the educational institutions' facilitating conditions and examines the students' attitudes as well as their intentions to adopt them. At the same time, it sheds light on their performance and effort expectations from using these interactive technologies.

Although, there are many contributions in academia that have focused on the students' acceptance of online technologies, in electronic learning (elearning) and/or mobile learning (mlearning) formats [31], in various contexts [32-35], currently, few studies investigated the students' perceptions, attitudes and intentions to use synchronous video conferencing technologies [18]. For the time being, there are no studies that have used the same constructs that were employed in this research.

This research differentiated itself from previous theoretical underpinnings as it evaluated the students' perceived interactivity as well as their attitudes towards synchronous technologies. These constructs were frequently overlooked from UTAUT/UTAUT2 researchers. In sum, this study reveals that the factors that affecting the research participants' intentions to continue using interactive software, to participate and engage in virtual lectures.

This timely paper provides a recent snapshot of the university students' perceptions on their institution's facilitating conditions and reveals their utilitarian motivations about the use interactive video conferencing programs to continue their learning journey. The results from this research suggest that these synchronous technologies are adding value to the students' learning experience.

2. Background

COVID-19 has accelerated the educators' engagement with remote learning technologies [36, 37]. It triggered them to embrace synchronous learning methodologies [30], as they were expected to interact with one another in virtual sessions, in real time [12]. The efficiency of their transition to remote learning (that includes the utilization of video conferencing software) was dependent on their preparedness as well as on the educational institutions' facilitating conditions through the provision of continuous training and development, ongoing support as well as adequate and sufficient investments in infrastructures for the benefit of students, as well as of employees.

It is imperative for educational institutions to raise awareness on the latest technologies to improve their students' online experiences. COVID-19 proved that students could continue with their learning journey if they can access digital learning resources through LMS and by attending to online meetings. However, virtual learning environments should be designed in such a way to entice students to engage in collaborative approaches [38]. Course instructors are expected to use active learning approaches and cooperative/collaborative learning methodologies to develop their students' social learning experiences. The use of video conferencing technologies could facilitate online (face-to-face) interactions among course participants, unless for some reason, they decide to mute themselves and leave their cameras off.

3. The theoretical framework and the presentation of hypotheses

Over the years, previous researchers sought to shed light on the individuals' acceptance and use of various technologies [20-21, 39-42]. Very often, they relied on different theoretical models, including Fishbein and Ajzen's (1975) theory of reasoned action (TRA) or its related theory of planned behavior (TPB) [43, 44] and Davis' (1989) technology acceptance model (TAM) among others. Many authors adapted them, as they included other constructs, e.g. Extended TAM2 [45, 46] and TAM3 [47, 48], among others.

Venkatesh et al. (2003) indicated that their Unified Theory of Acceptance and Use of Technology was drawn from TRA [43], TAM [20,21], TPB [44], Combined TAM and TPB (C-TAM-TPB) [49], the Motivational Model (MM) [22], the Model of PC Utilization (MPCU) [50], Innovation Diffusion Theory (IDT) [51, 52], and the Social Cognitive Theory (SCT) [53, 54]. Eventually, they formulated UTAUT2 [27], among others. Other academics modified the measures of these theoretical models to investigate the students' acceptance and use of educational technologies [41, 55].

This research has adapted key measures from UTAUT/UTAUT2 and integrated them with attitudes [39] and perceived interactivity construct [29, 56-58], to explore the key antecedents of the students' intentions to continue utilizing video conferencing technologies in a tertiary education context. Table 1 clarifies the meanings of the constructs that were used in this research.

Table 1. A definition of the key constructs that were used in this research.

Construct	Source	Definition
Performance expectancy (PE)	Unified theory of acceptance and ease of technology UTAUT (Venkatesh et al., 2003).	Performance expectancy is defined as the degree to which an individual believes that using the system will help him or her to attain gains in job performance.
Effort Expectancy (EE)	Unified theory of acceptance and ease of technology (Venkatesh et al., 2003).	Effort expectancy is defined as the degree of ease associated with the use of the system.
Perceived interactivity (PI)	Perceived interactivity (Chen et al., 2007; McMillan & Hwang, 2003).	Perceived interactivity is defined as web-based, two-way communications among persons, in real time.
Facilitating conditions (FC)	Unified theory of acceptance and ese of technology (Venkatesh et al., 2003).	Facilitating conditions is defined as the degree to which a person believes that organizational and technical resources exist to support the use of technology.
Attitude (AT)	Technology acceptance model (Davis, 1989; Fishbein and Ajzen, 1975).	Attitudes are defined as an individual's positive or negative feelings about performing the target behavior.
Intention (INT)	Technology acceptance model (Davis, 1989); Theory of reasoned action (Fishbein & Ajzen, 1975) Theory of planned behavior (Ajzen, 1991); Unified theory of acceptance and use of technology (Venkatesh et al., 2003).	Intention is defined as a measure of strength of one's intention to perform a specific behavior.

UTAUT and UTAUT2 specify that performance expectancy, effort expectancy, social influences and facilitating conditions among other constructs are direct determinants of the individuals' behavioral intentions to use technology [26-27, 59]. However, this study explored alternative causal paths that were overlooked in previous UTAUT/UTAUT2 research. Venkatesh et al. (2003) as well as Venkatesh et al. (2012) did not include social influences within their theoretical models. In this case, this research includes attitudes as well as perceived interactivity, in addition to performance expectancy, effort expectancy, facilitating conditions and intentions.

The educational institutions' facilitating conditions including the organizational and technical infrastructures are critical to students and educators, to overcome barriers for their engagement with technology, especially during the early stages of adoption [9, 60]. The individuals' positive perceptions on the functionality of devices or toward supporting infrastructures may reduce their technological anxiety. Venkatesh et al. (2003) maintained that support staff and their ongoing guidance play an important role in facilitating users in overcoming difficulties with the use of technology. Conversely, the lack of such conditions could hinder them from using the technology as they consider them as challenging or complicated to use.

The extent and type of assistance they can get may influence their perceptions on the interactivity of the technology. A few researchers pointed out that facilitating conditions can have a positive effect on the individuals' ease of use of technology [58]. In plain words, they may perceive that it takes less effort for them if they are supported to use technologies [61, 62] like interactive media [56, 57, 63].

Individuals may be intrigued to interact with systems if they perceive them as responsive to their needs. Arguably, the more convenient the respondents' access to online technologies, the more proficient they become in using them. Individuals may feel comfortable using interactive technologies like video conferencing technologies if they are provided with appropriate facilitating conditions. This argumentation leads to the following hypotheses:

H1: The facilitating conditions significantly affect perceived interactivity.

H2: The facilitating conditions significantly affect effort expectancy.

UTAUT's effort expectancy and performance expectancy constructs are synonymous with TAM/TAM2/TAM3's perceived ease of use and perceived usefulness of technology [61, 64-66]. Davis (1989) clarified that perceived ease of use was "the degree to which a person believes that using a particular system would be free of effort". Similarly, Venkatesh et al. (2003) reported that; "effort expectancy is the degree of ease associated with the use of the system". These authors also maintained that performance expectancy measures the extent to which users believe that technology will support them. This definition is also consistent with TAM's perceived usefulness construct.

TAM researchers suggest that perceived ease of use of technology anticipates perceived usefulness [41, 47, 67-70]. Very often, academic authors hypothesized that individuals would be intrigued to use technology that is easy to use. Hence, it could enhance the individuals' performance [9, 71]. However, unlike TAM studies, few UTAUT/UTAUT2 researchers have explored the effects of effort expectancy on performance expectancy of interactive technologies. Therefore, this research addresses this gap in the academic literature and hypothesizes that:

H3: Effort expectancy significantly affects performance expectancy.

Interactive communications are usually described as being reciprocal, responsive and speedy [72]. They connect online users in real time and facilitate virtual relationships [56, 57]. The users' interactive processes are usually evidenced in synchronous, simultaneous, and ongoing exchanges of information among online users through Voice over Internet Protocol, text chat, live chat, digital games, and via video conferencing software, among other options [29, 73-76].

Individuals may hold different perceptions toward interactive media. Many authors provided a definition for this concept [29, 77]. Chen et al. (2007) posited that perceived interactivity involves two-way interactions among online users. Other authors identified key attributes of interactive communications including perceived control, perceived responsiveness, connectedness, perceived personalization, real time interactions, personalization and playfulness, among others [76, 78, 79].

The perceived interactivity of technologies has a significant impact on their perceived usefulness [77]. In other words, one may argue that interactivity is a plausible antecedent of performance expectancy and could also affect the individuals' attitudes toward the mentioned technologies. The persons' attitudes may be considered as a predisposition to do something according to personal beliefs and emotions, as they may hold positive or negative feelings toward objects [26, 44].

Previous researchers confirmed that interactive media facilitate communication among online users [57, 76]. They can influence the individuals' perceptions on their usefulness [63, 75], including their performance expectancies, as well as their attitudes toward using them [56]. Hence, this research explores the following hypotheses:

H4: Perceived interactivity significantly affects performance expectancy.

H5: Perceived interactivity significantly affects attitudes.

H5a: Perceived expectancy mediates the perceived interactivity – attitudes link.

TAM postulated that the individuals' perceived usefulness of technology precedes their attitudes towards them [20, 21]. Several researchers confirmed that they found a significant relationship among these two constructs [80-83]. Arguably, there were instances where they found that individuals do not always have positive attitudes toward technologies, although they believe that they can enhance their performance if they use them. The reason for this is that many of them are expected to use specific technologies as a requirement for their work, whether they like them or not [84].

Several authors suggested that the strength of the relationship between perceived usefulness or performance expectancy and attitudes could differ across various technologies and in different contexts [26]. Other studies found that attitudes towards using systems only partially mediated the effect of perceived usefulness; and of perceived ease of use, on intentions, hence many researchers removed this construct from their revised TAM models [24, 85]. Kamble, Gunasekaran and Arha's (2019) study suggested that their respondents' perceived ease of use did not affect their attitudes.

Therefore, this research explores the link between UTAUT/UTAUT2's performance expectancy (that is synonymous with TAM's perceived usefulness) with attitudes toward technology. It hypothesizes the following:

H6: Performance expectancy significantly affects attitudes.

TAM postulates that the individuals' perceived usefulness of technology determine their intentions to use them [21, 22, 61, 65]. Whilst many researchers found significant relationships between perceived usefulness and intentions [86, 87], others did not always confirm that there was a significant correlation among the two constructs [88].

The utilitarian performance expectancy is one of the strongest predictors of the individuals' intentions to use technologies [26, 27]. Users would surely benefit from efficient and functional technologies to perform better tasks [58]. Hence, their positive attitudes toward useful technologies could also impact on their intentions to use them. In fact, Dwivedi et al. (2019) found that the users' attitudes indirectly affected the relationship between performance expectancy and their intentions to use information systems. This leads to the following hypotheses:

H7: Performance expectancy significantly affects intentions.

H7a: Attitudes mediates the performance expectancy – intentions link.

By and large, most empirical studies confirmed that there are higher significant effects between perceived usefulness and intentions than between perceived ease of use and intentions [45, 89]. Other research confirmed that there were mediocre to strong links between attitudes and intentions [41]. The inclusion of attitude in technology adoption models is consistent with TRA [43], TPB [44] as well as with DTPB [49]. Notwithstanding, the original TAM [21] suggested that attitudes construct has significant association with behavioral intentions. The relationship between attitudes and behavioural intentions implies that individuals form intentions to perform behaviors toward which they have positive attitude [39, 44]. This leads to the last hypothesis:

H8: Attitudes significantly affect intentions.

In sum, this study suggests that facilitating conditions is a significant antecedent of perceived interactivity and of effort expectancy. Effort expectancy and perceived interactivity are significant precursors of performance expectancy. Perceived interactivity as well as performance expectancy significantly affect attitudes. Moreover, attitudes and performance expectancy would significantly precede the individuals' intentions to use technologies. Figure 1 depicts the hypotheses of this research model.

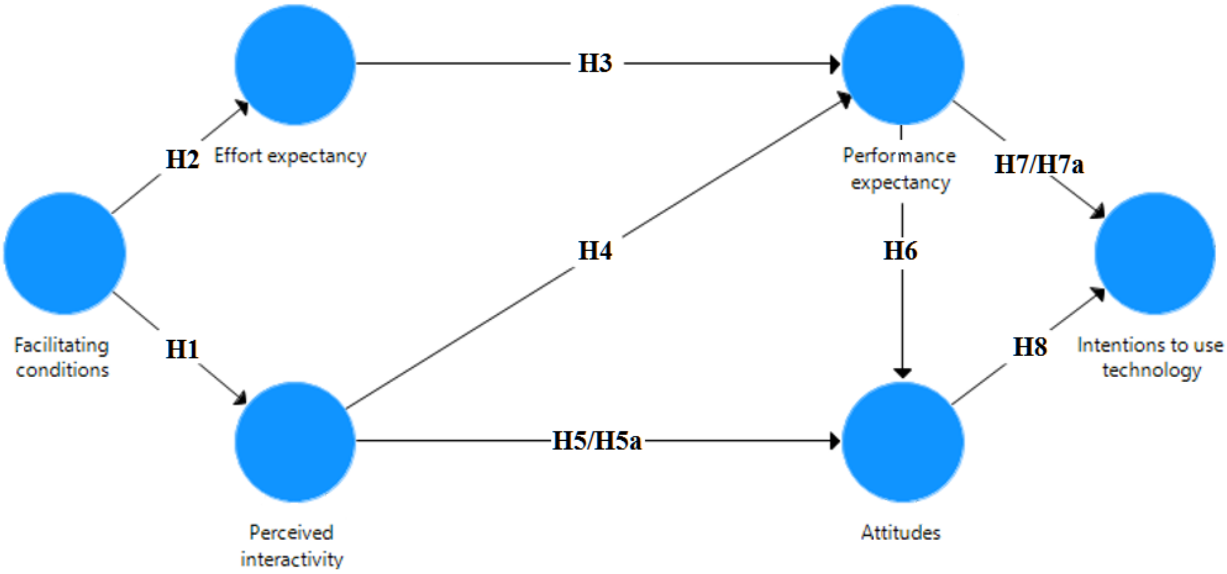


Figure 1. The utilitarian motivations to use interactive technologies

4. Methodology

4.1 The measures

This study's survey items were drawn from reliable and valid measures. They were used in previous studies that sought to explore technology adoption behaviors.

The questionnaire featured 21 questions that comprised socio-demographic variables including age, gender and experience with the use of video conferencing technologies, that were placed towards the last part of the survey. They could complete the questionnaire within a few minutes. The responses to the survey questions were coded through a 5-point Likert scale, where 1 represented 'strongly disagree' and 5 strongly agree, whilst 3 signaled a neutral position. The survey's measures were reliable and valid as the Technology Acceptance Model [21, 22, 59], the Theory of Planned Behavior [44] and the Unified Theory of Acceptance and Use of Technology [26, 27, 90, 91] were tried and tested in academia. This research adapted the measuring items on perceived interactivity [29, 92]. It explored the participants' perceptions about their performance expectancy (4 items), effort expectancy (4 items), perceived interactivity (3 items), facilitating conditions (3 items) and attitudes toward the use of video conferencing technologies (2 items) and their intentions (2 items) to them.

The questionnaire was pilot tested to identify any weaknesses in the survey instrument. The measuring items that were used in this study are featured in Table 2.

Table 2. The survey questionnaire's constructs and their corresponding items

Construct		Items
Performance expectancy (Venkatesh et al., 2003)	PE1	Video conferencing technologies are useful.
	PE2	Video conferencing technologies increase my chances of learning.
	PE3	Video conferencing technologies help me learn things.
	PE4	Video conferencing technologies improve my learning outcomes.
Effort expectancy (Venkatesh et al., 2003)	EE1	The use of video conferencing technologies is easy to learn.
	EE2	The use of video conferencing technologies is clear and understandable.
	EE3	I consider video conferencing technologies quite easy to use.
	EE4	I am skilled at using video conferencing technologies.
Perceived Interactivity (McMillan & Hwang, 2002).	PI1	Video conferencing technologies enable two-way communications.
	PI2	Video conferencing technologies are interactive.
	PI3	Video conferencing technologies enable conversations.
Facilitating Conditions (Venkatesh et al. 2003; 2012)	FC1	I have the resources I need to use video conferencing technologies.
	FC2	I have access to relevant information on the use of video conferencing technologies.
	FC3	I can ask for support from a helpdesk if I have difficulties in using video conferencing technologies.
Attitude (Venkatesh et al., 2003; 2012)	ATT1	The quality of online educational services that is provided through video conferencing technologies is good.
	ATT2	I enjoy using video conferencing technologies.
Behavioral Intention (Venkatesh et al., 2003; 2012)	INT1	Most probably, I shall continue using video conferencing technologies in future.
	INT2	It is very likely that I will use video conferencing technologies for other purposes, in my daily life.

The respondents were students who were pursuing courses at a university college in Malta, Europe. They received an email that included a link to an electronic survey questionnaire. There were more than 12,000 students, who were following full time and part time courses in this institution, who could have participated in this research.

After a few months, there were 785 responses to the survey as the respondents were frequently encouraged to participate in this research. Eight questionnaires were not considered as they were incomplete. Consequentially, the sample consisted of seven hundred seventy-seven valid responses (n = 777). There were 525 females, 246 males and 6 participants who did not indicate their gender. The respondents were classified into five age groups (18-21; 22-25; 26-29; 30-33; and over 34). The majority of the respondents were between 18 and 21 years old (n=558). There were 69 respondents who were between 22 and 25 years of age. Most of them (n=771) reported that they have been using synchronous video conferencing software in the past two years.

5. Data analysis

5.1 The descriptive statistics

Generally, the research participants agreed with the survey's items, as evidenced by the high mean figures. FC1 (M=4.073), FC2 (M=4.054) and FC3 (M=3.884) registered the highest means. On the other hand, PE2 (M=3.243) and PE4 (M=3.263) were the lowest scores. The findings suggested that the SD values varied from 0.784 (for FC2) to 1.219 (for ATT2) as reported in Table 3.

5.2 Model assessment

The structural equations modeling partial least squares (SEM-PLS) analysis evaluated the quality and robustness of the proposed research model [93, 94]. It indicated the values of the path coefficients, indirect effects, total effects as well as the values of the outer loadings, among other useful information. It clarified its predictive power, and reported the coefficients of determination (R^2) of the endogenous constructs and shed light on the effects (f^2) of each exogenous construct on them. PLS provided relevant information on the construct reliability and validity, as well as on their discriminant validity by illustrating the result from Fornell and Larcker's criterion and from HTMT procedure [95].

The results revealed that there were no collinearity issues as the VIF values were less than 3.3. PLS confirmed that the standardized loadings reported higher values than 0.7 [93]. Table 3 sheds light on the reliability and validity of the constructs. It reported that the reliability values were above 0.824. The values of Cronbach's Alpha and Rho_A were higher than the recommended threshold, except for FC constructs, as they were 0.678 and 0.684.

The average variance extracted (AVE) amounts of the constructs were above 0.6. This result confirmed the convergent validity of each construct as these values were above 0.5 [93]. The correlation values among the latent variables (within the respective columns) were lower than the square root value of AVE. Hence, these values confirmed that there was evidence of discriminant validity [96]. The presence of discriminant validity was reconfirmed as the values of the heterotrait-monotrait (HTMT) ratio of the correlations were lower than 1 [95], as shown on the right-hand side of Table 3 (these figures are featured in italic format).

Table 3. The descriptive statistics and an assessment of construct reliability and validity

	Construct	Items	Mean	Deviation	Loadings	Alpha	Rho_A	CR	AVE	1	2	3	4	5	6
1	Attitudes toward technology	ATT1	3.452	1.066	0.897	0.801	0.817	0.909	0.833	**0.913**	*0.704*	*0.942*	*0.806*	*0.961*	*0.688*
		ATT2	3.421	1.219	0.928										
2	Effort expectancy	EE1	3.714	1.085	0.889	0.882	0.884	0.919	0.738	0.600	**0.859**	*0.633*	*0.754*	*0.674*	*0.828*
		EE2	3.602	0.994	0.831										
		EE3	3.88	0.945	0.866										
		EE4	3.799	0.912	0.849										
3	Intentions to use technology	INT1	3.486	1.193	0.940	0.853	0.858	0.931	0.872	0.787	0.551	**0.934**	*0.716*	*0.860*	*0.568*
		INT2	3.432	1.155	0.927										
4	Perceived interactivity	PI1	3.668	0.929	0.828	0.769	0.772	0.867	0.686	0.638	0.621	0.581	**0.828**	*0.741*	*0.726*
		PI2	3.699	0.919	0.880										
		PI3	3.622	1.008	0.773										
5	Performance expectancy	PE1	3.714	1.081	0.851	0.902	0.903	0.932	0.774	0.820	0.604	0.756	0.618	**0.880**	*0.570*
		PE2	3.243	1.162	0.893										
		PE3	3.541	1.01	0.880										
		PE4	3.263	1.173	0.894										
6	Facilitating conditions	FC1	4.073	0.823	0.826	0.678	0.684	0.824	0.611	0.503	0.640	0.431	0.522	0.443	**0.782**
		FC2	4.054	0.784	0.813										
		FC3	3.884	0.948	0.700										

Note: The discriminant validity was evaluated through the HTMT procedure [95] and via the Fornell-Larcker criterion [96]. The value of the square root of AVE (that is represented by the figure in bold) was higher the corresponding values in the same column, as per Fornell-Larcker criterion [96]. The HTMT values were lower than 1 [95]. These figures are depicted (in italic format) on the right-hand side of this table.

A bootstrapping procedure was used to test the hypotheses. It was carried out with 500 samples, and with no sign changes option. It tabulated the standardized beta coefficients (i.e. the values representing the original sample), the bias corrected confidence intervals, the t-values and revealed their statistical significance (*p*). Table 4 features the results of the hypotheses of this study.

Table 4. The investigation of this study's hypotheses

Path Coefficient

		Original Sample (O)	**Confidence Intervals Bias Corrected**	**t-value**	***p***	**Decision**
H1	Facilitating conditions -> Perceived interactivity	0.522	[0.417, 0.619]	10.038	0.000	Supported***
H2	Facilitating conditions -> Effort expectancy	0.640	[0.542, 0.733]	13.102	0.000	Supported***
H3	Effort expectancy -> Performance expectancy	0.358	[0.199, 0.491]	4.776	0.000	Supported***
H4	Perceived interactivity -> Performance expectancy	0.396	[0.241, 0.510]	5.987	0.000	Supported***
H5	Perceived interactivity -> Attitudes toward technology	0.212	[0.118, 0.314]	4.028	0.000	Supported***
H6	Performance expectancy -> Attitudes toward technology	0.689	[0.607, 0.771]	16.016	0.000	Supported***
H7	Performance expectancy -> Intentions to use technology	0.339	[0.212, 0.498]	4.708	0.000	Supported***
H8	Attitudes toward technology -> Intentions to use technology	0.509	[0.336, 0.632]	6.896	0.000	Supported***

Note: *** $p<0.001$

5.3 The results

This study reported that the facilitating conditions construct was the precursor of perceived interactivity (H1: $\beta = 0.522$, $t = 10.038$, $p < 0.001$) and of EE (H2: $\beta = 0.640$, $t = 13.102$, $p < 0.001$). These findings suggest the educational institutions' facilitating conditions had a positive effect on the students' perceptions about the ease-of-use of the interactive the video conferencing program they used.

As expected, the results indicated that effort expectancy significantly anticipated performance expectancy (H3: $\beta = 0.358$, $t = 4.776$, $p < 0.001$). This is consistent with the technology acceptance model. Previous studies often reported that the individuals' perceived ease of use of the technology was a precursor for their perceived usefulness [97, 98]. Perceived interactivity also had a positive and significant effect on performance expectancy (H4: $\beta = 0.396$, $t = 5.987$, $p < 0.001$) and predicted the students' positive attitudes toward the video conferencing software (H5: $\beta = 0.212$, $t = 4.208$, $p < 0.001$).

The most significant link was reported between performance expectancy and attitudes toward the mentioned technology (H6: $\beta = 0.689$, $t = 16.016$, $p < 0.001$). Similar results were also found in other studies that relied on synonymous TAM constructs [80, 83]. Yet, Kamble et al. (2019) reported that their respondents' perceived ease of use did not yield a significant effect on their attitudes.

Performance expectancy predicted their intentions to use them (H7: $\beta = 0.339$, $t = 4.708$, $p < 0.001$). Other researchers reported similar findings [26, 27, 40, 66, 97]. This study revealed that the students held positive attitudes that were affecting their intentions to continue using the video conferencing technology in the future (H8: $\beta = 0.509$, $t = 6.896$, $p < 0.001$). Again, this result is congruent with other studies, including those that used TRA, TPB or TAM constructs [21, 22, 39, 41, 49].

Table 5 sheds light on the mediated relationships between perceived interactivity and attitudes toward technology as well as between performance expectancy and intentions to use technology. Table 6 summarizes the indirect effects of other constructs in this research model.

Table 5. The mediation analysis of indirect hypothesized relationships

	Causal path	Direct Effect	Indirect Effect	t-value	*p*	Total Effects	Confidence Intervals	t-value	*p*	Interpret
		Original sample (O)	Original sample (O)				Bias Corrected			
H5a	Perceived interactivity -> Attitudes toward technology (H5)	0.212		4.028	0.000	0.485	[0.355. 0.587]	8.281	0.000	Parti Mediat Supporte
	Perceived interactivity -> Performance expectancy -> Attitudes toward technology		0.273	5.703	0.000					
H7a	Performance expectancy -> Intentions to use technology (H7)	0.339		4.708	0.000	0.690	[0.604, 0.763]	17.391	0.000	Parti Mediat Supporte
	Performance expectancy -> Attitudes toward technology -> Intentions to use technology		0.351	6.411	0.000					
							TOTAL EFFECTS			

Note: *** $p<0.001$.

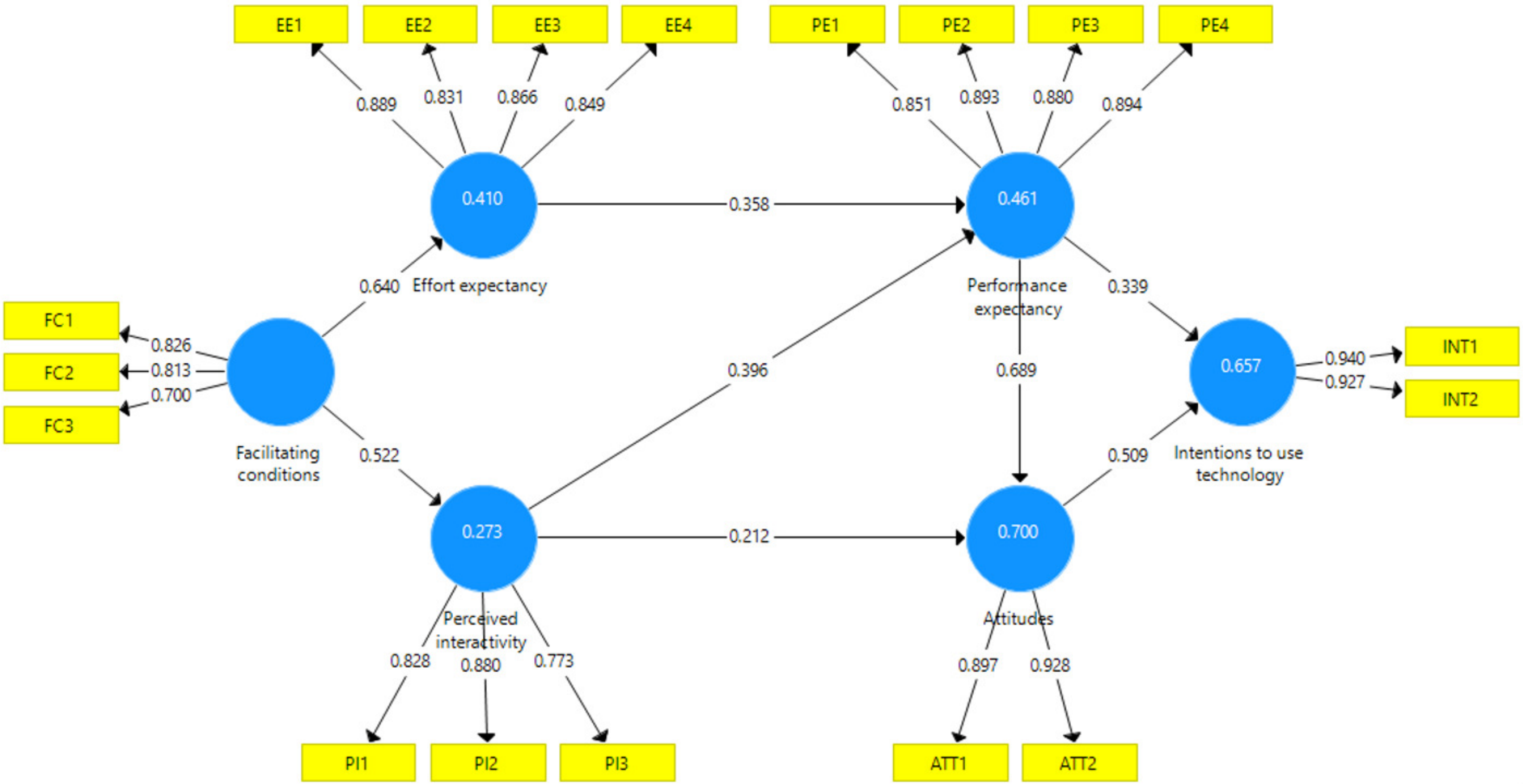
Table 6. Indirect effects within this research model

Causal path	Specific indirect effect Original Sample (O)	t-value	*p*	Total indirect effect Original Sample (O)	Confidence Intervals Bias corrected	t-value	*p*
Facilitating conditions -> Perceived interactivity -> Performance expectancy	0.207	5.010	0.000	0.436	[0.343, 0.518]	9.392	0.000
Facilitating conditions -> Effort expectancy -> Performance expectancy	0.229	4.587	0.000				
Facilitating conditions -> Perceived interactivity -> Attitudes toward technology	0.111	3.711	0.000				
Facilitating conditions -> Perceived interactivity -> Performance expectancy -> Attitudes toward technology	0.142	4.826	0.000	0.411	[0.329, 0.491]	9.711	0.000
Facilitating conditions -> Effort expectancy -> Performance expectancy -> Attitudes toward technology	0.158	4.233	0.000				
Facilitating conditions -> Perceived interactivity -> Performance expectancy -> Intentions to use technology	0.070	3.219	0.001				
Facilitating conditions -> Perceived interactivity -> Performance expectancy -> Attitudes toward technology -> Intentions to use technology	0.072	4.124	0.000				
Facilitating conditions -> Effort expectancy -> Performance expectancy -> Attitudes toward technology -> Intentions to use technology	0.080	3.423	0.001	0.357	[0.275, 0.429]	9.067	0.000
Facilitating conditions -> Perceived interactivity -> Attitudes toward technology -> Intentions to use technology	0.056	3.302	0.001				
Facilitating conditions -> Effort expectancy -> Performance expectancy -> Intentions to use technology	0.078	3.450	0.001				
Perceived interactivity -> Performance expectancy -> Intentions to use technology	0.134	3.701	0.000				
Perceived interactivity -> Performance expectancy -> Attitudes toward technology -> Intentions to use technology	0.139	4.365	0.000	0.381	[0.282, 0.471]	7.461	0.000
Perceived interactivity -> Attitudes toward technology -> Intentions to use technology	0.108	3.333	0.001				
Effort expectancy -> Performance expectancy -> Attitudes toward technology	0.247	4.377	0.000	0.247	[0.128, 0.353]	4.377	0.000
Effort expectancy -> Performance expectancy -> Attitudes toward technology -> Intentions to use technology	0.126	3.568	0.000	0.247	[0.144, 0.364]	4.511	0.000
Effort expectancy -> Performance expectancy -> Intentions to use technology	0.121	3.450	0.001				
				TOTAL INDIRECT EFFECTS			

Note: *** $p<0.001$.

Figure 2 the depicts the outer loadings, the direct effects and illustrates the coefficient of determination (R^2) values of the factors. The students' attitudes toward video conferencing technologies had the highest level of explanatory power in this research model (where $R^2 = 0.7$; with PE's $f^2 = 0.978$ and PI's $f^2 = 0.092$). The findings reported that students' intentions to use them was the second highest coefficient (i.e. $R^2 = 0.657$). This construct was affected by their attitudes ($f^2 = 0.247$) and their performance expectancy ($f^2 = 0.11$). The results indicated that there were moderate coefficients of determination for performance expectancy ($R^2 = 0.461$) and for effort expectancy ($R^2 = 0.41$). Performance expectancy was affected by effort expectancy ($f^2 = 0.146$) and perceived interactivity ($f^2 = 0.178$). Whilst effort expectancy was affected by facilitating conditions ($f^2 = 0.695$). Perceived interactivity had the lowest R^2 at 0.273. This construct was affected by facilitating conditions ($f^2 = 0.375$).

Figure 2. The results from PLS algorithm



6. Discussion and conclusions

6.1 Theoretical implications

Since the unprecedented outbreak of COVID-19, many educators have devoted their attention to the utilization of remote learning technologies. At the same time, several researchers sought to investigate the acceptance and use of synchronous and asynchronous systems that are intended to facilitate the students' learning journeys.

This empirical research sheds light on the casual path that is affecting the students' engagement with interactive video conferencing technologies. The findings from SEM-PLS reported that all hypotheses were supported and that they all evidenced highly significant effects among the constructs in our research model. More importantly, this contribution reconfirmed the reliability and validity of key constructs that were drawn from previous theoretical underpinnings (including UTAUT, TAM and perceived interactivity).

This research raises awareness on evaluating the individuals' attitudes toward technologies when conducting empirical studies that are meant to explore technology adoption behaviors. In this case, the research participants' attitudes were significantly affected by performance expectancy. In fact, PE-ATT link was the most significant causal path in this research model. Notwithstanding, attitudes also affected the individuals' intentions to use technologies. ATT-INT was found to be highly significant. Moreover, attitudes were significantly mediating the relationship between performance expectancy and intentions. Regrettably, many UTAUT/UTAUT2 researchers are not integrating the attitudes construct in their empirical models, even though this construct was one of the key factors that were used in TPB and in the earlier versions of TAM [80-83]. As a result, many authors are not examining their respondents' attitudes when they use UTAUT models [39].

This research reported that effort expectancy anticipated the performance expectancy. A review of the relevant literature reported that the definitions of effort expectancy and of performance expectancy constructs (as well as their measuring items), are very similar to TAM's perceived ease of use and perceived usefulness of technology. Hence, this study's EE-PE link has validated the perceived ease of use – perceived usefulness effect that is usually investigated in TAM/TAM2/TAM3 research [86, 87]. Again, many researchers who rely on UTAUT/UTAUT2 models are usually ignoring or overlooking the significant effects that exist between effort expectancy and performance expectancy (EE-PE).

This study indicated that the research respondents felt that the use of technology was much easier for them when they could benefit from certain facilitating conditions including their institution's resources, knowledge and support. The findings revealed that such facilitating conditions were strongly predicting their effort expectancy (FC-EE). Previous theoretical underpinnings reported that appropriate facilitating conditions including the organizational and technical infrastructure provide useful assistance to users of information systems, particularly during the early stages of technology adoption [58, 61, 62].

In this case, the findings suggest that the use of video conferencing technologies have facilitated the students' migration from traditional educational services to fully remote learning environments. Evidently, the educational institutions' (and their instructors') technical support enabled students to engage in simultaneous, synchronous, and continuous exchanges of information [29, 77] to continue their educational programs. In fact, the results suggest that that there was a very significant effect between facilitating conditions and the students' perceptions about the interactivity of video conferencing technologies (FC-PI).

Last but not least, this research clarified that the students' perceptions about the video conferencing technologies were influencing their performance expectancy (PI-PE). The use of synchronous conferencing technologies enabled them to interact with course instructors and with other students. Previous research shed light about the attributes and features of interactive technologies [56]. This study confirmed that video conferencing software facilitated two-way communications among online users [57] and allowed them to continue with their educational programs during COVID-19, and even after, when regulatory authorities have eased their social distancing restrictions.

In sum, this research suggests that these interactive video conferencing programs satisfied the students' performance expectations as they perceived them as useful tools to improve their learning outcomes. Their performance expectancy as well as their positive attitudes towards their virtual learning experience were significant predictors for their intentions to continue using these interactive technologies in the future.

6.2 Implications of study for policy makers in education

This research revealed that students felt that their educational institution provided them with suitable facilitating conditions that helped them in their transition to continue their learning journey via video conferencing technologies. The descriptive statistics suggest that they were satisfied with the assistance they received from their college and from course instructors.

In the main, the results reported that the research participants held positive perceptions and attitudes toward video conferencing technologies. They indicated that they considered them as easy to use and useful. They did not require much effort to learn how to use them as they were clear and understandable. They reported that they found them to be helpful, and that they increased their chances of learning and to achieve their learning outcomes.

Evidently, they were intrigued to use video conferencing software as they were interactive and enabled two-way communications. The findings suggest that they were willing to engage in online conversions with their lectures and other course participants. On the other hand, the research participants also revealed that they were not completely pleased with the quality of educational services that was delivered through video conferencing technologies. Reportedly, ATT2 was one of the lowest mean scores in this study. Yet, the respondents were still willing to continue using them in the future.

Video conferencing technologies allow educators to follow up on their students' progress [18, 99]. They facilitate online interactions, in real time, and enable them to obtain immediate feedback from their students. It also allows educational institutions to reach a wide array of students, including those who are situated in remote locations, or those that may be separated by geographical boundaries. In addition, virtual lectures may be recorded or archived for future reference. Hence, students or educators could access learning materials at their convenience. Notwithstanding, there are fewer chances of students' absenteeisms and on missing out on their lessons, as they can join online meetings from home or from other locations of their choice.

While the use of video conferencing technologies may appeal to a wide variety of individuals, educators are expected to use a range of resources when they are presenting their virtual lectures, in order to entice their students' curiosity. They can utilize digital learning resources, including videos and interactive presentations to keep the students' engaged in their lectures.

One of the biggest challenges of using digital media and mobile technologies is the individuals' struggle to focus on their screens for long periods of time [100]. Individuals may develop bad postures and other physical problems due to staying hunched in front of a screen. Students ought to be given regular breaks from the screens of their devices. Notwithstanding, those students who are pursuing their courses through virtual environments may be distracted by other digital (non-educational) content including websites and social media. Hence, educators ought to keep their lectures as lively as possible to capture their students' undivided attention.

6.3 Conclusion

COVID-19 has opened a window of opportunity for practitioners in education. It encouraged lecturers and teachers to utilize video conferencing technologies and other electronic learning resources to continue providing their educational services. COVID-19's social distancing measures have inevitably led them to experiment with software like Zoom and Microsoft Teams, among others, and to engage with students, in real time. This contribution suggests that the use of synchronous video conferencing could continue in the foreseeable future as they can easily be used in blended learning approaches, in a post COVID-19 context.

6.4 Research limitations and future research directions

An SEM-PLS analysis was used to validate the constructs that were employed in this contribution's research model. Further research can use other samples, methodologies, and analytical techniques to explore the students' utilitarian motivations to use video conferencing technologies in education. Future studies may consider alternative technology adoption models that were mentioned in this paper including TRA [43], TAM [20,21], TAM2 [45,46], TAM3 [47, 48], TPB [44], the Motivational Model (MM) [22], Combined TAM and TPB (C-TAM-TPB) [49], the Model of PC Utilization (MPCU) [50], Innovation Diffusion Theory (IDT) [51, 52], and the Social Cognitive Theory (SCT) [53, 54], among others Perhaps, they may use the same constructs and their corresponding items that were used in this research, to better understand the students' perceptions, attitudes and intentions toward using interactive media, in other settings. They could also explore the effects of moderating demographic variables including age, gender and experience, among others, on their research models.

Declarations

The authors declare that they have no conflict of interest.

The statistical data is available, on request.

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