Investigating university students' online proctoring acceptance during COVID-19: An extension of the technology acceptance model

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To ensure the normal operation of teaching and meet the needs of teaching quality assessment in the COVID-19 situation, universities in various countries have adopted online proctoring for assessment. The epidemic has accelerated the development of online education. Online proctoring, as an integral part of future online teaching, has not yet drawn sufficient attention. To understand students' experiences and attitudes towards initial online proctoring, an extended technology acceptance model was utilised to examine the motivations and barriers that influence students' online proctoring acceptance in terms of technology perception, presence and social influence. Structural equation models were used to analyse data from a questionnaire survey of 760 university students. Results revealed that social influence, social presence and perceived usefulness are the significant predictors of online proctoring acceptance. Social influence and social presence have significant positive effects on online proctoring acceptance through perceived usefulness, and social presence has a positive effect on perceived ease of use. However, perceived ease of use has a significant negative effect, while place presence has no significant effect. Implications, limitations and future work are discussed at the end.

Implications for practice or policy:

- Online proctoring organisers can bring a better exam experience to students by ensuring the flexibility and integrity of online proctoring.
- Online proctoring workers can improve students' exam experience by building a positive group atmosphere in the early stages of online proctoring applications.
- Social recognition and support for online proctoring can enhance students' choice and willingness to use online proctoring and increase opportunities for online proctoring development.

Keywords: online proctoring, technology acceptance model (TAM), social influence, perceived usefulness, social presence

Introduction

In the face of the unexpected COVID-19 pandemic, online instruction can help students avoid threats to their physical health and address the challenges that have hampered traditional offline instruction. In addition to the focus on student activities and quality of instruction, measuring student performance and ensuring the integrity of assessments were the main concerns in this large-scale online distance learning (Coghlan et al., 2021). To test the effectiveness of students' online learning and to ensure that the test results are authentic and credible, universities and institutions in higher education have adopted online proctoring for assessment (Burgess & Sievertsen, 2020). Although online proctoring remains highly

controversial in terms of security, privacy and ethical issues, with the ongoing COVID-19, online proctoring meets the needs of the times and undeniably offers great benefits and convenience. Online proctoring providers are increasingly offering advanced technology and high-quality services (e.g., ProctorU, https://www.proctoru.com/). Many schools have already used online proctoring tools for assessment, such as Harvard University, Massachusetts Institute of Technology, Michigan State University and Hong Kong University of Science and Technology (Raman et al., 2021). Online proctoring, as a practical and efficient idea, is expected to evolve into the global norm in higher education (Selwyn et al., 2021). This implementation of online proctoring is a challenge for schools and families, as well as for students. How to effectively organise and implement online proctoring in an unstable environment while ensuring the authenticity and validity of exam results is a test for schools and teachers. As students rely on their homes to complete their learning and assessments, families face the challenge of creating a distraction-free environment for students to take exams (Conijn et al., 2022). As test takers, students need to have self-control in an unconventional learning environment, but they also need to have a certain degree of adaptability and acceptance of online proctoring. Understanding students' attitudes and concerns about the new examination model is helpful for online proctoring providers, proctors and students to reach a consensus and avoid misunderstandings. It is also helpful to build a good online proctoring environment and improve students' experience and performance in online exams.

Online learning has been extensively researched, and researchers have emphasised the learning activities and experiences of students in the online learning (Konstantinidou & Nisiforou, 2022; Marković et al., 2021; Yildirim & Usluel, 2022). However, research on the testing process that includes home-based online proctoring is still limited. Existing research for online proctoring includes:

- System design and technological development for online proctoring (Atoum et al., 2017; Jia & He, 2022), especially the integration with smart technologies of AI (Nigam et al., 2021) and blockchain (Slusky, 2020)
- Opportunities and challenges of online proctoring development, especially privacy and cheating. The privacy and security of e-proctoring are considered to be decisive factors affecting the implementation of e-proctoring in online teaching (González-González et al., 2020). To ensure the authenticity and validity of online proctoring results, some scholars have proposed combining multi-factor authentication and authorisation (Slusky, 2020), biometrics (Labayen et al., 2021), application locks (Alessio et al., 2017), and question bank randomisation (Chua et al., 2019) in online proctoring.
- The challenges of online proctoring applications, including student attitudes and choices and the impact of online proctoring on student performance.

Before the COVID-19 outbreak, lower cost, comfort and less anxiety and stress were found to be motivating factors for students to choose online proctoring, but technical difficulties and unreliable Internet connections were great barriers that could even outweigh the benefits of motivation (James, 2016; Milone et al., 2017). Although during the COVID-19 pandemic, Kharbat and Abu Daabes (2021) investigated and found that students' overall satisfaction with online proctoring was lower than they expected, with major concerns about privacy and environmental and psychological factors. However, the study had not taken into account the technological contexts in online proctoring. To further examine students' choice of online proctoring, Raman et al. (2021) found a relative advantage related to the diffusion of innovation theory, compatibility, ease of use, trialability and observability as predictors of university students' adoption of online proctored exams. The difficulties and concerns that students have should be taken into account when implementing online proctoring, but research on the impact of online proctoring on students' experience is still very limited, especially after the epidemic brought opportunities for online proctoring. Therefore, a more comprehensive analysis of the factors that influence students' use of online proctoring is imperative.

The large-scale application of online proctoring for the first time was a new experience for students. Thus, this study examining online proctoring acceptance through the perspective of innovation adoption can provide insight into online proctoring adoption. The technology acceptance model (TAM) is based on the

theory of reasoned action and the theory of planned behaviour, combined with the self-efficacy theory and the expectation confirmation theory (Davis et al., 1989). As a classic model for studying users' behavioural intentions to use technological innovations in the field of information technology, TAM has proven to be widely applicable and credible (King & He, 2006). TAM suggests that perceived ease of use and perceived usefulness are the main reasons for technology innovation adoption (Davis et al., 1989). Useful and easy-to-use learning tools promote student engagement, satisfaction and willingness to continue learning (Al-Adwan, 2020; Esteban-Millat et al., 2018; Hsu et al., 2018; Mailizar et al., 2021). Presence theory suggests that "presence occurs when media users somehow ignore the role of technology in their experience" (Lombard et al., 2017). Social presence emphasises the salience of interactions and interpersonal relationships in human-computer interaction (Short et al., 1976). Place presence reflects the high level of engagement and immersion in a given virtual environment (Witmer & Singer, 1998). Research has focused on the impact of social presence and place presence on students' educational experiences and learning performance in online learning environments (Bodzin et al., 2021; Bulu, 2012; Doo & Bonk, 2020; Luo et al., 2019). Through presence theory, we can improve the online proctoring experience by enhancing the presence of students. In addition, the social environment has a significant impact on technology adoption decisions (Venkatesh et al., 2003). Therefore, this study extended and refined the research model based on TAM by including social presence, sense of place presence and social influence as external factors and investigates influential motivations and barriers from the technology perception, presence, and social influence of online proctoring.

Given these considerations, this study aimed to examine the challenges of implementing online proctoring by highlighting students' experiences and attitudes during the COVID-19 pandemic and how these processes can be improved from students' perspective. In addition, this study focused primarily on exploring the factors that facilitate and hinder student acceptance of online proctoring based on the extended TAM. This study provides important evidence for academic institutions to understand the most salient concerns of students regarding the implementation of online proctoring tools. It will not only provide some guidance for educational institutions to respond to the current epidemic emergency but also offer some practical suggestions for the future development of online proctoring.

The rest of the paper is as follows: It first discusses the student online proctoring acceptance model constructed based on the extended TAM. Then, the methodology and results are discussed. The implications, limitations and future research are discussed at the end.

Online proctoring

Online proctoring refers to proctors monitoring the status of students during exams via webcam and Internet connection to detect and prevent any misconduct (Hylton et al., 2016). Online proctoring takes place online and allows students to participate in exams remotely from outside the physical classroom, ensuring the integrity of course assessments (Simone et al., 2021). Hussein et al. (2020) identified three types of online proctoring. Live proctoring is where professionally trained human proctors monitor the student's real-time status via camera and microphone and flag cheating and misconduct. This mode can be implemented through better student-teacher ratios and multiple cameras to get a better understanding of the student's exam environment. Recorded proctoring analyses students' activities in exam footage through technology such as eye-tracking, facial detection and log analysis to generate reports for human review and intervention, but is very time-consuming and expensive. Automated proctoring has no time or place restrictions and by automatically identifying fraud and cheating through artificial intelligence or algorithms, humans do not proctor exams all the time but just review. Online proctoring tools on the market continue to evolve and are increasingly able to combine various algorithms and technologies to identify and monitor students' exam environments and exam behaviours, performing more sophisticated monitoring functions (ProctorU, n.d.). Online proctoring has a promising future in online education (Kubiatko, 2017). However, due to considerations of technical support, service costs, and privacy and security, schools that have chosen and implemented complex functional online exam proctoring tools are still in the minority.

The online proctoring model used in this study was live proctoring through videoconference software. Using this method, one instructor could monitor many students at once, as shown in Figure 1. The instructor monitored multiple students in real time through an online conference webcam and microphone, with no additional software involved. A maximum of 20 students in each group of the conference are matched with one instructor. Students prepared two devices: the monitoring device and the answering device. Students presented their ID and campus card to the camera in the monitoring device for authentication. During the examination, students were not allowed to leave the camera area of the monitoring device without consent. Failure to do so was considered a violation and would affect the exam grade. Students downloaded the test questions on the answering device and answered them. The use of live proctoring during the epidemic helps teachers to respond to various emergencies in a timely manner, especially when the online proctoring mode has not been extensively tested yet.

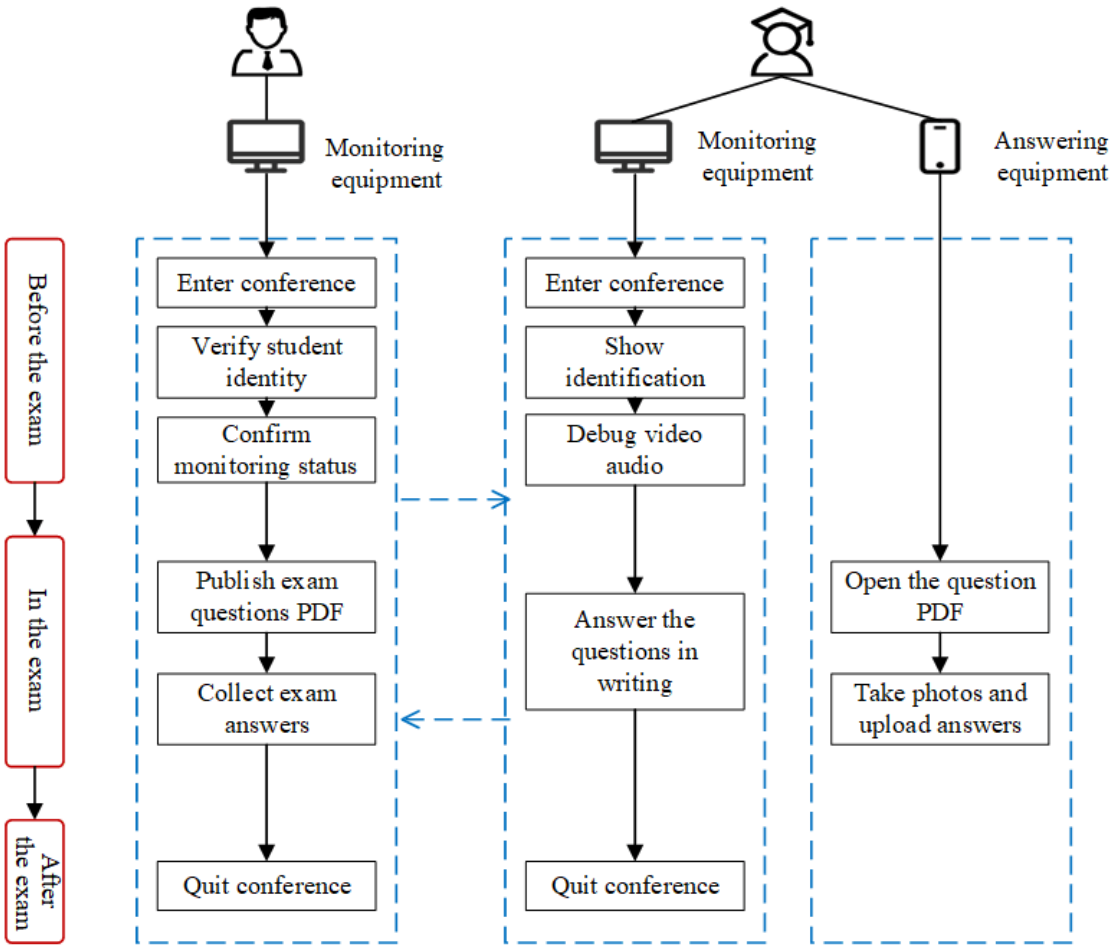

Figure 1. The online proctoring process

Perceived ease of use

TAM considers perceived ease of use as a direct influence on perceived usefulness and behavioural intention (Eraslan Yalcin & Kutlu, 2019). Perceived ease of use indicates how easy or difficult students perceive it is to use the online proctoring tool during the exam. Ease of use has been shown to be positively correlated with the acceptance of online proctoring (Raman et al., 2021; Sefcik et al., 2022). Unreliable systems can affect perceptions of the tool's usefulness during an exam and impede the willingness to use the online proctoring tool. When hampered by technical difficulties or unreliable Internet connections, students choose to discontinue their online proctoring experience (James, 2016). Hence, we proposed the following hypotheses:

- H1a: Perceived ease of use positively influences students' perceived usefulness.
- H1b: Perceived ease of use positively influences students' online proctoring acceptance.

Perceived usefulness

TAM considers perceived usefulness as an important determinant of users' persistent intention (Baki et al., 2018). Perceived usefulness indicates the perceived functionality and usefulness of the tool, and students' agreement of using an online proctoring tool has improved their exam experience. Due to the epidemic, students were unable to take traditional offline exams. As the first large-scale adoption of online proctoring, it can provide a better exam experience for students while meeting the requirements of integrity and fairness of the assessment. Online exams were associated with less test anxiety and test stress for students compared to traditional exams (James, 2016). When online proctoring can bring flexibility and convenience, for example, in time and location, students would be more receptive to online proctoring tools (Milone et al., 2017). Therefore, we proposed the following hypothesis:

- H2: Perceived usefulness positively influences students' online proctoring acceptance.

Social presence

Social presence is social interaction and cognitive exchange that involves a continuum from absence to low levels of psychological involvement to high levels of behavioural performance (Van Liere, 1978). In online learning contexts, social presence has been found to contribute to positive learning experiences, with significant positive effects on learning satisfaction, motivation and willingness to continue learning (Lim et al., 2021; Luo et al., 2019; Zuo et al., 2021). Social presence has also been found to influence users' enjoyment of e-learning and perception of the technology, including perceived ease of use and perceived usefulness (Ogonowski et al., 2014; Salimon et al., 2021). The physical and psychological distances between teachers and students have changed from a strong relationship at zero distance in offline learning to a weak relationship at a distance in online learning. Online proctoring through cameras and microphones helps students in a separate location form a certain sense of belonging and identity that would reduce the loneliness generated in the remote exam environment and enhance students' persistence in the exam. We proposed the following hypotheses:

- H3a: Social presence positively influences students' perceived ease of use.
- H3b: Social presence positively influences students' perceived usefulness.
- H3c: Social presence positively influences students' online proctoring acceptance.

Place presence

Place presence is defined as a subjective and psychological sense of an individual in a particular virtual environment (Sheridan & Thomas, 1992). Place presence is related to students' perception of immersive tendencies. In virtual world learning, place presence is positively related to students' system satisfaction (Bodzin et al., 2021; Bulu, 2012). The online proctoring in our study was a combination of online videoconference proctoring by the instructor and offline question answering by students, a combination of a contextualised virtual world environment and a real task. By simulating a traditional offline exam situation, it provided students with a psychological sense of taking the exam proctored by the teachers in the real context. Therefore, this study suggests that students who feel a real presence in online proctoring would feel a stronger sense of intimacy and immediacy, and would have a higher willingness to use the online proctoring tool. We proposed the following hypothesis:

- H4: Place presence positively influences students' online proctoring acceptance.

Social influence

Social influence indicates the extent to which specific people or organisations influence technological innovation, including surrounding people, mass media, and government norms. In online learning environments, social influence is an important predictor of students' perceived usefulness (Wu & Chen, 2017) and willingness to continue learning (Hossain et al., 2019; Olasina, 2019). In our study, social influence was mainly from the calls and promotion of government and schools, including the Ministry of Education's (2020)_advocacy of "suspending classes without stopping learning," the promotion of completing teaching tasks on time through online learning and the standardisation and implementation of online proctoring by schools and teachers for teaching inspections and assessments. These will enhance students' perceptions of the usefulness and importance of online proctoring tools. We proposed the following hypotheses:

- H5a: Social influence positively influences students' perceived usefulness.
- H5b: Social influence positively influences students' online proctoring acceptance.

Control variables: gender, major, grade and online learning experience

The characteristics of the respondents included are thought to enhance the explanatory power of TAM, such as gender and experience (Morris & Venkatesh, 2000; Sun & Zhang, 2006). In online instruction, gender was found to significantly affect university students' e-learning satisfaction (Hsi-Peng Lu, 2010). Gender and age had significant moderating effects between technology perception and e-learning acceptance (Tarhini et al., 2014). However, studies that examined the effect of respondents' characteristics on online learning intentions remain limited, and findings are not always consistent. To further investigate online proctoring acceptance, respondents' characteristics were included as control variables in the proposed research model. The study hypothesised that gender, major, grade and online learning experience lead to different intentions to accept online proctoring tools.

The research model is shown in Figure 2.

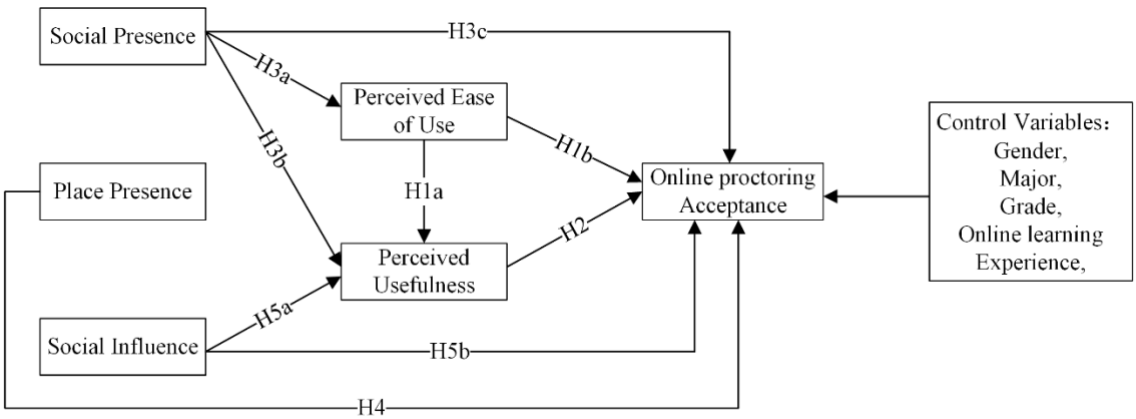

Figure 2. The online proctoring acceptance research model

Materials and methods

Participants

To test the proposed model, this study conducted an online questionnaire survey in China. First, in response to the epidemic's hindrance to education, China explicitly proposed and implemented an online teaching policy (Ministry of Education, 2020). Second, for summative assessments, Chinese students generally valued traditional offline exams before the epidemic, and large-scale online proctoring was a new and profound experience for them. The studies involving human participants were reviewed and approved by Hubei University, School of Education, Ethics Committee (HREC number 20200616). Data on students' attitudes towards the use of online proctoring were collected anonymously online from

university students in Hubei Province, China, from July 28 to 31, 2020. A total of 992 questionnaires were returned. After eliminating questionnaires that were filled out within 60 seconds, show discrepancies in the reverse questions or have all the same responses to the scale items, a total of 760 valid questionnaires were obtained, with a response rate of 76.6%. The respondents' profiles were presented in Table 1. Males and females accounted for 41.97% and 58.03% respectively in the sample.

Table 1
Respondents' profile (*N* = 760)

Profile	Frequency	Percentage (%)
Gender		
Males	319	41.97%
Females	441	58.03%
Major		
Science	293	38.55%
Liberal arts	166	21.84%
Engineering	301	39.61%
Physical education	0	0%
Grade		
Freshman	360	47.37%
Sophomore	221	29.08%
Junior	153	20.13%
Senior	26	3.42%
Online learning experience		
Less than 1 year	583	76.71%
1 to 2 years	114	15%
2 to 3 years	46	6.05%
More than 3 years	17	2.24%

Instruments

The questionnaire was divided into two parts. The first part included demographic information on gender, major, grade and online learning experience. The second part included six factors in the research model, as shown in Table 2. Overall, the six factors in the research model were measured with 21 closed-ended questions. A 5-point Likert scale was used to measure respondents' opinions, with 5 representing *strongly agree* and 1 representing *strongly disagree*.

Table 2
Measurement items

Constructs	Items	Statements	Source
Perceived ease of use (PEOU)	PEOU1	I can easily meet the equipment and network requirements for online proctored exams.	Davis et al. (1989)
	PEOU2	It's easy for me to learn how to take an online proctored exam.	
	PEOU3	It is easy for me to proficiently use the platform for online proctored exams.	
	PEOU4	I think the interactive logic of the online proctoring platform is straightforward and easy to understand.	
Perceived usefulness (PU)	PU1	I find the online proctoring approach useful in solving the challenge of being unable to take traditional exams during the epidemic.	Davis et al. (1989) Cho et al. (2009)
	PU2	I think the online proctoring platform is very functional and helps me do well in online proctored exams.	
	PU3	I feel that online proctoring provides a more flexible and convenient way to take exams.	
Social presence (SP)	SP1	I feel comfortable taking exams on the online proctoring platform.	Shea & Bidjerano (2010)
	SP2	I feel comfortable taking exams with my classmates on the Internet.	
	SP3	I feel like I belonged to the test when I saw familiar teachers and classmates on the screen.	
	SP4	In online proctored exams, even though I may not do as well as other students, I still feel a sense of closeness and trust towards them.	
Place presence (PP)	PP1	In online proctored exams, I felt strongly that I was taking the exam.	Slater (2016)
	PP2	In online proctored exams, I almost forgot that I was taking the exam online and felt like I was taking it in a regular classroom.	
	PP3	When I think back to my online proctoring experience in online proctored exams during the epidemic, I feel that the process of answering and solving questions was not quite different from that in the previous exams in a regular classroom.	
	PP4	For most of the time during the online proctored exam, I felt like I was taking the exam as usual with my classmates.	
Social influence (SI)	SI1	The school has put in place various policies and regulations to standardise online proctored exams, which will make me more willing to try online proctored exams.	Zainab et al. (2018)
	SI2	The course management team's careful process design and maintenance for orderly online proctoring will make me feel comfortable with online proctoring.	
	SI3	Online proctoring is a major trend at this particular time, and I am willing to try online proctoring.	
	SI4	I am willing to try online proctoring because of the high praise for online proctoring.	
Online proctoring acceptance (OPA)	OPA1	I am willing to continue to participate in online proctoring in the future.	Lin & Wang (2012)
	OPA2	I think online proctoring is the inevitable trend in education in the future.	

Results

This study aimed to examine the influencing factors of online proctoring acceptance, and structural equation modelling was considered appropriate, as it helps to explain causal relationships among constructs (Grace et al., 2012). Internal consistency reliability, convergent validity, discriminant validity and common method bias tests were conducted to assess the measurement model. Then, to test the research hypotheses, the structural equations were modelled and analysed using Analysis of Moment Structure software.

Measurement analysis

J. Hair et al. (2017) indicated that both the Cronbach's alpha and composite reliability greater than 0.7 mean high reliability of the scales. The Cronbach's alpha and composite reliability values shown in Table 3 were both greater than 0.7, indicating that each construct exhibited strong internal reliability.

All indicator factor loadings were significant and greater than 0.5, and when the average variance extracted (AVE) for each construct exceeded the variance of that construct (Fornell & Larcker, 1981a), then the convergent validity was achieved. As shown in Table 3, all item loadings were statistically significant ($p < 0.001$) and greater than 0.50, and all constructs had AVE values greater than 0.5. Therefore, the convergent validity condition was achieved.

To achieve discriminant validity, the square of the correlation coefficient must be less than the two AVE estimates (Chin, 1998). As shown in Table 4, the square root values of all AVEs exceeded the estimated values of the correlation coefficients between the constructs, so discriminant validity was achieved.

For testing common method bias that can easily occur with the same questionnaire method and data source, this study used two approaches. The Harman' s single factor test and controlling for the effects of a single unmeasured latent method factor. In the first approach, the confirmatory factor analysis test found that the fit indices of the single factor confirmatory factor analysis model ($\chi^2 = 3098.576$, $df = 186$, $\chi^2/df = 16.395$***, root-mean-square error of approximation (RMSEA) = 0.142, CFI = 0.758, TLI = 0.731) did not meet the fit good criteria, indicating that the CMB was not severe (Williams et al., 2004). In the second approach, common methods variance was added as a latent variable to the structural equation model to compare the changes in model fitting before and after adding (Podsakoff et al., 2003). The analysis results showed no significant improvement in the model fitting ($\Delta\chi^2 = 276.697$, $\Delta df = 21$, $\Delta\chi^2/df = 1.282$), which also indicated that the common method bias was not problematic.

Table 3
Results of construct reliability and convergent validity

Construct	Items	Factor loading (> 0.5)	Cronbach's alpha (> 0.7)	Composite reliability (> 0.7))	Average variance extracted (> 0.5)
Perceived ease of use	PEOU1	0.775	0.89	0.90	0.68
	PEOU2	0.817			
	PEOU3	0.865			
	PEOU4	0.766			
Perceived usefulness	PU1	0.726	0.89	0.89	0.72
	PU2	0.723			
	PU3	0.741			
Social presence	SP1	0.745	0.89	0.89	0.68
	SP2	0.792			
	SP3	0.683			
	SP4	0.564			
Place presence	PP1	0.625	0.88	0.88	0.65
	PP2	0.846			
	PP3	0.710			
	PP4	0.705			
Social influence	SI1	0.724	0.90	0.90	0.70
	SI2	0.740			
	SI3	0.740			
	SI4	0.660			
Online proctoring acceptance	OPA1	0.547	0.75	0.77	0.64
	OPA2	0.839			

Table 4
Results of correlation matrices and discriminant validity (Diagonal elements are square roots of average variance extracted.)

Construct	PEOU	PU	SP	PP	SI	OPA
Perceived ease of use (PEOU)	0.83					
Perceived usefulness (PU)	0.60	0.85				
Social presence (SP)	0.53	0.65	0.82			
Place presence (PP)	0.52	0.64	0.72	0.81		
Social influence (SI)	0.55	0.71	0.71	0.67	0.84	
Online proctoring acceptance (OPA)	0.36	0.63	0.61	0.59	0.67	0.80

Structural model analysis

The goodness-of-fit analysis was used to assess the degree of fit of the proposed model to the collected data (Fidell et al., 2013). As shown in Table 5, CFI (0.916), AGFI (0.888), NFI (0.933), CFI (0.951), RMR (0.032) and RMSEA (0.057) were within the recommended range, and although χ^2/df (3.432) was greater than 3.00, it was less than 5.00 and acceptable (Kline, 2011). Therefore, the model was assumed to have a good fit.

Table 5
Results of model fit indices

Goodness-of-it indices	Observed value	Recommended value	Source
χ^2/df	3.432	≤3.00	Kline (2011)
GFI	0.916	≥0.90	Bagozzi & Yi (1988)
AGFI	0.888	≥0.80	Fornell & Larcker (1981b)
NFI	0.933	≥0.90	J. F. Hair et al. (2009)
CFI	0.951	>0.90	Fornell & Larcker (1981b)
RMR	0.032	≤0.10	Fidell et al. (2013)
RMSEA	0.057	<0.08	J. F. Hair et al. (2009)

To test the hypotheses, we conducted a path analysis. Figure 3 depicts the results of the analysis, and Table 6 shows the results of the direct, indirect and total effects among the variables. The results of the analysis indicated that perceived usefulness (β = .259, p < 0.01), social presence (β =.236, p < 0.01), and social influence (β = .442, p < 0.01) positively affect online proctoring acceptance. Therefore, H2, H3c and H5b were supported. Perceived ease of use (β = .253, p < 0.01), social presence (β =.240, p < 0.01) and social influence (β = .462, p < 0.01) positively influenced perceived usefulness. Therefore, H1a, H3b and H5a were supported. Social presence (β = .604, p < 0.01) positively influenced perceived ease of use, and H3a was supported. However, perceived ease of use (β =-.168, p < 0.01) negatively influenced online proctoring acceptance and place presence (β = .084, p = 0.16) had no effect on online proctoring acceptance. Therefore, H1b and H4 were not supported. Overall, the structural model explained 36.5% of perceived ease of use, 69.2% of perceived usefulness and 72.8% of online proctoring acceptance.

To further examine the mediating role of perceived usefulness, the meditation test of indirect effects by performing bootstrapping indicated that the effects of social presence (β = .062, 95% CI = .025 to .117) and social influence (β = .120, 95% CI = .057 to .214) on online proctoring acceptance through perceived usefulness were significant.

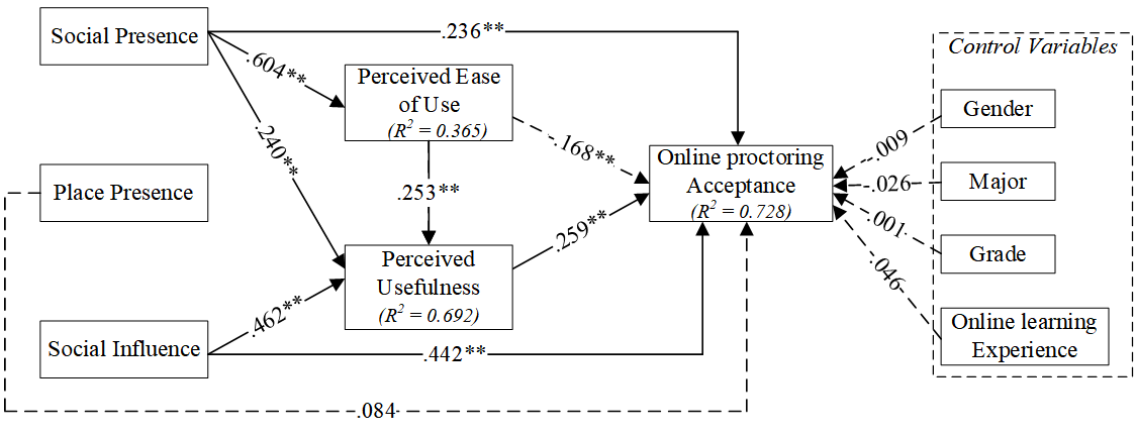

Figure 3. Results of hypotheses test (n = 760) (*p < 0.05, **p < 0.01, ***p < 0.001)

Table 6
*Results of hypotheses test (n = 760) (*p < 0.05, **p < 0.01, ***p < 0.001)*

Hypotheses		Standardised (β)			Supported
		Direct effect	Indirect effect	Total effect	
H1a	Perceived ease of use—>Perceived usefulness	.253**	-	.253**	Yes
H1b	Perceived ease of use—>Online proctoring acceptance	-.168**	.065**	-.102**	No
H2	Perceived usefulness—>Online proctoring acceptance	.259**	-	.259**	Yes
H3a	Social presence—>Perceived ease of use	.604**	-	.604**	Yes
H3b	Social presence—>Perceived usefulness	.240**	.153**	.392**	Yes
H3c	Social presence—>Online proctoring acceptance	.236**	.001**	.237**	Yes
H4	Place presence—>Online proctoring acceptance	.084	-	.084	No
H5a	Social influence—>Perceived usefulness	.462**	-	.462**	Yes
H5b	Social influence—>Online proctoring acceptance	.442**	.120**	.561**	Yes

Discussion

This study aimed to investigate the potential factors of students' online proctoring acceptance. We proposed a conceptual model to study the influencing factors from technology perception, presence, and social influence of online proctoring from the student's perspective. The whole model is significant in explaining online proctoring acceptance.

Regarding the technological context, surprisingly, the results showed that perceived ease of use related to technical operation did not significantly and positively affect online proctoring acceptance. Although this finding is in contradiction with previous studies, it may be explained by familiarity with the technical requirements of online proctoring. In this study, the main technical support required for online proctoring was a reliable Internet connection, and the students surveyed generally agreed that "the device and network requirements for online proctoring can be easily reached" (M = 3.76) and "it is easy to become proficient in using the platform for online proctoring" (M = 3.77). With access to a fast and stable Internet connection and technical support already, students may not be overly concerned with the perceived technical features in online proctoring, but rather focus primarily on the answering process in exams. This suggests that in online proctoring where the technological requirements are low or easily met, students' perceptions of technological ease of use do not affect students' online proctoring acceptance. Similarly, Wu and Chen (2017) found no significant association between perceived ease of use and attitudes in examining MOOC continuance intention, and attributed the results to the ease of use of the MOOC, as each MOOC platform is accessible through a web browser. Also, the results revealed that perceived usefulness was an important predictor of online proctoring acceptance. Previous studies have also emphasised the convenience and completeness of online proctoring as an important motivation for choosing online proctoring (James, 2016; Milone et al., 2017). Overall, online proctoring is a good solution to the challenge of being unable to take traditional offline exams during an epidemic, it reduces the additional time and physical effort for students to take the exam and provides a more flexible and convenient exam experience.

Our findings also showed that social presence had a significantly positive effect on perceived ease of use, perceived usefulness, and online proctoring acceptance. This is consistent with the study of Ogonowski et al. (2014) that higher social presence increased users' usefulness and trust in a system when they first used it. In summative assessment in higher education, the transition from traditional offline proctoring to online proctoring was in the early phase. Students may be more accustomed to being connected with teachers and classmates at a close psychological and physical distance. Social presence theory emphasises

the influence of social presence on the level of interaction and frequency of use in computer-mediated communication (Huang et al., 2012). Therefore, when seeing familiar teachers and classmates on the screen in online proctoring, students with higher social presence would have stronger persistence on online proctoring use. This suggests that online proctoring requires organisations to build a good group atmosphere. However, the results showed that place presence was not a significant predictor of online proctoring acceptance. In the study, online proctoring was a combination of online videoconference proctoring and offline paper-based or online question answering, so students were able to perceive that it is "not quite different from the regular classroom exam" (M = 3.25). However, there was no effect on online proctoring acceptance. This means that the degree to which students perceive a realistic experience with traditional offline exams does not affect students' use of online proctoring.

Regarding the social influence, the results revealed that social influence played the most important role in students' perceived usefulness and online proctoring acceptance, as it was the strongest predictor of perceived usefulness and online proctoring acceptance. This suggests that social recognition and support for online proctoring are important for students' choice and use of online proctoring (Hossain et al., 2019; Olasina, 2019). The outbreak disrupted the normal state of learning and living, and online teaching was a good policy to help students complete their learning tasks successfully. Students appreciate the usefulness of online proctoring tools when they receive calls from organisations and positive remarks from teachers, the government and schools. Students valued the opinions of the government and schools, so they were motivated to accept and use online proctoring tools in exams by the requirements and organisations of the government and school. In addition, students' initial decision to use online proctoring tools depended largely on the opinion of the government and the school.

The finding did not observe any significant effects of gender, major, grade, or online learning experience on the acceptance of online proctoring as control variables. This could be attributed to the fact that after a period of online home learning during covid pandemic, students with diverse demographic backgrounds have accustomed to the home learning environment. Furthermore, the examination procedure for live proctoring in the study is relatively straightforward and comprehensible, with identity verification and device debugging requiring minimal technical knowledge from students. Consequently, there are no significant barriers for students with varying professional backgrounds and online learning experiences to accept the online proctoring exam format.

Research implications

This study has several important research implications. From a theoretical perspective, this study introduces an extended TAM on innovation adoption to explain the motivations and concerns of online proctoring acceptance. This allowed us to better understand how the technology perception, presence, and social influence of online proctoring affect students' attitudes towards and use of online proctoring. At the same time, this study is one of the few studies on online proctoring acceptance, especially when the epidemic brought more opportunities for online proctoring. We hope that our study will provide a corresponding pre-study basis for subsequent studies and will be valuable for the future development of online proctoring standardisation.

From a practical perspective, the findings provide practical implications for online proctoring providers and organisers to improve the online proctoring environment. They can focus on the technology perception, presence and social influence of online proctoring because they have a significant effect on students' online proctoring acceptance. Among the technological characteristics, the significant effect of perceived usefulness on online proctoring acceptance provides important insights for online proctoring developers. Developers should focus on the substantive usefulness and value of online proctoring. When designing online proctoring, developers can focus on the key role of information technology, such as deep learning (Ahmad et al., 2021) and artificial intelligence (Nigam et al., 2021), to improve online proctoring functions and services. Among the perceived presences, the significant positive effect of social presence on perceived ease of use, perceived usefulness and online proctoring acceptance indicates the importance of a good group atmosphere. Online proctoring organisers can create diverse interaction channels and a trusting group atmosphere in exams, thus enhancing students' experience and willingness

to use it. The study shows that social influence is the most important influencing factor. This suggests the critical role of government policy and school organisation in the implementation of online proctoring. Educational institutions and schools can facilitate the change from traditional exams to online exams and increase opportunities for online proctoring development. Online learning institutions and university teachers can also adopt online proctoring as one of the ways of summative assessment of courses.

Limitations and future work

There are some limitations of this study. First, the sample of the study was only from China. Because online proctoring has developed differently in different countries, students' experiences with online proctoring may also differ. The results also need to consider the influence of the online proctoring development and cultural background. Second, this study was conducted in the specific context of emergency measures in response to a major health and safety event. The factors influencing the future development of online proctoring will have to be further refined. Also, although the variance explaining student online proctoring acceptance in this study was high, there were other variables we did not consider, such as cheating and privacy. Future research could include these variables to extend the model.

In this study, perceived ease of use in technical characteristics did not significantly and positively affect online proctoring acceptance as we hypothesised, which may be explained by the low technology requirements of the online proctoring. For the future development of online proctoring systems, subsequent research needs to clarify the impact of the technological characteristics of online proctoring on students' willingness to use it in combination with the types and functions of online proctoring, so as to build a more comprehensive research model.

Author contributions

Xinyu Jiang: Conceptualisation, Data analysis, Writing – original draft, review and editing; Tiong-Thye Goh: Formal analysis, Writing – review and editing; Xinran Chen: Writing-polishing and editing; Mengjun Liu: Conceptualisation, Data collection and analysis, Writing – review and editing; Bing Yang: Writing – review and editing.

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References

Ahmad, I., AlQurashi, F., Abozinadah, E., & Mehmood, R. (2021). A novel deep learning-based online proctoring system using face recognition, eye blinking, and object detection techniques. *International Journal of Advanced Computer Science and Applications*, *12*(10), 847–854. https://doi.org/10.14569/IJACSA.2021.0121094

Al-Adwan, A. S. (2020). Investigating the drivers and barriers to MOOCs adoption: The perspective of TAM. *Education and Information Technologies*, *25*(6), 5771–5795. https://doi.org/10.1007/s10639-020-10250-z

Alessio, H. M., Malay, N., Maurer, K., Bailer, A. J., & Rubin, B. (2017). Examining the effect of proctoring on online test scores. *Online Learning*, *21*(1), 146–161. https://doi.org/10.24059/olj.v21i1.885

Atoum, Y., Chen, L., Liu, A. X., Hsu, S. D. H., & Liu, X. (2017). Automated online exam proctoring. *IEEE Transactions on Multimedia*, *19*(7), 1609–1624. https://doi.org/10.1109/TMM.2017.2656064

Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science*, *16*(1), 74–94. https://doi.org/10.1007/BF02723327

Baki, R., Birgoren, B., & Aktepe, A. (2018). A meta analysis of factors affecting perceived usefulness and perceived ease of use in the adoption of e-learning systems. *Turkish Online Journal of Distance Education*, *19*, 4–42. https://doi.org/10.17718/tojde.471649

Bodzin, A., Junior, R. A., Hammond, T., & Anastasio, D. (2021). Investigating engagement and flow with a placed-based immersive virtual reality game. *Journal of Science Education and Technology*, *30*(3), 347–360. https://doi.org/10.1007/s10956-020-09870-4

Bulu, S. T. (2012). Place presence, social presence, co-presence, and satisfaction in virtual worlds. *Computers & Education*, *58*(1), 154–161. https://doi.org/10.1016/j.compedu.2011.08.024

Burgess, S., & Sievertsen, H. H. (2020, April 1). *Schools, skills, and learning: The impact of COVID-19 on education*. https://voxeu.org/article/impact-covid-19-education

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. *Modern Methods for Business Research*, *295*(2), 295–336.

Cho, V., Cheng, T. C. E., & Lai, W. M. J. (2009). The role of perceived user-interface design in continued usage intention of self-paced e-learning tools. *Computers & Education*, *53*(2), 216–227. https://doi.org/10.1016/j.compedu.2009.01.014

Chua, S. S., Bondad, J. B., Lumapas, Z. R., & Garcia, J. D. L. (2019). Online examination system with cheating prevention using question bank randomization and tab locking. In *Proceedings of the 4th International Conference on Information Technology* (pp. 126–131). Institute of Electrical and Electronic Engineers, Inc. https://doi.org/10.1109/INCIT.2019.8912065

Coghlan, S., Miller, T., & Paterson, J. (2021). Good proctor or "big brother"? Ethics of online exam supervision technologies. *Philosophy & Technology*, *34*(4), 1581–1606. https://doi.org/10.1007/s13347-021-00476-1

Conijn, R., Kleingeld, A., Matzat, U., & Snijders, C. (2022). The fear of big brother: The potential negative side-effects of proctored exams. *Journal of Computer Assisted Learning*, *38*(6), 1521–1534. https://doi.org/10.1111/jcal.12651

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science*, *35*(8), 982–1003. https://doi.org/10.1287/mnsc.35.8.982

Doo, M. Y., & Bonk, C. J. (2020). The effects of self-efficacy,self-regulationand social presence on learning engagement in a large university class using flipped Learning. *Journal of Computer Assisted Learning*, *36*(6), 997–1010. https://doi.org/10.1111/jcal.12455

Eraslan Yalcin, M., & Kutlu, B. (2019). Examination of students' acceptance of and intention to use learning management systems using extended TAM. *British Journal of Educational Technology*, *50*(5), 2414–2432. https://doi.org/10.1111/bjet.12798

Esteban-Millat, I., Martínez-López, F. J., Pujol-Jover, M., Gázquez-Abad, J. C., & Alegret, A. (2018). An extension of the technology acceptance model for online learning environments. *Interactive Learning Environments*, *26*(7), 895–910. https://doi.org/10.1080/10494820.2017.1421560

Fidell, S., Tabachnick, B., Mestre, V., & Fidell, L. (2013). Aircraft noise-induced awakenings are more reasonably predicted from relative than from absolute sound exposure levels. *Journal of the Acoustical Society of America*, *134*(5), 3645–3653. https://doi.org/10.1121/1.4823838

Fornell, C., & Larcker, D. F. (1981a). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, *18*(1), 39–50. https://doi.org/10.1177/002224378101800104

Fornell, C., & Larcker, D. F. (1981b). Structural equation models with unobservable variables and measurement error: Algebra and statistics. *Journal of Marketing Research*, *18*(3), 382–388. https://doi.org/10.2307/3150980

González-González, C. S., Infante-Moro, A., & Infante-Moro, J. C. (2020). Implementation of e-proctoring in online teaching: A study about motivational factors. *Sustainability*, *12*(8), Article 3488. https://www.mdpi.com/2071-1050/12/8/3488

Grace, J. B., Schoolmaster, D. R., Guntenspergen, G. R., Little, A. M., Mitchell, B. R., Miller, K. M., & Schweiger, E. W. (2012). Guidelines for a graph-theoretic implementation of structural equation modeling. *Ecosphere*, *3*(8), Article 73. https://doi.org/10.1890/es12-00048.1

Hair, J., Hollingsworth, C. L., Randolph, A. B., & Chong, A. Y. L. (2017). An updated and expanded assessment of PLS-SEM in information systems research. *Industrial Management & Data Systems*, *117*(3), 442–458. https://doi.org/10.1108/IMDS-04-2016-0130

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2009). *Multivariate data analysis*. Prentice Hall.

Hossain, A., Quaresma, R., & Rahman, H. (2019). Investigating factors influencing the physicians' adoption of electronic health record (EHR) in healthcare system of Bangladesh: An empirical study. *International Journal of Information Management*, *44*, 76–87. https://doi.org/10.1016/j.ijinfomgt.2018.09.016

Hsi-Peng Lu, M. J. C. (2010). The impact of individual differences on e-learning system satisfaction: A contingency approach. *British Journal of Educational Technology*, *41*(2), 307–323. https://doi.org/10.1111/j.1467-8535.2009.00937.x

Hsu, J.-Y., Chen, C.-C., & Ting, P.-F. (2018). Understanding MOOC continuance: An empirical examination of social support theory. *Interactive Learning Environments*, *26*(8), 1100–1118. https://doi.org/10.1080/10494820.2018.1446990

Huang, M.-S., Hsiao, W.-H., Chang, T.-S., & Hu, M.-H. (2012). Design and implementation of a cooperative learning system for digital content design curriculum: Investigation on learning effectiveness and social presence. *Turkish Online Journal of Educational Technology*, *11*(4), 94–107. http://www.tojet.net/articles/v11i4/1149.pdf

Hussein, M. J., Yusuf, J., Deb, A. S., Fong, L., & Naidu, S. (2020). An evaluation of online proctoring tools. *Open Praxis*, *12*(4), 509–525. https://doi.org/10.5944/openpraxis.12.4.111

Hylton, K., Levy, Y., & Dringus, L. P. (2016). Utilizing webcam-based proctoring to deter misconduct in online exams. *Computers & Education*, *92-93*, 53–63. https://doi.org/10.1016/j.compedu.2015.10.002

James, R. (2016). Tertiary student attitudes to invigilated, online summative examinations. *International Journal of Educational Technology in Higher Education*, *13*(1), Article 19. https://doi.org/10.1186/s41239-016-0015-0

Jia, J., & He, Y. (2022). The design, implementation and pilot application of an intelligent online proctoring system for online exams. *Interactive Technology and Smart Education*, *19*(1), 112–120. https://doi.org/10.1108/ITSE-12-2020-0246

Kharbat, F. F., & Abu Daabes, A. S. (2021). E-proctored exams during the COVID-19 pandemic: A close understanding. *Education and Information Technologies*, *26*(6), 6589–6605. https://doi.org/10.1007/s10639-021-10458-7

King, W. R., & He, J. (2006). A meta-analysis of the technology acceptance model. *Information & Management*, *43*(6), 740–755. https://doi.org/10.1016/j.im.2006.05.003

Kline, R. B. (2011). Principles and practice of structural equation modeling. Guilford Press.

Konstantinidou, A., & Nisiforou, E. (2022). Assuring the quality of online learning in higher education: Adaptations in design and implementation. *Australasian Journal of Educational Technology*, *38*(4), 127–142. https://doi.org/10.14742/ajet.7910

Kubiatko, M. (2017). Are ICT being used correctly? Small reflection about correct using of ICT in education. *Problems of Education in the 21st Century*, *75*, 4–5. https://doi.org/10.33225/pec/17.75.04

Labayen, M., Vea, R., Flórez, J., Aginako, N., & Sierra, B. (2021). Online student authentication and proctoring system based on multimodal biometrics technology. *IEEE Access*, *9*, 72398–72411. https://doi.org/10.1109/ACCESS.2021.3079375

Lim, J. R. N., Rosenthal, S., Sim, Y. J. M., Lim, Z.-Y., & Oh, K. R. (2021). Making online learning more satisfying: the effects of online-learning self-efficacy, social presence and content structure. *Technology, Pedagogy and Education*, *30*(4), 543–556. https://doi.org/10.1080/1475939X.2021.1934102

Lin, W.-S., & Wang, C.-H. (2012). Antecedences to continued intentions of adopting e-learning system in blended learning instruction: A contingency framework based on models of information system success and task-technology fit. *Computers & Education*, *58*(1), 88–99. https://doi.org/10.1016/j.compedu.2011.07.008

Lombard, M., Lee, S., Sun, W., Xu, K., & Yang, H. (2017). Presence theory. In P. Rössler (Ed.), *The international encyclopedia of media effects* (pp. 1–13). Wiley. https://doi.org/10.1002/9781118783764.wbieme0087

Luo, N., Zhang, Y., & Zhang, M. (2019). Retaining learners by establishing harmonious relationships in e–learning environment. *Interactive Learning Environments*, *27*(1), 118–131. https://doi.org/10.1080/10494820.2018.1506811

Mailizar, M., Burg, D., & Maulina, S. (2021). Examining university students' behavioural intention to use e-learning during the COVID-19 pandemic: An extended TAM model. *Education and Information Technologies*, *26*(6), 7057–7077. https://doi.org/10.1007/s10639-021-10557-5

Marković, M., Pavlović, D., & Mamutović, A. (2021). Students' experiences and acceptance of emergency online learning due to COVID-19. *Australasian Journal of Educational Technology*, *37*(5), 1–16. https://doi.org/10.14742/ajet.7138

Milone, A. S., Cortese, A. M., Balestrieri, R. L., & Pittenger, A. L. (2017). The impact of proctored online exams on the educational experience. *Currents in Pharmacy Teaching and Learning*, *9*(1), 108–114. https://doi.org/10.1016/j.cptl.2016.08.037

Ministry of Education. (2020, February 12). 教育部办公厅 工业和信息化部办公厅关于中小学延期开学期间“停课不停学”有关工作安排的通知 [Notice on the work arrangement of "Suspending classes without stopping learning" during the delayed start of primary and secondary schools]. http://www.moe.gov.cn/srcsite/A06/s3321/202002/t20200212_420435.html

Morris, M. G., & Venkatesh, V. (2000). Age differences in technology adoption decisions: Implications for a changing work force. *Personnel Psychology*, *53*(2), 375–403. https://doi.org/10.1111/j.1744-6570.2000.tb00206.x

Nigam, A., Pasricha, R., Singh, T., & Churi, P. (2021). A systematic review on AI-based proctoring systems: Past, present and future. *Education and Information Technologies*, *26*(5), 6421–6445. https://doi.org/10.1007/s10639-021-10597-x

Ogonowski, A., Montandon, A., Botha, E., & Reyneke, M. (2014). Should new online stores invest in social presence elements? The effect of social presence on initial trust formation. *Journal of Retailing and Consumer Services*, *21*(4), 482–491. https://doi.org/10.1016/j.jretconser.2014.03.004

Olasina, G. (2019). Human and social factors affecting the decision of students to accept e-learning. *Interactive Learning Environments*, *27*(3), 363–376. https://doi.org/10.1080/10494820.2018.1474233

Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, *88*(5), 879–903. https://doi.org/10.1037/0021-9010.88.5.879

Raman, R., B, S., G, V., Vachharajani, H., & Nedungadi, P. (2021). Adoption of online proctored examinations by university students during COVID-19: Innovation diffusion study. *Education and Information Technologies*, *26*(6), 7339–7358. https://doi.org/10.1007/s10639-021-10581-5

Salimon, M. G., Sanuri, S. M. M., Aliyu, O. A., Perumal, S., & Yusr, M. M. (2021). E-learning satisfaction and retention: A concurrent perspective of cognitive absorption, perceived social presence and technology acceptance model. *Journal of Systems and Information Technology*, *23*(1), 109–129. https://doi.org/10.1108/JSIT-02-2020-0029

Sefcik, L., Veeran-Colton, T., Baird, M., Price, C., & Steyn, S. (2022). An examination of student user experience (UX) and perceptions of remote invigilation during online assessment. *Australasian Journal of Educational Technology*, *38*(2), 49–69. https://doi.org/10.14742/ajet.6871

Selwyn, N., O'Neill, C., Smith, G., Andrejevic, M., & Gu, X. (2021). A necessary evil? The rise of online exam proctoring in Australian universities. *Media International Australia*. https://doi.org/10.1177/1329878X211005862

Shea, P., & Bidjerano, T. (2010). Learning presence: Towards a theory of self-efficacy, self-regulation, and the development of a communities of inquiry in online and blended learning environments. *Computers & Education*, *55*(4), 1721–1731. https://doi.org/10.1016/j.compedu.2010.07.017

Sheridan, & Thomas, B. (1992). Musings on telepresence and virtual presence. *Presence Teleoperators & Virtual Environments*, *1*(1), 120–125.

Short, J., Williams, E., & Christie, B. (1976). *The social psychology of telecommunications*. Wiley.

Simone, A., Alessandra, G., Marco, T., Aristide, S., & Pierpaolo, V. (2021). State-of-the-art of commercial proctoring systems and their use in academic online exams. *International Journal of Distance Education Technologies*, *19*(2), 55–76. https://doi.org/10.4018/IJDET.20210401.oa3

Slater, M., Steed, A., McCarthy, J., & Maringelli, F. (2016). The influence of body movement on subjective presence in virtual environments. *Human Factors: The Journal of the Human Factors & Ergonomics Society*, *40*(3), 469–477. https://doi.org/10.1518/001872098779591368

Slusky, L. (2020). Cybersecurity of online proctoring systems. *Journal of International Technology and Information Management*, *29*(1), 56–83. https://doi.org/10.58729/1941-6679.144

Sun, H., & Zhang, P. (2006). The role of moderating factors in user technology acceptance. *International Journal of Human-Computer Studies*, *64*(2), 53–78. https://doi.org/10.1016/j.ijhcs.2005.04.013

Tarhini, A., Hone, K., & Liu, X. (2014). Measuring the moderating effect of gender and age on e-learning acceptance in England: A structural equation modeling approach for an extended technology acceptance model. *Journal of Educational Computing Research*, *51*(2), 163–184. https://doi.org/10.2190/EC.51.2.b

Van Liere, K. D. (1978). [Review of the book *The end of progress: Adjusting to a no-growth economy*, by Edward F. Renshaw]. *Contemporary Sociology*, *7*(1), 30–32. https://doi.org/10.2307/2065897

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*(3), 425–478. https://doi.org/10.2307/30036540

Williams, L. J., Ford, L. R., & Nguyen, N. (2004). Basic and advanced measurement models for confirmatory factor analysis. In S. G. Roselberg (Ed.), *Handbook of research methods in industrial and organizational psychology* (pp. 366–389). https://doi.org/10.1002/9780470756669.ch18

Witmer, B. G., & Singer, M. J. (1998). Measuring presence in virtual environments: A presence questionnaire. *Presence Teleoperators & Virtual Environments*, *7*(3), 225–240. https://doi.org/10.1162/105474698565686

Wu, B., & Chen, X. (2017). Continuance intention to use MOOCs: Integrating the technology acceptance model (TAM) and task technology fit (TTF) model. *Computers in Human Behavior*, *67*, 221–232. https://doi.org/10.1016/j.chb.2016.10.028

Yildirim, D., & Usluel, Y. (2022). Interrelated analysis of interaction, sequential patterns and academic achievement in online learning. *Australasian Journal of Educational Technology*, *38*(2), 181–200. https://doi.org/10.14742/ajet.7360

Zainab, A. M., Kiran, K., Karim, N. H. A., & Sukmawati, M. (2018). UTAUT'S performance consistency: Empirical evidence from a library management system. *Malaysian Journal of Library & Information Science*, *23*(1), 17–32. https://doi.org/10.22452/mjlis.vol23no1.2

Zuo, M., Hu, Y., Luo, H., Ouyang, H., & Zhang, Y. (2021). K-12 students' online learning motivation in China: An integrated model based on community of inquiry and technology acceptance theory. *Education and Information Technologies*. https://doi.org/10.1007/s10639-021-10791-x

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