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Identifying factors influencing study skills engagement and participation for online learners in higher education during COVID-19

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Abstract

The COVID-19 pandemic disrupted education across the world as campuses closed to restrict the spread of the virus. UK universities swiftly migrated to online delivery. The experiences of students and staff during this transition can inform our return to campus and our ability to deal with future disruption. This study draws on Moore's theory of transactional distance to understand factors influencing student study skills engagement and participation in online learning during this period. We surveyed students ($n = 178$) in a computing school at a UK university. A partial least squares (PLS) analysis was used to explore the influence of transactional distance (between students/teachers and between students/students), access to e-learning capital, and perceived usefulness on two measures: study skills engagement and participation in online collaborative activity. Results show that transactional distance influences participation, and e-learning capital influences study skills engagement. Our findings suggest that if universities continue with aspects of online learning for previously on-campus students they should provide access to

infrastructure and training on utilising the online eco-system to avoid disadvantaging students. Further investment in students' e-learning capital, such as signposting and adapting existing resources, is also necessary to support this key influence in study skills engagement.

Practitioner notes

What is already known about this topic
- Moore's transactional distance theory recognises that the significant distance of distance learning is not of time or place, but rather a communication and psychological distance between the learner and teacher that is affected by the structure of the course, the dialogue between the learner and teacher, and the autonomy of the learners. Transactional distance affects student engagement.
- Studies using Davis' technology acceptance model have found perceived usefulness of the virtual learning environment to be an important factor in student engagement with online learning.
- Computer self-efficacy is a factor related to engagement with digital learning technologies.

What this paper adds
- This study identifies the relationship between factors of transactional distance (transactional distance between student and teacher TDST and transactional distance between students TDSS) with study skills engagement and participation, as mediated by perceived usefulness.
- We introduce the term *e-learning capital* as a measure of self-expressed ability (skills and resources) to utilise the online learning environment. This e-learning capital influences students study skills engagement but not participation.
- Transactional distance between students and teacher did not directly affect study skills engagement or participation.
- Low student-student transactional distance positively affects participation in online activities and this relationship is mediated by perceived usefulness of these activities.

Implications for practice and/or policy
- Universities should draw on this study's findings in order to focus on students' online study skills engagement and participation for any future online or hybrid online and face-to-face learning.
- Further investment in students' e-learning capital is necessary as a key influence in study skills engagement and this should be reflected in university policies.
- Lecturers should direct efforts to signposting the value of participation and academic advisors should reframe practical advice relating to study skills for online learners.
- This cohort effect of student-student transactions should be encouraged further in online learning activities, including facilitating sharing study approaches.

INTRODUCTION

In 2020, most teaching moved online as a result of the COVID-19 pandemic causing campus closures. Across higher education, academic staff and students in most countries were quickly required to adopt online learning and assessment. Universities found themselves under pressure to ensure that students remained engaged with their learning and achieved equivalence in both learning and assessment results. Some universities and academics were better prepared than others, due to prior experience of online and blended learning and ready access to online learning platforms.

Many recent improvements in our understanding of how best to design and run online courses stem from Moore's theory of transactional distance (Moore, 1993). Moore's theory recognises that the significant distance of distance learning is not of time or place, but rather a communication and psychological distance between the learner and teacher that is affected by (i) the structure of the course, (ii) the dialogue between learner and teacher, and (iii) the autonomy of the learners. This communication and psychological distance is termed transactional distance (TD). Moore's theory has proved useful in providing an overarching view of key components of distance and online education and has been taken up and extended by researchers, as online learning experienced growth in both numbers of learners and in online technology to facilitate distance/online learning. In this study, we use Moore's theory to understand higher education students' engagement with study skills and participation in online learning discussions during the pandemic.

The COVID-19 context

The transition to a new learning environment presented technical and pedagogical challenges and called for both lecturers and students to re-orient themselves in this new learning ecosystem. Some early studies exploring online learning as part of the response to the global pandemic have been published, showing a mixed picture. Kostaki and Karayianni (2021) explored student engagement in online courses during the pandemic to find an unsurprising negative correlation with technical difficulties. Garris and Fleck (2020) surveyed students across the US to ask them to provide an evaluation of one of their online courses. Following the transition to online learning, their survey participants found the online courses less interesting, instilled less learning, held their attention less and motivated less effort. The shift in learning spaces has also highlighted the issue of digital inequality and access to technology (Office for Students, 2020). Notably, the digital divide is not a simple dichotomy of those who have access to technology and those who have not, because access to technology is not the same as being able to use technology effectively (Selwyn, 2004). It is thus important to investigate how the differences in factors relating to access and use of technology interact with student engagement in the learning environment. As yet, there are no studies specifically relating to the relationships between online experiences (including ability with online learning tools, teacher-student dialogue, student-student dialogue and perceived usefulness of the online learning approaches) and student self-study skills engagement and student participation. The purpose of this study was to learn about student engagement and its relationship with transactional distance by means of partial least squares—structural equation modelling (PLS-SEM). By gaining a better understanding of student study skills engagement and participation during the necessary migration to online learning in a higher education setting, we can make recommendations for teaching practice for online learners and for students returning to campus, if aspects of online learning are subsequently incorporated. As such, the literature review focuses on these dimensions.

Researching student experience of online learning during COVID-19

Moore's theory of transactional distance has previously been highly influential in understanding the nature of distance and online learning, providing a descriptive (rather than predictive) theory (Delgaty, 2018). Moore (1989) identified three forms of transactional interaction affecting transactional distance (student–teacher interaction TDST, student–content interaction TDSC and student–student interaction TDSS). As technology in computer-supported cooperative work has improved, student-technology interactions have increasingly become a feature of online learning through, for example, accessing online materials, supporting group discussions and assignments. Previous studies found that learning technology mediates these transactional interactions and consequently affects student satisfaction (Chen, 2001; Jung, 2001; Weidlich & Bastiaens, 2018).

Many studies on effectiveness of online learning draw on Moore's theory of transactional distance to locate the relationship between course design and delivery on the one hand, and student learning outcomes on the other (Cheawjindakarn et al., 2013; Ekwunife-Orakwue & Teng, 2014; Rajabalee et al., 2020). Factors of success include high levels of student engagement, well-organised content and access to appropriate technology.

However, it has also been argued that the theory of transactional distance is unable to correlate transactional distance per se with the achievement of learning outcomes (for example, Gorsky & Caspi, 2005). Indeed, *student engagement* is more commonly used to measure the effectiveness of online learning (for example, Dixson, 2015; Weidlich & Bastiaens, 2018). Handelsman et al. (2005) identified four factors of student engagement: study skills engagement, which includes the general learning strategies that students use; participation, which represents student engagement through interaction with instructors and other students; emotional engagement, which characterises students' emotional involvement with the course; and performance, which links to grades. Dixson (2015) developed the online student engagement (OSE) based on the four factors identified by Handelsmann et al. by identifying the equivalent actions for these factors in an online environment. This study focussed on: study skills engagement and participation. Two aspects of student engagement used previously (emotional engagement and performance) were not part of this study. While emotional engagement has been linked to having an interest in a course and levels of interest are positively linked to high levels of student engagement (Bates & Khasawneh, 2007; Dembo et al., 2006), the move to online learning was a necessity, not a student preference. In the current study, learners' assignment grades were not available, nor had they any option but to transition to online learning. Because of the enforced pivot to online learning and teaching precipitated by the pandemic, previous models used to study online learning engagement did not apply in their entirety, leading to the PLS-SEM approach taken to test a new model.

Another well-established approach to understanding online engagement has centred on the adoption of online technology including virtual learning environments (VLEs) that support cooperative learning, online classes, voting systems and other learning technologies. Such studies have used the technology acceptance model (TAM) and its subsequent versions (Davis, 1989; Venkatesh et al., 2003) to predict learner acceptance of VLEs. TAM presents a causal chain of belief-attitude-intention-behaviour, developed from theories of reasoned action and planned behaviour, to predict actual use of a technology (in this case, the platforms providing online learning) (Ajzen, 1991; Fishbein & Ajzen, 1975). The TAM has evolved over time; for example, Venkatesh et al.'s (2003) unified theory of acceptance and use of technology (UTAUT) added social influence and facilitating conditions (such as user belief of support available) as factors that affect user intention to use technology and subsequent usage behaviour. Tao (2009) found that learning resources perceived to be useful will be used (rather than due to ease of use of the technology). This study set out to explore whether transactions (TDST and TDSS) hosted by the technology were perceived to

be useful, and its subsequent impact on student engagement (study skills engagement and participation). The current study draws on both the theory of transactional distance and TAM to explore students' experiences of online learning precipitated by the COVID-19 pandemic in a large computer science department of a UK university.

RESEARCH MODEL AND HYPOTHESES

Using PLS-SEM, which is useful for exploring extensions of established theories (Hair et al., 2019), this study explores the relationships between factors of transactional distance and factors of student engagement, as well as the contributing role of perceived usefulness in these relationships. Previous studies have found that student-teacher interactions and student-student interactions affect students' learning outcomes and their perceptions of the learning environment (Ekwunife-Orakwue & Teng, 2014; Swan, 2010). Student-student and student-teacher interactions are factors of transactional distance (Paul et al., 2015). Bolliger and Halupa's (2018) study with online distance learning students found a linear correlation between the perception of transactional distance and student engagement. In Bolliger and Halupa's study, transactional distance was the combined factors of TDSS, TDST and TDSC, whereas engagement was the combined factors of skills, participation, performance and emotional engagement, based on Dixson's online student engagement (OSE) (Dixson, 2015). To understand how the distinct factors interact, this study expands this work by decomposing the factors of transactional distance and engagement. In addition, changes in the model were introduced to fit the current climate. We did not measure students' TDSC: as courses took different approaches to their delivery during the emergency transition to online learning: it would be difficult for a student to evaluate overall programme content when one course experience was different from another. The focus was on students' behavioural engagement with their studies, so factors included from the original OSE were study skills engagement and participation, (Dixson, 2015). Factors omitted from the OSE were performance (as student grades were not available at the time of the study) and emotional engagement (as this transition to online learning was imposed, rather than as a result of choice). Instead, perceived usefulness (PU) was introduced to consider whether PU had a moderating effect on how students perceived transactional distance in an online learning environment, as had been found in previous studies (eg, Horzum, 2011). Theoretical justifications of the research model (see Figure 1) are discussed below.

E-learning capital

In this study, we introduce the term *e-learning capital* as a measure of self-expressed ability and resources to utilise the online learning environment, drawing on Ragnedda's (2018) definition of *digital capital*, which is the "accumulation of digital competencies and digital technology" (p. 2367). E-learning capital draws upon the construct of computer self-efficacy and facilitating conditions within the technology acceptance literature. Computer self-efficacy, which is the individual's self-judged ability to use technology, influences perceived usefulness of digital learning technologies and consequently student engagement with these technologies (Howard et al., 2016; Hsu et al., 2009; Teo & Zhou, 2014). UTAUT's facilitating conditions (FC), defined as the degree to which an individual believes that an organisational and technical infrastructure exists to support the use of the system (Venkatesh et al., 2003), influences student intention and consequent use of learning technologies (El-Masri & Tarhini, 2017; Indrawati & Has, 2016). Support in the form of access to technology resources was found to increases student engagement (Lynch & Kim, 2016; Phillips & Loch, 2011).
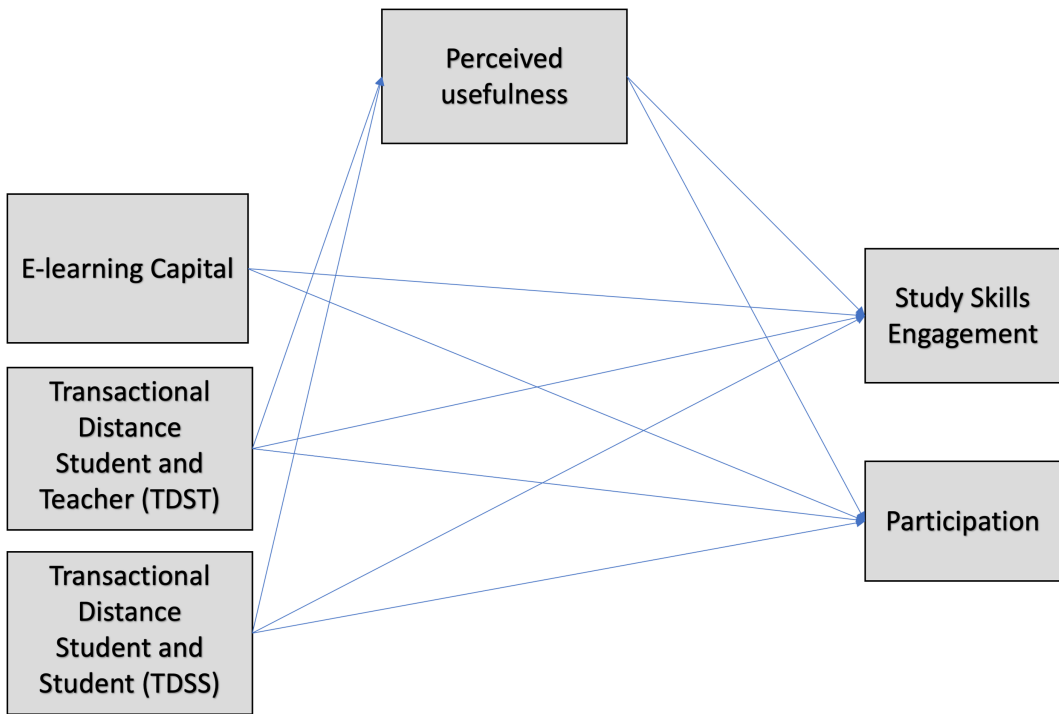
FIGURE 1 Research model

Summers et al.' (2022) comparison of pre-pandemic and peri-pandemic use of technology in a UK university identified that students from disadvantaged backgrounds were more active users of university and learning resources (like library books, pre-recorded videos) in comparison to those from non-disadvantaged backgrounds pre-pandemic. But this difference shifted during the pandemic, with students from disadvantaged backgrounds watching fewer pre-recorded lecturers. This suggests a probable link between access/or availability of resources and student engagement and its factors (skills engagement and participation).

In this study, we specifically conceive e-learning capital to refer to a students' ability to access and make use of the VLE and the resources within that ecosystem (digital competencies), as well as access to digital technology. As such, it combines aspects of both technology self-efficacy and technology availability. The ability to use the virtual environment influences student engagement, including study skills engagement (such as organisation of learning, study time management, etc.) (Bates & Khasawneh, 2007; Pellas, 2014). The availability of infrastructure influences use of (or participation in) e-learning systems (Lynch and Kim, 2016; Summers et al., 2022). Therefore, we hypothesise that:

H 1 *E-learning capital positively affects study skills engagement.*
H 2 *E-learning capital positively affects participation.*

Transactional distance between student and teacher

Student-teacher interaction is an important factor in delivering effective online learning. Within these interactions, the teacher aims to "seek to stimulate, or at least maintain students' interest in what is to be taught, to motivate the student to learn, to enhance and maintain the learner's interest, including self-direction and motivation" (Moore, 1989, p. 2). Students find

activities that facilitate communication between lecturers and students as the more important instructor practices in an online learning environment (Dennen et al., 2007). Low transactional distance between students and teachers (TDST), characterised by the availability of the teacher, including prompt responses to student questions (Weidlich & Bastiaens, 2018), is linked with positive outcomes for students (Ekwunife-Orakwue & Teng, 2014; Swan, 2010). Student-teacher interaction has been found to link to higher student engagement (Aldhafeeri & Alotaibi, 2022). The perception of support of e-learning and social bonds with the group (both lecturers and students) were linked to engagement and use of e-learning technologies (Chu & Chen, 2016). In a study of experiences of students in an online study skills subject, regular communication with lecturers was identified as a critical element in online learning (McDougall, 2019). Teacher prompts and reminders in an online learning environment were linked to improved study habits (Au, 2014). Drawing on models for technology acceptance, teacher interactions (such as feedback, clear communication of expectation and support) influence perceived usefulness of online learning (Lee et al., 2009; Shen et al., 2006). So, the following hypotheses are constructed:

H 3 *Low transactional distance between student and teachers positively affects perceived usefulness of the learning activities.*
H 4 *Low transactional distance between student and teachers positively affects student's skills engagement.*
H 5 *Low transactional distance between student and teachers positively affects student's participation in online learning activities.*

Transactional distance between students

A low TDSS is characterised by high quality dialogues that are perceived to support students in their learning. Interactions and relationships with other students have been widely found to predict students' engagement in a course (Richardson et al., 2017; Sun et al., 2019). As there are many approaches and technologies that offer a range of experiences relating to how such dialogue is facilitated, it is unsurprising that there are also studies that have found no strong link between TDSS and student satisfaction (for example, Weidlich & Bastiaens, 2018). Dialogue-facilitating learning technology has been found to be an important consideration in the perception of student-student dialogue (Falloon, 2011; Thoms & Eryilmaz, 2014). As such, it is likely that students will experience TDSS differently according to the context, the technology used and the way it is integrated into the online course.

From the field of learner technology acceptance, social influence (ie, others' attitudes to the learning technology) has a positive effect on perceived usefulness of e-learning systems (Abbas, 2016; Sabah, 2016), which consequently affects learning engagement and satisfaction (Chu & Chen, 2016; Weng et al., 2015). For example, teachers, peers and friends' opinions affect how students perceive the usefulness of the learning environment and so affect their engagement with online learning. In Tuckman's (2007) study, the inclusion of study skills support groups influenced students, particularly those with a high-tendency to procrastinate, to stay on task in their e-learning modules. Student-student dialogue can influence the emergence of communities of inquiry within which students construct knowledge (Benson & Samarawickrema, 2009). Such activity may influence perceptions of the usefulness of online learning activity. We formulated the following hypotheses:

H 6 *Low transactional distance between students positively affects perceived usefulness of the learning activities.*

H 7 *Low transactional distance between students positively affects student's study skills engagement.*

H 8 *Low transactional distance between students positively affects student's participation in online learning activities.*

Perceived usefulness

As discussed earlier, PU is widely used in technology acceptance studies to predict a be-havioural intention to use a technology (Davis, 1989). Perceived usefulness of e-learning is a key determinant of user acceptance and uptake of e-learning technologies. Many studies have linked learners' perceptions of usefulness of online learning to engagement with online learning (for example, Hassan & Nika, 2021; Sahin & Shelley, 2008) and PUs mediating role within the technology acceptance model (Huynh & Thi, 2014). How learn-ers perceive the usefulness of learning activities is linked with how they direct their strate-gies for learning (Liaw & Huang, 2013). For example, in Ellis and Calvo's (2006) study on how students use online discussion boards, students who perceive participation in online discussion boards as a useful strategy for learning engage with the activity in a more reflective way. In the current study, we are interested to determine whether PU affects two factors of engagement: study skills engagement and participation. We formulated the following:

H 9 *Perceived usefulness of the learning activities positively affect students' skills engagement.*

H 10 *Perceived usefulness of the learning activities positively affect students' participation in the online learning environment.*

We also hypothesise that the relationship between the transactional distance constructs (TDST and TDSS) and student engagement (ie, study skills engagement and participation) is mediated by how students perceive the usefulness of the learning activities.

H 11 *Low transactional distance between student and teachers positively affects student's skills engagement via usefulness.*

H 12 *Low transactional distance between student and teachers positively affects student's participation via usefulness.*

H 13 *Low transactional distance between students positively affects student's study skills engagement via usefulness.*

H 14 *Low transactional distance between students positively affects student's participation via usefulness.*

METHODOLOGY

Participants and procedure

An online survey was administered between November and December 2020. All under-graduate students within the school of computing were invited to complete the survey. A total of 260 responses were collected; however, some responses were excluded from the analysis. Students undertaking part-time studies ($n = 36$) and duplicate responses ($n = 11$) were excluded from the analysis. Finally, responses with significant number of missing re-sponses ($n = 35$) were also removed. This left a total of 178 survey responses used in the

analysis. Students included in this survey were taking a variety of computing degree programmes such as Digital Media, Computer Science and Software Development. None of these courses were delivered online before the pandemic, though course materials were made available in the Virtual Learning Environment. A summary of participant demographics is shown in Table 1. Note that there is a higher percentage of female respondents in the study in comparison to the school's population (18% female students). The "new students" category includes first year students and those who recently transferred to the university from another institution to continue their studies in second or third year.

Instruments and measures

The instrument used in this study was adapted from Zhang's revised transactional distance scale (RTDS) (Paul et al., 2015) and Dixson's (2015) online student engagement questionnaire, in addition to the constructs introduced by the researchers to measure e-learning capital and perceived usefulness of the learning activities. We used two subscales from Zhang's RTDS: TDSS and TDST. From Dixson's OSE, we used the items related to participation and skills engagement. We adapted Dixson's OSE to the context, changing the original response scale ranging from *not at all characteristic of me* to *very characteristic of me* to a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Students' previous strategies and approach to learning would likely have changed in this sudden transition and so the choice of whether a description is characteristic of them or not in the current environment would not necessarily apply. The e-learning capital items included five questions related to students' ability and resources to access the online learning environment and were also rated on a five-point Likert scale ranging from 1 (inadequate) to 5 (very good). The usefulness scale included four strategies typically employed by lecturers to promote course participation and engagement online and

TABLE 1 Summary of participant demographic characteristics

Demographic characteristic	*N* = 178	Percentage (%)
Gender		
Female	55	30.90
Male	117	65.73
Other	6	3.37
Year level		
First year	30	16.85
Second year	32	17.98
Third year	66	37.08
Fourth/fifth year	50	28.09
Age group		
Below 20	59	33.15
21–24	59	33.15
25 and above	60	33.71
Enrolment		
New	75	42.13
Returning	103	57.87

were also rated on a five-point Likert scale ranging from 1 (not useful at all) to 5 (very useful). In all these subscales, the middle point (3) represents a neutral response. The full instrument was assessed by the lecturers and researchers for face validity. Reliability and construct validity of the construct of the instrument were assessed as part of the measurement model of PLS-SEM and is shown in Table 2. The instrument used is listed in the Appendix.

TABLE 2   Reliability and validity of the constructs

| Construct/Item | *M* (SD) | Convergent validity | | Reliability | |
		Loadings	AVE	Cronbach's alpha	Composite reliability
CAPITAL (CAP)	4.09 (0.70)	–	0.59	0.80	0.88
CAP1	4.35 (0.84)	0.62			
CAP2	4.12 (0.87)	0.78			
CAP3	4.11 (0.91)	0.84			
CAP4	3.85 (1.07)	0.81			
CAP5	4.01 (1.01)	0.76			
USEFULNESS (USE)	3.52 (1.00)	–	0.60	0.77	0.86
USE1	3.81 (1.15)	0.81			
USE2	4.02 (1.14)	0.79			
USE3	3.39 (1.28)	0.75			
USE4	3.13 (1.38)	0.74			
TDST	3.83 (0.80)	–	0.69	0.84	0.90
TDST1	3.8 (0.94)	0.86			
TDST2	3.56 (1.08)	0.78			
TDST3	3.93 (0.93)	0.84			
TDST4	4.01 (0.93)	0.84			
TDSS	3.78 (0.87)	–	0.82	0.89	0.93
TDSS1	3.72 (0.96)	0.89			
TDSS2	3.7 (0.97)	0.89			
TDSS3	3.92 (0.96)	0.93			
SKILLS (SKL)	3.57 (0.91)	–	0.62	0.83	0.89
SKL1	3.74 (1.07)	0.86			
SKL2	3.37 (1.18)	0.82			
SKL3	3.7 (1.08)	0.73			
SKL4	3.57 (1.26)	0.77			
SKL5	3.48 (1.18)	0.77			
PARTICIPATION (PAR)	3.31 (0.92)	–	0.64	0.85	0.90
PAR1	2.62 (1.31)	0.75			
PAR2	3.32 (1.19)	0.71			
PAR3	3.65 (1.04)	0.78			
PAR4	3.59 (1.13)	0.86			
PAR5	3.38 (1.10)	0.87			

Data analysis

The data was analysed using SmartPLS 3 (Ringle et al., 2015). The PLS-SEM research model consists of a measurement model (to assess the reliability and validity of the latent constructs) and structural model (to assess the relationship between the latent constructs) (Hair et al., 2017). PLS-SEM was considered (rather than CB-SEM) due to its smaller sample size requirement, non-requirement of normal distribution and the exploratory nature of the model (Hair et al., 2017). The sample size for this study meets the required 10 times the largest number of structural paths directed at a construct and Cohen's (1992) power analysis for regression models. A limitation of PLS-SEM is its lack of global goodness-of-fit measures, although recent research has used standardized root mean square residual (SRMR) as a means to validate the model (Henseler et al., 2014). Hence, we also report SRMR, but this needs to be interpreted with caution.

RESULTS

Descriptive statistics

This section provides contextual information about the results of the questionnaire. Means and standard deviations for the latent constructs and indicators are shown in Table 2. Students have identified that they have adequate access to resources (*e-learning capital* $M = 4.07$, SD = 0.70). Student agreement about the usefulness of the learning activities was around the neutral mark ($M = 3.52$; SD = 1.0) with self-check quizzes (USE2) having the highest mean score ($M = 4.02$; SD = 1.14) and breakout rooms (USE4) having the lowest score ($M = 3.13$; SD = 1.38). The mean transactional distance between teachers and students (TDST) was 3.83 (SD = 0.80) and between students (TDSS) was 3.78 (SD = 0.87), which are indicative of a low transactional distance (the higher the score, the lower the transactional distance). Skills engagement average was 3.57 (SD = 0.91), indicating a neutral agreement overall. The construct *participation* on average was 3.31(SD = 0.92), which can be interpreted as neutral agreement overall. This construct scored the lowest in comparison to the other constructs. By showing the descriptive statistic scores for the indicators and latent variables, we hope to have provided context about our participants. The following section will cover the structural model, which is the focus of this paper.

Measurement model

To evaluate the measurement model, we examined its reliabilities, convergent and discriminant validities. First, all outer loadings were above the 0.708 recommended threshold values except for *CAP1,* which was 0.62. Hair et al. (2017) advised that "researchers should carefully examine the effects of item removal on the composite reliability and content validity of the construct" (p. 113). This variable was kept because this refers to the students' self-reported ability to use the VLE and retaining the variable has not radically changed the reliability and validity values. Reliability was assessed using composite reliability and Cronbach alphas. Cronbach alphas are deemed to be conservative measures whereas composite reliabilities are considered to be more liberal (Hair et al., 2019), so we report both values to show consistency between the two measures. All values for composite reliability (range between 0.86 to 0.93) and Cronbach alphas (range 0.77 to 0.89) were above 0.70 and none were above 0.95, which indicates a satisfactory-to-good level of internal consistency. Convergent validity was assessed using the average variance extracted (AVE) for each

construct. All values were above the 0.50 threshold and thus indicate that the construct explains at least 50% of the variance of its items (Hair et al., 2019). Finally, discriminant validity of the constructs, assessed using heterotrait-monotrait (HTMT) ratio of correlations, were all below the 0.85 threshold level and the HTMT confidence interval does not include one, thus indicating evidence for the constructs' discriminant validity. Table 2 shows the reliability and validity measures as well as the mean and standard deviations for each construct. Table 3 shows the correlation matrix with the square root of AVE in the diagonal.

Structural model

The structural model is illustrated in Figure 2. All variance inflation factor (VIF) values of the construct are below 5, which can be interpreted as the predictors not having critical levels of collinearity. The effect size (f2) and predictive relevance (Q2) provide insight about the quality of the PLS path model (Hair et al., 2017). Guidelines for assessing f2 are 0.02 for small effect, 0.15 for medium effect and 0.35 for large effects (Cohen, 1988). Within this model, paths with a significant relationship had small and medium effects, as shown in Table 4. Using the blindfolding technique to assess the predictive relevance of the model, the following Q2 values for USE (0.16), SKL (0.156) and PAR (0.270) are all above 0 with PAR having the highest Q2. This suggests that the model has acceptable predictive relevance. In addition, the model fit index, standardized root mean square residual (SRMR), was 0.074 which is below the 0.08 threshold, indicating an acceptable fit (Hair et al., 2017). Table 4 shows the structural model and its relevant *p*-values. E-learning capital has a significant positive effect to students' skills engagement (H1: β = 0.38, *p* < 0.001, f2 = 0.15), which is a medium effect. The transactional distance between teachers and students (H3: β = 0.41, *p* < 0.001, f2 = 0.22) and the transactional distance between students (H6: β = 0.25, *p* = 0.006, f2 = 0.08) both significantly influence perceived usefulness of the learning activities, although the former has a medium effect and the latter a smaller effect on perceived usefulness. Transactional distance between students (H8: β = 0.42, *p* < 0.001, f2 = 0.27) and perceived usefulness (H10: β = 0.38, *p* = 0.001, f2 = 0.18) significantly affect participation. Overall, TDST and TDSS explain 29% of the construct PU. E-learning capital, TDST and TDSS explain 27.7% of the variance in skills engagement and 45.2% of the variance for participation.

Mediation analysis

To understand the mediating effects of perceived usefulness of the learning activities on the relationship between transactional distance factors and engagement factors, we further examined the indirect effects among the latent variables of the structural model. Table 5

TABLE 3 Correlation matrix with the square root of AVEs in the diagonal

	CAP	PAR	SKL	TDSS	TDST	USE
CAPITAL	**0.77**					
PARTICIPATION	0.29	**0.80**				
SKILLS	0.48	0.49	**0.79**			
TDSS	0.31	0.57	0.31	**0.90**		
TDST	0.45	0.32	0.31	0.29	**0.83**	
USEFULNESS	0.33	0.54	0.32	0.37	0.49	**0.77**

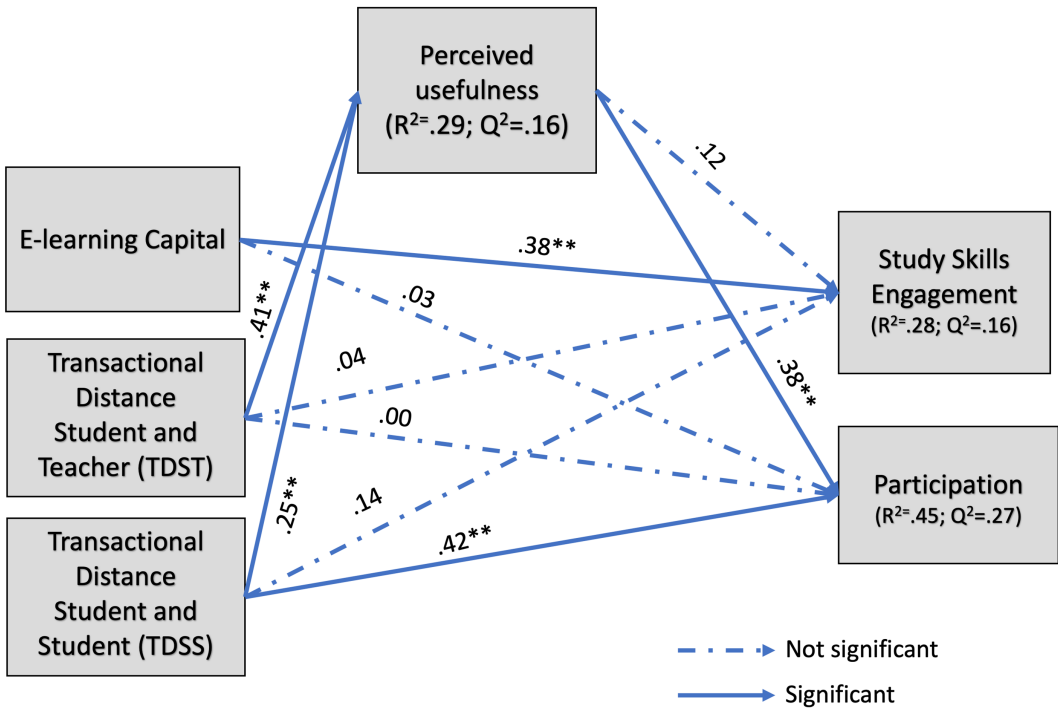*Note:* Numbers in bold denote the square root of AVEs.

FIGURE 2 The structural model

TABLE 4 Result of the structural model

HYP#	Relationship	Standard beta	Standard error	p-value	Effect size f2
H1	CAP → SKL	0.38	0.08	**<0.001**	0.15
H2	CAP → PAR	0.03	0.09	0.735	0.00
H3	TDST → USE	0.41	0.08	**<0.001**	0.22
H4	TDST → SKL	0.04	0.11	0.738	0.00
H5	TDST → PAR	0.00	0.11	0.969	0.00
H6	TDSS → USE	0.25	0.09	0.**006**	0.08
H7	TDSS → SKL	0.14	0.09	0.141	0.02
H8	TDSS → PAR	0.42	0.08	**<0.001**	0.27
H9	USE → SKL	0.12	0.11	0.263	0.01
H10	USE → PAR	0.38	0.11	0.**001**	0.18

Bold indicates statistical significance ($p < 0.05$).

TABLE 5 Indirect effects

	Relationship	Indirect effect	Std. error	p-value
H11	TDST → USE → SKL	0.05	0.05	0.302
H12	TDST → USE → PAR	0.15	0.06	0.**010**
H13	TDSS → USE → SKL	0.03	0.03	0.334
H14	TDSS → USE → PAR	0.09	0.05	0.**047**

Bold indicates statistical significance ($p < 0.05$).

shows that there is a significant indirect effect for the paths TDST → USE → PAR (H12) but as TDST → PAR (H5) is not significant, this means that there is an indirect-only mediation, the mediator construct USE accounts for all the observed relationship between TDST and PAR. There was also a significant indirect effect for TDSS → USE → PAR (H14). In this instance, as TDSS → PAR (H5) is also significant, there is complementary mediation, which means that USE accounts for some of the observed relationship between TDSS and PAR.

DISCUSSION

To learn about students' experiences of enforced online learning in a higher education setting, this study identified the relationships between factors of e-learning capital and transactional distance on study skills engagement and participation, as mediated by perceived usefulness. The discussion section first considers study skills engagement and then participation.

Study skills engagement

While on campus, students had previously been able to access study skills resources including one-to-one advice. In this research, study skills engagement involved studying regularly, keeping up with the course, making notes and putting in time. Our structural model identified that *only* e-learning capital significantly affects study skills engagement. Previous studies have found that computer self-efficacy increased student engagement (Bates & Khasawneh, 2007; Pellas, 2014). The pandemic has foregrounded messages about digital poverty (Scott, 2020). This finding reveals such disadvantage. The digital divide is not a dichotomy but a more elaborate hierarchy and having access does not necessarily mean using the technology well (Selwyn, 2004). The relationship between e-learning capital and study skills engagement raises the question of how we empower students so that they succeed in the online learning ecosystem. It would seem there is a need to provide a more targeted approach to training that would help students optimise their use of the VLE.

In our model, none of the identified constructs of transactional distance (TDST, TDSS) were found to significantly affect study skills engagement, which is counter to previous studies (eg, Dixson, 2015; Moore, 1993). Furthermore, how students perceived the usefulness of the online learning did not present a significant link with their study skills engagement. For previously on-campus learners, regular lectures, lab work and tutorials may have acted to provide a level of organisation and structure that the online lectures and increasingly self-paced study did not. Visibility of peer behaviours, such as taking notes in class, serves as motivation to engage with study skills (Bishop, 2006). Those electing to study online have multiple demands on their time, often balancing study with work or home-life, so potentially struggle to engage with study skills such as establishing regular study schedules (Blackmon & Major, 2012; Brown et al., 2015; Kahu, 2013). The students in this study had not elected to study online; however, many found themselves with new and sudden home-based pressures such as: inadequate, unplanned workspaces; home-based distractions including other affected family members, TV and games; and anxieties resulting from the pandemic. Perhaps unsurprisingly therefore, in this study only e-learning capital positively affected study skills engagement.

While students may be keen to return to on-campus learning (Neves & Hewitt, 2021), online learning is likely to play a role in their future skills development. For example, some aspects of online learning will almost certainly be retained by universities in the academic sessions following the first waves of the COVID-19 pandemic. If this is the case, the way academic study skills are taught in most universities will require an overhaul, with more

attention to study skills specific to online courses. Universities' motivation for continuing with aspects of online learning should be pedagogical, rather than to maximise intake for financial reasons (Dickinson, 2021). In addition, teachers should be encouraged to introduce discussions on study skills, and individual approaches to study, into their online teaching, making sure there is a time and space for students to share their study skills approaches and challenges with each other. Such social influencing could act to provide a new online channel for observing and sharing good study skills behaviours.

Participation

In this study, participation was reported by students as getting to know other students in various ways, being active in online discussions and helping fellow students.

E-learning capital was not found to be associated with participation. So, while in this study e-learning capital positively influenced study skills engagement, such capital does not necessarily imply that students actively engaged in activities that invited their input, such as the discussion board or group discussions in breakout rooms. This seems counter-intuitive. How could having access and knowing how to use online technology influence students keeping up with their studies, but not act to influence participation in online discussions that are almost certainly hosted on such platforms? One factor could be related to the types of discussion platforms in use. Some of the traditional VLE-supported platforms were ill-suited to group discussions, certainly in comparison to on-campus tutorial rooms with large physical whiteboards. In the participants' university department, some student discussions migrated to games and social platforms students were familiar with those from more social contexts. Rules of engagement when online gaming/socialising may be quite different to how students would normally present themselves and their ideas to fellow students and teachers. As such, there is a need to enable both teachers and students to use and understand new protocols. Technology training has been found to improve lecturers' knowledge of designing effective online learning environments (Rienties et al., 2013), but it is not just teachers that need this training: students who may have used apps previously in informal settings could benefit from new, shared rules of engagement. Teachers can post a question on a discussion board but if students are not experienced in the effective use of the discussion board, then the teacher's prompts for interaction may not be successful. This finding requires further exploration so that the considerable additional effort teachers have to put in to migrate online is directed to the right activities.

Contrary to literature that found links between TDST and student participation (Ekwunife-Orakwue & Teng, 2014; Palau et al., 2021; Swan, 2010), our findings identified *no* direct effect between TDST and participation. Instead, links between TDST and participation were mediated by how students perceive the usefulness of the online learning activities. One of the factors behind successful online discussions is the value placed on participation in the discussions by teachers (Swan, 2010). Commenting on the pivot to online learning, Nordmann et al. (2020) recommend that teachers make rules of participation explicit, and our findings back this up. We recognise the pace with which this all had to happen, but recommend that in future lecturers explicitly set expectations of student participation and signpost the value of participation.

Our model for participation identified that low transactional distance between students and their peers (TDSS) contributes to increased levels of participation in online learning. This relationship is also mediated by how students perceived the usefulness of the learning activities. The relationship between TDSS and participation is widely supported in the literature, where interactions with other students predict participation (Richardson et al., 2017; Sun et al., 2019). Social context and communication are factors that promote interaction

in learning communities (Tu & McIsaac, 2002). Walton and Cohen (2007) introduce the term 'belonging uncertainty', which is associated with reduced motivation, engagement and achievement. As we cater to more online learning, it is important that we design activities that promote student belonging. During the swift transition to online learning, the focus may have been on establishing ways for students to participate (involving teachers learning often unfamiliar technology), rather than expressing how participation benefits learning. If online collaborative tools remain in use, their purpose in learning must be addressed in addition to any technical instructions for effective use.

In this study, the quality of teacher and student interaction (TDST), and the interaction of students with their peers (TDSS) in the online learning environment, were important factors affecting how students *perceive the usefulness* of online learning activities and how this perception mediates participation. Previously, technology acceptance research has identified social influence as a factor that affects online learning engagement (Chu & Chen, 2016). Teacher-related characteristics, such as fairness and clarity of instruction, have also been identified as factors that affect perceived usefulness of learning activities (Lee et al., 2009). These characteristics influence the dialogue between teacher and students. Just as dialogue lowers the transactional distance between students and teachers in Moore's theory of transactional distance model, our current study also identified that lower transactional distance affects how students perceived the usefulness of the learning activities in the online learning environment. In the technology acceptance model, perceived ease of use or familiarity with using the system influences perceived usefulness and consequently learner interaction with the learning environment (Davis, 1989). Levels of familiarity with the online learning environment varied amongst staff and students. Familiarity has been increasing at pace, but it is important that both teachers and students are provided with ongoing training to help them effectively navigate the online ecosystem and retain beneficial perceptions of usefulness.

CONCLUSION

This timely study followed the swift and necessary transition of universities to online learning caused by the COVID-19 pandemic. Students' prior modes of learning were significantly disrupted, while universities sought to continue teaching by mobilising online learning. Encouragingly, we found evidence of low transactional distance between students and teachers, and between students and students, both of which are considered pre-conditions for successful online learning. This influenced how useful students thought their online learning courses were. However, *only* the student-student transactional distance influenced participation in online activities such as getting to know fellow students and course-related discussions. This cohort effect should be supported in future online activity, especially to promote and share online study skills and effective approaches to learning.

Universities should draw on this study's findings in order to focus on students' online study skills engagement and participation for any future online or hybrid online/face-to-face teaching. Of immediate concern is that the transactional distance between students and teacher did not directly affect study skills engagement or participation. So, while lecturers were giving prompt feedback, being helpful and paying attention to students, this effort did not translate into students engaging in ways that have been shown to be beneficial to their learning. Instead, students seemed a bit at sea regarding how their previously acquired study skills could be mobilised in this new mode of study. The value of participation needs to be signposted, along with practical advice relating to online study skills. These recommendations are equally appropriate for contexts such as professional learning or international settings.

In the context of the pandemic, recognition that students and lecturers needed to acquire new skills for the online learning environment was somewhat lost due to the speed of the transition. This needs attention if online learning, for previously on-campus students, is to continue post-pandemic, for example, in the form of blended or hybrid learning environments. Students need to acquire skills such as online communication skills to be able to build on the cohort effect to encourage student participation. In the same way, lecturers also need training in delivering online and hybrid learning module to encourage student participation and engagement.

E-learning capital was found to influence on students' study skills engagement. It is important that students are provided with continuous training and support to help them navigate the online ecosystem. A targeted approach to training would help students optimise their use of the VLE. Investing in e-learning capital, through access to computer infrastructure and training on online platforms, could better support students and this should be possible in future scenarios, with all we now know. As face-to-face teaching returns, e-learning capital should remain a focus for investment to ensure students continue to engage in study skills to take advantage of legacy resources, especially as some reliance on online activity is likely to continue.

Limitations and future work

There are several limitations with the current model. The study is situated in a single university and focussed on computing students. Future work could be extended to look at the relationship of transactional distance and student engagement using a more diverse group. The instrument in this study uses self-reported measures, which could introduce some bias (for example, social desirability bias, recall bias, etc.). Self-report measures, however, can be particularly useful for assessing students' subjective perceptions (such as their perception of transactional distance) and patterns of engagement that are not directly observable (Fredricks & McColskey, 2012). As both lecturers and students had just transitioned to this new online space, it is difficult to measure the intensity of their engagement, when engagement could have been happening in alternative environments (for example, using non-official channels for communication rather than the VLE). Learning analytics within the VLE, third-party observation or interviews with students could provide additional data to triangulate measures of student engagement. Another limitation is that the survey captures how students were experiencing emergency transition to online learning at a particular point in time. The students were engaged in more than one class, so although they were asked to rate their overall experience, a salient experience in a particular module could affect how the students felt about transactional distance. Future research could capture wider experiences, such as library resources and student support, to evaluate how this relates to overall student engagement, in addition to their teaching experience. Further research is also needed to identify other variables that could positively influence students' learning strategies in such an enforced online learning environment.

Within this research, we introduced the concept of e-learning capital to relate to the e-learning competencies and resources required to access the online learning environment. This aspect is mostly exploratory and further research is needed to identify the other forms of resources that fall within this capital (for example, the time available to a student to do online learning). Student characteristics (such as gender and age) are factors that are known to affect engagement; however, the small sample sizes of these demographic groups meant that a multigroup analysis based on these variables was not possible and future studies could address this.

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APPENDIX

Construct	Indicators	Item
E-learning Capital	CAP1	Your ability to use Moodle (virtual learning environment)
	CAP2	Your ability to use the synchronous online learning environment (eg, Teams, Webex, Zoom)
	CAP3	Your ability to use various forms of technology for communication with peers and lecturers (eg, email, discussion boards, slack, chats, etc)
	CAP4	Your ability to access resources provided by the university (eg, access library books, software, etc)
	CAP5	Your access to hardware and software for online learning (including connectivity)

Construct	Indicators	Item
Transactional distance student-teacher	TDST1	Most of the lecturers pay attention to me
	TDST2	I receive prompt feedback from most of my lecturers on my academic performance
	TDST3	Most of the lecturers are helpful
	TDST4	The lecturers can be turned to when I need help in the course
Transactional distance student-student	TDSS1	I get along well with my classmates
	TDSS2	My classmates value my ideas and opinions
	TDSS3	My classmates respect me in online classes
Usefulness	USE1	The use of polls is useful
	USE2	The use of self-check quizzes is useful
	USE3	The use of discussion boards is useful
	USE4	The use of breakout rooms is useful
Study Skills	SKL1	I'm studying on a regular basis
	SKL2	I'm up-to-date with all reading and work
	SKL3	I've been looking over stuff between classes
	SKL4	I'm making notes from the materials online and online lectures
	SKL5	I'm putting in the right amount of effort
Participation	PAR1	I've got to know my classmates
	PAR2	I've been active in online discussion
	PAR3	I've been able to help my fellow students
	PAR4	I've been engaging in conversations with other students
	PAR5	I've been asking questions and sharing my thoughts and ideas