5-11-2023

QUALITY AND COMPETENCY FOR SUSTAINABLE DIGITAL FUTURE OF EDUCATION: CONTEXT OF DIGITAL LEARNING SYSTEM

Mehwish Waheed
Université Paris-Saclay, Univ Evry, IMT-BS, LITEM, m.waheed9@outlook.com

Noor UL-Ain
Léonard de Vinci Pôle Universitaire, Research Center, noor.ul-ain@devinci.fr

Liudvika Leišytė
Technische University of Dortmund, liudvika.lisyte@tu-dortmund.de

QUALITY AND COMPETENCY FOR SUSTAINABLE DIGITAL FUTURE OF EDUCATION: CONTEXT OF DIGITAL LEARNING SYSTEM

Research Paper

Mehwish Waheed, Université Paris-Saclay, Univ Evry, IMT-BS, LITEM, 91025, Evry-Courcouronnes, France. Mehwish.waheed@imt-bs.eu
NoorUl Ain, Léonard de Vinci Pôle Universitaire, Research Center, 92916 Paris La Défense, France.Noor.ul-ain@devinci.fr
Liudvika Leišytė, Technische Universität Dortmund, Germany. Liudvika.leisyte@tu-dortmund.de

Abstract

A sustainable digital future of education is at its high call and various digital tools are being used to establish digital learning – but limited attention is paid to quality and virtual competence for the success of Digital Learning System (DLs). This study addresses the gap and outlines satisfaction as a function of quality factors (perceived knowledge quality and interactive quality) and virtual competence that subsequently determines net benefits (perceived learning). DLs success model is proposed by mapping into sequential building blocks of DeLone and McLean IS success model and integrating social cognitive theory. Quantitative online survey data from 156 German and Swedish students confirm that perceived knowledge quality, sociability-based interactive quality, and virtual competence play an important role towards students' satisfaction and perceived learning. The salient highlighted factors provide a novel contribution deemed indispensable for DLs success. The findings suggest future research avenues for theory and practice.

Keywords: Virtual Competence, Perceived Knowledge Quality; Interactive Quality; Perceived Learning; Digital Learning System; DeLone and McLean IS model.

1 Introduction

The infusion of technology has catalyzed a significant transformation in the conventional approach to education. One such transformation is the Digital Learning System (DLs), which supports the achievement of a sustainable digital future of education. More recently, the outbreak of COVID-19 pandemic has posed significant challenges, leading to a pervasive disruption of conventional educational practices. As a result, a growing number of educational institutions have been compelled to embrace digital transformation by implementing DLs (Mardini and Mah'd, 2022, Al-Nuaimi et al., 2022, Shirish et al., 2021). The transformation has been supported by web-based technologies and platforms such as Microsoft Teams, Google Meet, Zoom, Telegram, Discord, Kahoot, Moodle, and Blackboard (Sava, 2023, L. Ceci, 2023, Mardini and Mah'd, 2022) to facilitate effective interaction and learning experience. However, a successful DLs is accompanied by a critical assessment of several contributing factors – where quality and virtual competence are considered indispensable. After the outbreak of COVID European Union (EU) policy initiative (Digital Education Action Plan (2021 – 2027)) (DEAP, 2021) also calls for addressing high quality digital education and enhancing

digital competence as key priority areas to support successful and sustainable adaptation of conventional educational approach to the digital age.

Studies on digital education point to the importance of perceived difficulty for online learning satisfaction during COVID-19 (Conrad et al., 2022), perceived usefulness, ease of use, and acceptance of digital learning technologies (Sprenger and Schwaninger, 2021), personalized flipped classrooms (Melzer and Schoop, 2017), and information quality assessment in an eLearning context (Alkhattabi et al., 2011), information verifiability in online social networks (London et al., 2022). More recently, Schöbel et al. (2023) discussed gamifying online training programs and suggested considering the students' engagement and design of the learning environment to support their problem-solving skills as a learning outcome.

Given the massive digital transformation and the role played by DLs in knowledge dissemination and supporting online interaction, it is important to take into account students' perceived knowledge quality, interactive quality, and virtual competence as important indicators of DLs success. The extent to which the students perceive the online content is fit for use to determine their perceived evaluation of knowledge quality. The quality of online content is an essential component of knowledge construction and contributes towards meaningful learning (Rodríguez-Ardura and Meseguer-Artola, 2016). In DLs context, what is the extent to which the content in DLs is fulfilling the essentials of quality knowledge and contributing towards students' perceived learning is viable to unearth. Furthermore, Conrad et al. (2022) reported that active interaction between students and teachers overcomes the students' anxiety and brings ease to the online learning experience. Students are more than passive consumers (Dabbagh and Kitsantas, 2012) and they take into account the interaction either with their fellow peers or the platform (Wegener and Leimeister, 2012, Yeh et al., 2011). Recently, Schöbel et al. (2023) found that emotional engagement in online training contributes towards learners' problem-solving skills as a learning outcome. We argue that DLs facilitate interaction, however, scant discussion on the system-based interaction quality such as the role of the platform and sociability-based interactive quality (Yeh et al., 2011) in students' perceived learning needs further investigation. Additionally, the current digital transformation has significantly immersed students in digital learning (Nadine Diaz-Infante et al., 2022), thus, their level of virtual competence plays a vital role in perceived learning. If the online course requires higher technical skills, then students perceive it difficult (Conrad et al., 2022) – in case of limited virtual competence. Similarly, Adamovic et al. (2022) reported that employees' sense of virtual work self-efficacy impact on virtual work adoption. Evaluating only internet self-efficacy (Panigrahi et al., 2021) limits the holistic approach towards virtual competence measurement. Thus, we posit that it is important to investigate the students' virtual social skills and virtual self-efficacy (as formative virtual competence measurement) to benefit from the potential merits of DLs, such as perceived learning.

The above discussion emphasizes the need to investigate the factors essential for students' perceived learning and the success of DLs. The success of a system is determined through the attained net benefits (Delone and Mclean, 2003) – given the importance of knowledge quality, interactive quality, and virtual competence, and considering the time and resources students invest in DLs, we argue that it would be useful to investigate what benefits they perceive they obtain – such as perceived learning (Mitra, 2023). The research gap demands a framework that delineates the quality and students' virtual competence factors in the behavioral model of the European DLs. To do so, DeLone and McLean's (2003) information systems (IS) success model (D&M) is adapted and mapped DLs success into the building blocks of DeLone and McLean's model i.e., ***quality → satisfaction → net benefits***. The sequential flow of building blocks is extended by adding virtual competence and proposing a simplified extended version of the DeLone and McLean model. The adapted DLs success model focuses on the ***quality (perceived knowledge quality, interactive quality), virtual competence → satisfaction → and perceived learning (net benefits)***. Qualitative assessment of knowledge quality dimensions (Waheed et al., 2016b) followed by empirical validation of reflective knowledge quality second-order construct (Waheed et al., 2016a), and formative virtual competence second-order construct of Wang and Haggerty (2011) are acknowledged and integrated and further explained in the expanded DLs success model. This study seeks to answer the question, *how do perceived knowledge*

quality, interactive quality, and virtual competence influence students' satisfaction and how does students' satisfaction with DLs use impact their perceived learning?
The following sections are organized as follows. First, analysis of related DLs literature followed by the development of DLs success model and hypothesis development. Second, the proposed research methodology and the data analysis are presented. Finally, the contributions and limitations are discussed.

2 Literature Review

2.1 Digital Learning System and its Success

The term Digital Learning System (DLs) is referred to a system which facilitates education delivery through any electronic media either an intranet or hypermedia documents (Mardini and Mah'd, 2022). The use of new interactive technology for delivering lectures and training sessions relates to the notion of Digital Learning. In DLs, students are provided with electronic learning material through any Learning Management System (LMS) (Ifinedo et al., 2018), for example, Canvas, or Moodle.

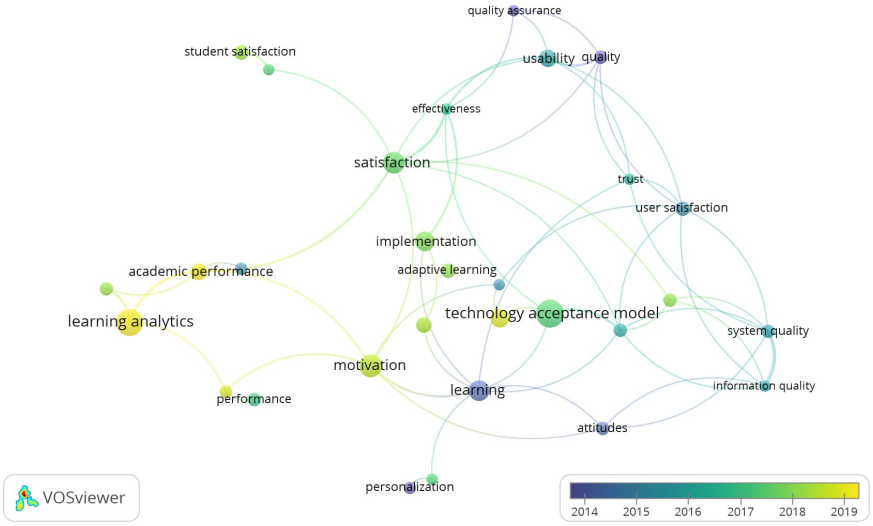

Figure 1. Prominent clusters emerged in digital learning literature.

In an effort to review the authoritative studies on DLs, systematic data extraction from the Web of Science (WoS) highlighted major clusters. Literature has majorly focused on evaluating the usefulness and ease of use by using the technology acceptance model (TAM), for instance, for eLearning system acceptance (Ho et al., 2015), blended learning course acceptance (Tselios et al., 2011), continued use of flipped classroom instructions (Cai et al., 2019), interest in online learning (Pakaja and Wafa, 2021), technology skill training in the online simulation environment (Ari et al., 2022), and effective use of big data in higher education (Xing and Wang, 2022). Other contributions to understand the motivation (Edwards and Taasoobshirazi, 2022, Khan et al., 2018, Shao, 2018) and learning (Gamlath and Wilson, 2022, Lee et al., 2009, Leung et al., 2022) in DLs are prominent. A recent incline can be seen to study analytics, particularly from a technical perspective e.g. Intervention of learning analytics to enhance student engagement in blended learning (Yang and Ogata, 2022), use of analytics for online students' performance (Li et al., 2022), students facing learning analytics for self-regulated learning (Galaige et al., 2022) and MOOC provide analytic analysis. Figure 1 shows other clusters in detail which highlight the scant attention towards research on the quality of knowledge and interaction, and competency evaluation in DLs context. This research gap highlights the importance of unearthing salient factors indispensable for the success of DLs.
The following section delineates the theoretical underpinnings of DeLone and McLean's (2003) IS success model and Bandura's (1986) social cognitive theory adapted in this study to map the DLs success model.

2.2 Digital Learning System Success Model - Theory and Hypothesis

DLs require a constant stream of activities to maintain the continuous usage that is essential for its success. IS continuance or technology usage behavior models such as the Expectation confirmation model (ECM) (Bhattacherjee, 2001) and TAM (Davis, 1989) are well known to conceptualize continuous use. The models benefit from the insight into contributing factors e.g., usefulness and ease of use and the intended usage as the endpoint. The outcome of use is not discussed which is the key concern of this study. Most widely adapted DeLone and McLean's (2003) IS success model delineates the outcomes as net benefits of use. IS success model discussed the impact of service quality, system quality, and information quality on user satisfaction and highlighted the further net benefits (service enhancement, cost control, increased sales per customer etc.) e.g. from the e-commerce, tax administration enterprise resource planning, and cyber threat platform perspective (DeLone and McLean, 2004, Banafo Akrong et al., 2022, Zibak et al., 2021). The model has grouped all measures associated with the benefit or impact category under 'net benefit' and opportunely addressed the merits as a productive line of inquiry for associated net benefits. From the perspective of the consumer, industry, and societal impacts net benefits are documented as cost saving, expanded markets, and time-saving. However, from DLs perspective 'net benefit' is regarded as students' perceived learning from the digital, flipped, and hybrid medium. Nonetheless, net benefits (perceived learning) cannot be achieved without having detailed insight into quality factors as per IS success model sequential flow. Having said this, the sequential flow of ***quality → satisfaction → net benefits*** from DeLone and McLean's (2003) information systems (IS) success model is adapted in this study with the novel integration of virtual competence using the lens of Social Cognitive Theory (SCT) (Bandura, 1986).

SCT, as a psychological framework, stem from social learning theory (Bandura, 1986) that involves cognitive, behavioural, and humanist views. This view of learning considers the individual as a key stakeholder and acknowledges that learning is influenced by individuals' goals, attitudes, values, knowledge, and experience. SCT discusses human behaviour in a learning context (Janson et al., 2017) and also posits a dynamic reciprocated triadic association between human behaviour, environment, and learners (Bandura, 1986). Human behaviour is a function of cognitive and environmental factors – where individual autonomy is not sufficient, individuals learn from others and the environment to build their personal competence belief (Adamovic et al., 2022). Personal observations are fundamental to SCT – where learning solely corresponds to individual activity such as imitating behaviours, observations, and consequent actions (Panigrahi et al., 2021). SCT stresses that individuals' strong self-efficacy belief fosters thoughts of effective actions, and reiteration of these self-efficacy beliefs strengthens one's own self-efficacy belief (Wood and Bandura, 1989). Individuals' self-belief to have effective communication and learning skills leads to a positive course of action. Individuals only indulge in the activities or environments in which they believe they are competent enough and will give beneficial outcomes. We posit that in DLs context students' self-belief in their virtual competence that pertains to social skills and self-efficacy in a virtual environment leads to goal achievement, such as desired learning. Though the literature has used the SCT to determine employee's performance (Wang and Haggerty, 2011, Saleem et al., 2021), its use to understand the relationship between virtual competence and perceived learning is under researched. Thus, we aim to investigate the virtual competence (such as virtual social skills, and virtual self-efficacy) – and perceived learning using the SCT lens.

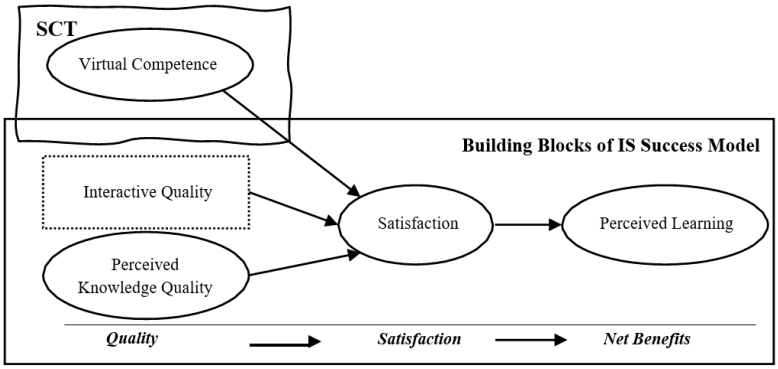

Figure 2. DLs success model mapped to IS success model's building blocks (Interactive quality: Representation-al name two latent constructs

Considering the previous discussion and importance of DeLone and McLean model and SCT – DLs success model is mapped into sequential building blocks of the DeLone and McLean model. Which outlines satisfaction as a function of two quality factors (knowledge quality and interactive quality) and virtual competence that in turn leads to net benefits (perceived learning). A simplified extended version of DeLone and McLean's model focuses on the ***quality (knowledge quality, interactive quality), virtual competence → satisfaction → perceived learning (net benefits)*** sequential flow, as shown in Figure 2. The flow asserts that the acquisition of quality knowledge, provision of interactive quality, and understanding of the students' virtual competencies contribute towards students' satisfaction and impact their perceived learning.

The following section explains the hypothetical relationships for the expanded DLs success model that includes second-order reflective perceived knowledge quality, two-dimensional interactive quality, second-order formative virtual competence, satisfaction, and perceived learning.

2.3 Student's Satisfaction

Satisfaction is often used as an essential determinant to measure information system success (Delone and Mclean, 2003), knowledge management success (Kulkarni et al., 2007) and eLearning success (Hassanzadeh et al., 2012). Students' satisfaction is associated with content quality and students' perceived learning (Islam, 2013). Satisfied students show higher performance than unsatisfied (Hsieh and Shannon, 2005, Lee and Lee, 2008). Considering the associated benefits, it is important to study the students' satisfaction. It will help in assessing the students' learning from DLs by considering the influencing factors (knowledge quality, interactive quality, and virtual competence).

2.4 Perceived Knowledge Quality

Perceived knowledge quality (KQ) is referred to as "Knowledge gained from content that is fit for use, accessible and actionable to the online user" (Waheed et al., 2016a). The explicit content provided in DLs is a source of knowledge for the students – and certain indispensable intrinsic, contextual and actionable factors are imperative for the KQ judgment (Yoo et al., 2011). Taking account of students' perception, we assessed the perceived KQ in DLs context by employing the multidimensional perceived KQ construct – encompassing five dimensions: Intrinsic KQ, Contextual KQ, Representational KQ, Accessible KQ, and Actionable KQ (Waheed et al., 2016a).

The sense of being satisfied is likely to be affected by an individual's evaluation of various outcomes like "ease of getting the knowledge needed, satisfaction with the access to knowledge, adequacy of the knowledge to meet one's needs" (Kulkarni et al., 2007). Students' satisfaction is preceded by the understanding of the quality factors. Jennex and Olfman (2006) and Kulkarni et al. (2007) assert that KQ determines user satisfaction from knowledge repositories in firms. Hassanzadeh et al. (2012) reported a strong relationship between content quality and individual satisfaction with the eLearning system. These observations suggest that a similar link might exist in DLs, particularly, the extent to

which the students gain quality knowledge from the use of explicit content in DLs determines their satisfaction. Therefore, the following hypothesis is proposed:
Hypothesis 1: Perceived KQ positively influences students' satisfaction with DLs.

2.5 Virtual Competence

Virtual competence is an individual's ability to leverage virtual settings to their maximum potential (Wan et al., 2008). Virtual competence is drawn upon formative conceptualization explaining virtual self-efficacy & virtual social skills (Wang and Haggerty, 2011). We assert in this study that 'an individual's self-confidence to perform a certain task or to achieve a goal in a virtual setting is referred to as *Virtual Self-Efficacy'*. Similarly, we explain that 'an individual skill to build a social relationship in the virtual environment reflects their *Virtual Social Skills'*. The literature suggests that a positive interaction leads to job satisfaction, due to the fulfilment of social needs (Repetti and Cosmas, 1991). It is theorized that individuals having a high level of virtual competency are capable to interact more harmoniously in a virtual environment (Ahuja and Galvin, 2003) – which impacts their satisfaction. This study argues that students perceive to have high virtual self-efficacy and are skilled-full to interact with their peers and handle challenging tasks in a positive manner instead of being frustrated, which might lead to dissatisfaction. Therefore, it is hypothesized that:

Hypothesis 2: Students' virtual competence positively influences students' satisfaction with DLs.

2.6 Interactive Quality

In DLs, students make their social network and interact via different applications and functions. Interactivity is supported by the wise use of the online interface, available navigational features, and service content (Rhode, 2009). In this study system-based interaction is taken into account – in which students interact with the different applications and functions of DLs to communicate with peers and teachers (for social connection) or to access hypermedia content (for platform interaction). Adapting Yeh et al. (2011) conceptualization to this study context, DLs is considered as a platform that improves the sense of communication direction, control over the content, and response to information requests works as a tool to enhance *platform-based interactive quality*. While *sociability-based interactive quality* can be achieved by having ease of communication with time flexibility, sense of place, interactive two-way communication, and desired results after communication.
Students' appropriate utilization of available applications/features in the platform builds control over the available content (Rhode, 2009). Underutilization may reduce the interaction which in-turns affect the students' satisfaction and performance (Kuo et al., 2014). Engaging in social interaction in the form of learner-instructor/learner-learner two-way reciprocal communication propels students' understanding and satisfaction (Janson et al., 2017, Moore, 1989, Wegener and Leimeister, 2012). This study acknowledges the multi-dimensional nature of interactive quality (Yeh et al., 2011) and measures it by considering the platform-based and sociability-based interactive quality – and proposed the following hypothesis:
Hypothesis 3a. Platform-based interactive quality positively influences the students' satisfaction with DLs.

Hypothesis 3b. Sociability-based interactive quality positively influences the students' satisfaction with DLs.

2.7 Perceived Learning

Students' self-evaluation of their learning progress or knowledge gained from any system or environment is referred to as perceived learning (Bacon, 2016, Mitra, 2023). For instance, students' perceived self-belief in achieving required learning goals after engaging in DLs activities. On the other hand, actual learning determines students' new knowledge acquisition, skills, or understanding – such as final exam grades (McGill and Klobas, 2009, Bacon, 2016). Perceived and actual learning does not always align – thus the distinction is considered and students' perceptual evaluation of learning

outcomes is used in this study. A key reason students use the DLs is to consult explicit content or interact with other peers (students or teachers), which they perceive as a contribution to their learning. Alluding to DeLone and McLean's (2003) net benefits, perceived learning is deemed to be an associated perceived benefit for students. Thus, the students' perception of learning from the DLs is considered a net benefit of DLs use. The literature has explored the students' learning process satisfaction and perceived learning success (Janson et al., 2017). Ifinedo et al. (2018) found that anticipated academic performance stems from satisfaction and support in the blended learning environment. Waheed et al. (2021) also reported a significant relationship between researchers' satisfaction and perceived learning for academic social media success. Drawing on the above explanation, it is hypothesized that:

Hypothesis 4. Students' satisfaction with DLs use influences their perceived learning.

3 Research Methodology

A cross-sectional online survey design with a quantitative research approach was employed in this study. The following sections describe the measures, data collection, and analytical methods. Five-point Likert scale (Strongly Agree =1 to Strongly Disagree=5) online quantitative survey was used by adapting the prior validated measures from Waheed et al. (2016a) (perceived knowledge quality), Yeh et al. (2011) (interactive quality), Wan et al. (2008) (virtual competence), Lee (2010) (Satisfaction and perceived learning). This study investigated the case of eight public sector universities in Germany and Sweden. These countries were selected because of technological advancement and significant investment in higher education, research, and technological innovations – and being at the lead in EU (Sadurskis, 2016). All of the selected university cases offered online degree programs and, in these universities, different digital learning tools have been used for document management, communication, and data sharing, as shown in Table 1.

Tools	Names	Usage
LMS	Canvas, It's Learning, Moodle, Blackboard, LISAM, Desire to Learn	To upload weekly lectures, course materials, discussion forums, Quizzes, Assignments, and Gradings.
Communication Tools	Cisco Webex, Adobe Connect, Zoom, Bambuser, Skype, Teams, Meets	Connect the students through live streaming and provide a synchronous live communication facility.
Data sharing Tools	Box, Google Drive, SharePoint	Embedded in the learning management system to enable the students to securely share the data and collaborate.

Table 1. Digital Learning Tools used in case study institutions.

The Official portals for the accredited German (http://www.akkreditierungsrat.de/) and Swedish (http://www.uka.se/) universities, and online business administration master programs (http://www.distancelearningportal.com) were consulted using the English language filter (to avoid language biases in data collection.). Initially, an official request for data collection and responses anonymity was ensured. Program coordinators facilitated survey distribution through i) the web page of the selected online program and ii) Sent by email to registered students.

4 Results

The data is subject to reliability and validity diagnostics. Along with the descriptive analysis, exploratory factor analysis is applied to extract the factors that fit with the data and final model. The final model after Exploratory Factor Analysis (EFA) is tested using structural equation modelling to analyze the hypothesized relationships. The statistical analysis is performed in IBM SPSS V25 and SmartPLs 4.

4.1 Descriptive Statistics

We obtained 181 responses out of N = 679 yielding a response rate of 27%, of which n = 156 were viable after the erasure of erroneous and missing data. The refined sample encompasses more male (51.9%) students than female (48.1%). The majority were between the age range of 24-30 (44.9%) and were from Western (33.97%) and North Europe (28.21%). It was found that 26.07% of students were spending 1 to less than two hours using the DLs, while the majority had 6 months to a year (39.1%) and more than 2 years of DLs usage experience. Additionally, the statistics highlighted that 53% of students faced the problem of inadequate digital learning training (See Table 2 for detail).

Measures	Description	Frequency	Percent
Gender	Male	81	51.9%
	Female	75	48.1%
Age	18 – 23	20	12.8%
	24 – 30	70	44.9%
	31 and above	66	42.3%
Region of Residence	Western Africa	2	1.28%
	South America	9	5.77%
	Eastern Asia	6	3.85%
	Eastern Europe	13	8.33%
	Northern Europe	44	28.21%
	Southern Europe	25	16.03%
	Western Europe	53	33.97%
	Australia and New Zealand	2	1.28%
DLs usage experience	Less than a Month	5	3.2%
	6 Months to a Year	61	39.1%
	1 – 2 years	42	26.9%
	More than 2 Years	48	30.8%
Time spent in using the DLs (hours/day)	Less than one hour	35	10.03%
	1 – less than two hours	91	26.07%
	2 – 3 hours	30	8.60%
Activity you perform the most in DLs	Discussion Forums	20	12.8%
	Content Downloading	62	39.7%
	Assignments	56	35.9%
	Grade Checking	4	2.6%
	Collaborative solving of study problems	6	3.8%
Problem Faced	Broken links	38	29.2%
	Inadequate Digital Learning training	70	53.8%
	Login Issues	22	16.9%

Table 2. Respondents' Profile.

Also, we have observed (Figure 3) that a significantly high majority of students used the trial-and-error method (62.0%) to understand DLs, while 18% learn by supervisor guidance.

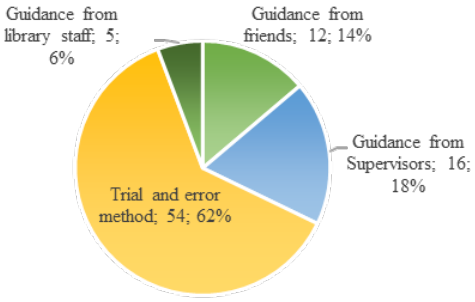

Figure 3. Source of learning DLs.

4.2 Exploratory Factor Analysis

The data from a survey is subjected to Exploratory Factor Analysis (EFA) to identify factor structure (Tabachnick and Fidell, 2008) and factorization of a large number of items into smaller ones. A varimax rotation method and Principal Component Analysis (PCA) as an extraction method are used. The factorability of the correlation matrix was achieved by getting a significant value for Bartlett's test of Sphericity ($p < 0.001$) and a Kaiser-Meyer Olkin's (KMO) value of 0.809 – > .6 (Kaiser, 1974). As per the eigenvalue rule (>1.0) (DeVellis, 2012) and varimax rotation four factors (19 items) were extracted for perceived knowledge quality without any cross-loading (> .5) and are above .05 (Hair et al., 2010). The factor loadings revealed that items of contextual KQ and representational KQ are loading on the same factor (see Table 3) and measuring the same aspects. Similar findings are also documented for the information quality framework by Alkhattabi et al. (2010). Hence, based on EFA contextual and representational KQ is taken as a single factor and named as contextual representational KQ – and an updated four factors are retained for perceived KQ. The final output from the EFA corresponds to the proposed 4 sub-dimensions and 19 items. The other two second-order constructs interactive quality and virtual competence adequately loaded on their respective two latent constructs respectively. In total, 10 factors were extracted that meet the required benchmarks, three exogenous constructs composed of eight latent factors namely, perceived knowledge quality (intrinsic KQ, contextual representational KQ, accessible KQ, and actionable KQ), interactive quality (platform-based interactivity, sociability-based interactivity), and virtual competence (virtual self-efficacy, virtual social skills) – and two endogenous constructs that are satisfaction and perceived learning.

4.3 Reliabilities and Validities

Table 3 explains the reliability and validity statistics of the research model. The standardized loadings of all items were above the suggested benchmark i.e. > 0.5 (Hair et al., 2010). The reliability analysis presented Cronbach's alpha coefficients between 0.70 to .901 which is above the (Churchill and Gilbert, 1979) suggested threshold i.e., 0.70. The values (0.503 to 0.671) of Average Variance Extracted (AVE) were also above 0.5. Additionally, the threshold value of 0.70 for Composite Reliability (CR) was met for all the variables (Fornell and Larcker, 1981). Furthermore, the values of the variance inflation factor (VIF) ranging from 1.193 to 3.576 were below 10 which eliminated the multicollinearity factor (Howitt and Cramer, 2011).

Construct/Items	St. Loading/Weights*	α	AVE	CR	R^2
PERCEIVED KQ		0.879	0.541	0.896	
Intrinsic KQ. The content available in DLs.	0.653*	0.879	0.624	0.908	0.205
I1. Is Accurate	0.8144				
I2. Is Unbiased	0.6822				
I3. Is Trustworthy	0.8253				
I4. Is Justifiable	0.7694				
I5. Is Believable	0.8184				
I6. Is Updated	0.8212				
Contextual Representational KQ	0.860*	0.893	0.612	0.916	0.740
CR1. Gives adequate detail	0.7675				
CR2. Is Relevant	0.8117				
CR3. Is Timely available	0.7655				
CR4. Is Value Added	0.7146				
CR5. Has compact presentation	0.7938				
CR6. Is Consistent	0.8267				
CR7. Is Understandable	0.7913				
Accessible KQ	0.686*	0.854	0.774	0.911	0.471
Acc1. Is easily accessible	0.8448				
Acc2. Has no technical accessibility issue	0.9118				
Acc3. Has quick access response	0.8819				

Actionable KQ	0.723*	0.828	0.744	0.897	0.523
Act1. Is Adaptable	0.8813				
Act2. Is Applicable	0.8678				
Act3. Is Expandable	0.8394				
VIRTUAL COMPETENCE		0.801	---	0.858	
Virtual Self-Efficacy	0.643*	0.825	0.740	0.895	
In a virtual setting, I could complete my work using a new system, if					
VSE1. I had never used one like this before	0.8556				
VSE2. there is no support available to tell me its usage	0.8390				
VSE3. I had seen someone else using it before trying it myself	0.8864				
Virtual Social-Skills	0.541*	0.766	0.682	0.865	

Table 3. Reliabilities and Convergent Validity.

The R^2 values in Table 3 presented percentage change in the endogenous constructs due to their respective exogenous constructs. The combined effect of the perceived KQ, virtual competence, platform-based, and sociability-based interactive quality explained a 32.0% variance in satisfaction. At the same time, perceived learning accounted for 13.0% of the variance in satisfaction.

Construct	Tolerance	VIF
Dependent Variable: Satisfaction		
Intrinsic KQ	0.625	1.600
Contextual representational KQ	0.544	1.839
Accessible KQ	0.685	1.459
Actionable KQ	0.691	1.446
Virtual Self Efficacy	0.665	1.503
Virtual Social Skills	0.613	1.632
Platform-based interactivity	0.623	1.605
Sociability-based interactivity	0.709	1.411
Dependent Variable: Perceived Learning		
Satisfaction	1.00	1.00

Table 4. Collinearity diagnostics.

The Variance Inflation Factor (VIF) values (Table 4) ranged from 1.41 to 1.83 and its associated tolerance values ranged from .544 to .709 for both models, which was within the acceptable range (i.e., VIF < 10 and tolerance > .1) (Howitt and Cramer, 2011). In Table 5, the correlation between the latent constructs is presented through off-diagonal values and the higher AVE square root values (in bold) than the correlation between any pair of constructs for all reflective measures – suggesting adequate discriminant validity (Hair et al., 2013).

	PKQ	VC	PIQ	SIQ	Satisfaction	PL
Perceived KQ	**0.74**					
Virtual Competence	0.313**	n/a				
Platform-based interactivity	0.424**	-0.012	**0.88**			
Sociability-based interactivity	0.128	0.508**	0.113	**0.79**		
Satisfaction	0.225**	0.505**	-0.136	0.274**	**0.86**	
Perceived Learning	0.241**	0.302**	-0.064	0.171*	0.364**	**0.77**
Note: Diagonal bold values represent AVE square root values; *p < 0.05, **p < 0.01, ***p < 0.001. VC is a formative construct, thus no AVE.						

Table 5. Discriminant Validity.

4.4 Structural Model Analysis

In the second step, postulated relational links between latent constructs were tested and inspected using bootstrapping and regression weights. SmartPLS's bootstrapping technique ensures a valid test for the item loading, regardless of the underlying not normal data distribution. Bootstrapping facilitates the retrieving level of significance among constructs. Resampling at 1000 was tested, and the schematic illustration in Figure 4 highlights the significance level between postulated paths – that is extracted through bootstrapping.

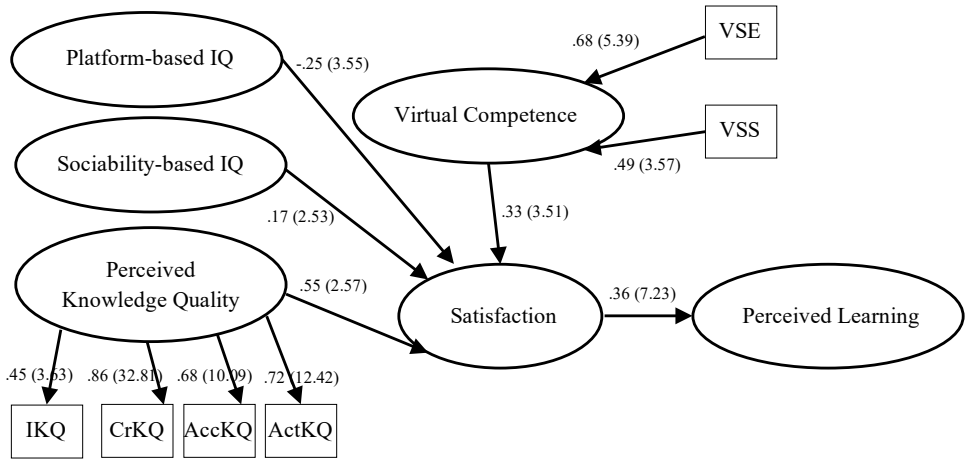

Figure 4. Results of bootstrapping for proposed structural model (IKQ = Intrinsic KQ, CrKQ = Contextual Representational KQ, Acc KQ = Accessible KQ, Act KQ = Actionable KQ, IQ = Interactive Quality, VSE = Virtual Self-efficacy, VSS = Virtual social skills)

The tabulated regression weights in Table 6 present the effect size among hypothesized links. The results indicated a significant association between perceived KQ and students' satisfaction with DLs' content at the coefficient of $\beta = 0.553$ and $P < .001$ – thus our H1 is supported. The relationship between virtual competence and satisfaction is also supported by the effect size of $\beta = 0.333$ and $P < .000$. The coefficient between platform-based interactive quality and satisfaction is $\beta = -0.253$ at $P<0.000$ indicating a negative but significant relationship Thus, the H3a is not supported. On the contrary, Sociability-based interactivity has a significant and positive relationship with satisfaction at the coefficient of $\beta = 0.178$ and $P < .001$ – supporting H3b. Finally, it was found that students' satisfaction is significantly related to perceived learning at $P<0.000$ and a coefficient of $\beta = 0.365$, which provided support for H3.

	Paths	Weights (β)	T-Statistics	Decision
H1	Perceived Knowledge Quality – Satisfaction	0.553	2.578**	Supported
H2	Virtual Competence – Satisfaction	0.333	3.514***	Supported
H3a	Platform-based Interactive Quality – Satisfaction	-0.253	3.557***	Not Supported
H3b	Sociability-based Interactive Quality – Satisfaction	0.178	2.532**	Supported
H4	Satisfaction – Perceived Learning	0.365	7.239***	Supported

Table 6. Structural Relationships.

5 Discussion

The findings adequately support the second-order constructs' (perceived KQ, virtual competence) measurement and proposed mapping of DL success into DeLone and McLean's IS model and integration of virtual competency in a structural relationship.

A second-order perceived KQ construct confirmed four reflective indicators (intrinsic KQ, Contextual Representational KQ, Accessible KQ, and Actionable KQ). Followed by the validation of two indicators to fit the other second-order formative virtual competence construct (*virtual self-efficacy, virtual social skills*). For the next structural relationship, perceived KQ by students proved to be a highly influential factor in the proposed relationships. The significant relationship confirms that the content fulfils the requirements of contextual representation, accessibility, actionability, and intrinsic nature that have further impacted students' satisfaction with the quality of knowledge gained. Students believe that the material provided is presented, easy to access and understand, provides opportunities for engagement and application, and aligns with their interests and needs. This improves the overall

learning (net benefit) and can lead to better retention of information and the success of DLs, in line with an earlier study (Waheed et al., 2016b). Similarly, sociability-based interactive quality has a significant impact on satisfaction, it shows that students feel a sense of belonging, are better able to participate in online discussions, and collaborate with peers and instructors through the DLs that influenced their satisfaction with DLs. Surprisingly, contrary to Yeh et al. (2011) findings, platform-based interactivity is not supported in this study – the plausible reason could be limited control over the DLs functions and services. Finally, virtual competence is also found to be a significant determinant – it is because in the current digital era students have rapidly embraced new technologies and built the competencies to effectively use them, which has improved their adaptability to new systems. Therefore, the findings prove that students have considerable competence to handle the new technology and engage in their virtual social circle which leads to their satisfaction with DLs. Furthermore, the last significant relationship between satisfaction and perceived learning highlights that students are satisfied with the DLs due to the provision of perceived knowledge quality, sociability-based interactivity, and their virtual competence – which has helped them to achieve the desired learning outcomes.

6 Conclusion

A sustainable digital future of education is crucial for higher education institutions – particularly in the post-COVID scenario. COVID-19 restrictions forced an abrupt shift from conventional education methods to Digital learning (Shirish et al., 2021). A worldwide online education report documented 733 million users of online learning platforms in 2023, which is significantly higher since the COVID-19 outbreak in 2020 i.e. 565 million users (Statista, 2023). However, this digital disruption has brought several challenges in many sectors due to a lack of training, evaluation of user perception, and quality of the content (Nadine Diaz-Infante et al., 2022). Students highlighted productivity and learning loss during the pandemic (Hvalshagen et al., 2021), although positive learning experiences through digital tools is also reported (Hussein et al., 2022). Nonetheless, the COVID-19 induced digital transformation has precipitated the issue of desired learning and the DLs success. This certainly augments the need to understand what benefits students perceive they obtain, such as perceived learning from DLs – given the importance of quality digital education and digital competence (DEAP, 2021). Through our study, we investigated the salient factors for the DLs success – and confirm that satisfaction is a significant function of salient factors (knowledge quality, sociability-based interactive quality, and virtual competence) – which contributes to the students' perceived learning (net benefit).

7 Theoretical and Practical contribution

This study makes a number of theoretical and practical contributions. *First*, the Development of the DLs success model by mapping DLs success factors into the building blocks of DeLone and McLean's model i.e., ***quality → satisfaction → net benefits*** is one of the key theoretical contributions of the study. A sequence of influencing factors is mapped to determine the DLs success. Second, the study considers the importance of quality in digital learning and provides detailed insights into the students' perceived knowledge quality and system-based interaction quality. Information quality measurement in the eLearning context (Alkhattabi et al., 2011) and knowledge quality in the organization (Yoo et al., 2011) is documented, however, the updated four-factor perceived KQ construct contributes by providing a comprehensive construct to measure KQ in the European higher education DLs context. Though prior research has shown the importance of information verifiability in online social networks (London et al., 2022), quality of the information in the eLearning context (Alkhattabi et al., 2011), and student-teacher interaction (Conrad et al., 2022), such studies do not emphasize on the role of perceived knowledge quality and system-based interaction quality (platform and sociability based interactive quality) in students' satisfaction with DLs. Our study addresses this gap when these factors have gained more importance due to current digital disruption and demand for high quality digital education (DEAP, 2021). *Second*, this research is one of few IS studies that has theorized multidimensional formative virtual competence (*virtual self-efficacy, virtual social skills*) in DLs

context. The current excessive deployment of web technologies for digital learning after the COVID-19 outbreak (Sava, 2023, L. Ceci, 2023, Mardini and Mah'd, 2022) has made digital competence a key prerequisite to successfully use the DLs. Having said this, the evaluation of only internet self-efficacy limits the understanding and holistic perspective on virtual competence. *Third*, empirical validation of structural relationship between DLs success factors (perceived knowledge quality, interactive quality), virtual competence → satisfaction→ perceived learning (net benefits)) confirms the theoretical integration. This asserts that these factors help to improve students' perceived learning from DLs and avoid blockages of knowledge flow.

The practical contributions are not avoided, *First*, the evidence supported insights benefit the educational community (teachers, coordinators, and platform designers) and provide suggestions for the improvement of pedagogical methods. For example, a careful content contribution by the teachers/coordinators, and the designer's effort for a supportive and error-free platform. *Second*, getting an idea of students' perceptions will highlight the factors that a) have received little attention, and b) are beneficial for the improvements of the online learning environment. It allows higher education institutions to set up standards to better cater for the perceived learning needs of students and develop an environment which provides effective learning opportunities. Providing students with opportunities to gain experience and skills using technology and providing them with the necessary support and resources can help to boost their virtual competence. *Finally*, the study also contributes towards the excellence of teaching at European higher education institutions – where it is suggested that understanding the student's competencies, provision of quality knowledge and interaction not only enhance learning but also build a positive long-term relationship between students and DLs.

8 Limitation and Future Research

The study has significant contributions; however, the limitations can never be neglected and provides an avenue for future research. *First*, the digital transformation due to COVID-19 affected all areas of organization and personal life. However, our research setting focuses only on higher education, where there is a frequent discussion on improving the quality of digital education (DEAP, 2021). Future research involving other research settings considering the massive digital transformation due to COVID-19 is suggested. The DLs success framework adaptation in non-academic settings, for instance, in healthcare with other perceived net benefits, can improve the research generalizability and framework validation at a wider level. *Second*, the proposed framework is tested using the data set collected from German and Swedish university master-level students of English language programs, which limits the provide holistic perspective. Future research from wider audiences, perhaps from other different geographical regions, different languages, and undergraduate levels can give a good comparative perspective. *Third*, we took a novel endeavor and integrated knowledge quality and virtual competence factors into DeLone and Maclean's (2003) IS success model. Though our model has an evident theoretical contribution, other salient factors such as service quality, system, privacy concerns, technology fear and the associated depression (Chennamaneni and Gupta, 2022, Yang et al., 2021), particularly in current time due to COVID induced digital disruption and more screen time might differ the satisfaction level. *Finally*, we have examined only students' perceived learning as a learning outcome, investigating actual learning and other novel outcome variables such as motivation, sense of belonging, and continuous intention (ter Beek et al., 2019, Møgelvang et al., 2023, Rodríguez-Ardura and Meseguer-Artola, 2016) is suggested for interesting future research. Though, the current study provides a holistic perspective to improve the DLs quality and equitable digital education – addressing to future recommendations would advance the insight of the current research area.

References

Adamovic, M., Gahan, P., Olsen, J., Gulyas, A., Shallcross, D. & Mendoza, A. (2022). "Exploring the adoption of virtual work: the role of virtual work self-efficacy and virtual work climate". *The International Journal of Human Resource Management,* 33**,** 3492-3525.

Ahuja, M. K. & Galvin, J. E. (2003). "Socialization in virtual groups". *Journal of Management,* 29**,** 161-185.

Al-Nuaimi, M. N., Al Sawafi, O. S., Malik, S. I. & Al-Maroof, R. S. (2022). "Extending the unified theory of acceptance and use of technology to investigate determinants of acceptance and adoption of learning management systems in the post-pandemic era: a structural equation modeling approach". *Interactive Learning Environments***,** 27.

Alkhattabi, M., Neagu, D. & Cullen, A. (2010). "Information quality framework for e-learning systems". *Knowledge Management & E-Learning: An International Journal (KM&EL),* 2**,** 340-362.

Alkhattabi, M., Neagu, D. & Cullen, A. (2011). "Assessing information quality of e-learning systems: a web mining approach". *Computers in Human Behavior,* 27**,** 862-873.

Ari, F., Arslan-Ari, I., Abaci, S. & Inan, F. A. (2022). "Online simulation for information technology skills training in higher education". *Journal of Computing in Higher Education,* 34**,** 371-395.

Bacon, D. R. 2016. Reporting actual and perceived student learning in education research. Sage Publications Sage CA: Los Angeles, CA.

Banafo Akrong, G., Yunfei, S. & Owusu, E. (2022). "Development and validation of an improved DeLone-McLean IS success model - application to the evaluation of a tax administration ERP". *International Journal of Accounting Information Systems,* 47**,** 100579.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*, Prentice-Hall, Inc.

Bhattacherjee, A. (2001). "Understanding Information Systems Continuance: An Expectation-Confirmation Model". *MIS Quarterly,* 25**,** 351-370.

Cai, J., Yang, H. H., Gong, D., Macleod, J. & Zhu, S. (2019). "Understanding the continued use of flipped classroom instruction: a personal beliefs model in Chinese higher education". *Journal of Computing in Higher Education,* 31**,** 137-155.

Chennamaneni, A. & Gupta, B. (2022). "The privacy protection behaviours of the mobile app users: exploring the role of neuroticism and protection motivation theory". *Behaviour & Information Technology***,** 1-19.

Churchill, J. & Gilbert, A. (1979). "A paradigm for developing better measures of marketing constructs". *Journal of Marketing Research,* 16**,** 64-73.

Conrad, C., Deng, Q., Caron, I., Shkurska, O., Skerrett, P. & Sundararajan, B. (2022). "How student perceptions about online learning difficulty influenced their satisfaction during Canada's Covid-19 response". *British Journal of Educational Technology,* 53**,** 534-557.

Dabbagh, N. & Kitsantas, A. (2012). "Personal Learning Environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning". *The Internet and higher education,* 15**,** 3-8.

Davis, F. D. (1989). "Perceived usefulness, perceived ease of use, and user acceptance of information technology". *MIS quarterly***,** 319-340.

Deap. (2021). *Digital Education Action Plan* [Online]. European Commission. Available: https://education.ec.europa.eu/focus-topics/digital-education/action-plan [Accessed 06.03.2023 2023].

Delone, W. H. & Mclean, E. R. (2003). "The DeLone and McLean model of information systems success: a ten-year update". *Journal of Management Information Systems,* 19**,** 9-30.

Delone, W. H. & Mclean, E. R. (2004). "Measuring e-commerce success: Applying the DeLone & McLean information systems success model". *International Journal of Electronic Commerce,* 9**,** 31-47.

Devellis, R. F. (2012). *Scale Development: Theory and Applications,* London, SAGE Publications.

Edwards, O. V. & Taasoobshirazi, G. (2022). "Social presence and teacher involvement: The link with expectancy, task value, and engagement". *Internet and Higher Education,* 55**,** 11.

Fornell, C. & Larcker, D. F. (1981). "Evaluating structural equation models with unobservable variables and measurement error". *Journal of Marketing Research (JMR),* 18.

Galaige, J., Steele, G. T., Binnewies, S. & Wang, K. (2022). "A Framework for Designing Student-Facing Learning Analytics to Support Self-Regulated Learning". *IEEE Transactions on Learning Technologies,* 15**,** 376-391.

Gamlath, S. & Wilson, T. (2022). "Dimensions of student-to-student knowledge sharing in universities". *Knowledge Management Research & Practice,* 20**,** 542-556.

Hair, J. F., Black, W. C., Babin, B. J. & Anderson, R. E. (2010). *Multivariate data analysis: A Global Perspective,* New Jersey, Pearson.

Hair, J. F., Tomas, G., Hult, M., Ringle, C. & Sarstedt, M. (2013). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM),* London, Sage.

Hassanzadeh, A., Kanaani, F. & Elahi, S. (2012). "A model for measuring e-learning systems success in universities". *Expert Systems with Applications,* 39**,** 10959-10966.

Ho, C. K. Y., Ke, W. & Liu, H. (2015). "Choice decision of e-learning system: Implications from construal level theory". *Information & Management,* 52**,** 160-169.

Howitt, D. & Cramer, D. (2011). *Introduction to SPSS statistics in psychology: for version 19 and earlier*, Pearson.

Hsieh, H.-F. & Shannon, S. E. (2005). "Three approaches to qualitative content analysis". *Qualitative Health Research,* 15**,** 1277-1288.

Hussein, M. H., Ow, S. H., Al-Azawei, A. & Ibrahim, I. (2022). "What drives students' successful reuse of online learning in higher education? A case of Google Classroom". *Australasian Journal of Educational Technology,* 38**,** 21.

Hvalshagen, M., Nittala, L., Raman, R., Sullivan, N. & Zolbanin, H. M. (2021). "When worlds collide: Framing students' challenges with stay-at-home learning during COVID-19 through the lens of conflicting role identities". *Communications of the Association for Information Systems,* 48**,** 29.

Ifinedo, P., Pyke, J. & Anwar, A. (2018). "Business undergraduates' perceived use outcomes of Moodle in a blended learning environment: The roles of usability factors and external support". *Telematics and Informatics,* 35**,** 93-102.

Islam, A. K. M. N. (2013). "Investigating e-learning system usage outcomes in the university context". *Computers & Education,* 69**,** 387-399.

Janson, A., Söllner, M. & Leimeister, J. M. (Year) Published. "Individual appropriation of learning management systems—antecedents and consequences". AIS Transactions on Human-Computer Interaction, 2017. 173-201.

Jennex, M. E. & Olfman, L. (2006). "A model of knowledge management success". *International Journal of Knowledge Management (IJKM),* 2**,** 51-68.

Kaiser, H. F. (1974). "An index of factorial simplicity". *Psychometrika,* 39**,** 31-36.

Khan, I. U., Hameed, Z., Yu, Y., Islam, T., Sheikh, Z. & Khan, S. U. (2018). "Predicting the acceptance of MOOCs in a developing country: Application of task-technology fit model, social motivation, and self-determination theory". *Telematics and Informatics,* 35**,** 964-978.

Kulkarni, U. R., Ravindran, S. & Freeze, R. (2007). "A knowledge management success model: theoretical development and empirical validation". *Journal of Management Information Systems,* 23**,** 309-347.

Kuo, Y.-C., Walker, A. E., Schroder, K. E. E. & Belland, B. R. (2014). "Interaction, Internet self-efficacy, and self-regulated learning as predictors of student satisfaction in online education courses". *The Internet and Higher Education,* 20**,** 35-50.

L. Ceci 2023. Leading learning and education apps in the United States in 2022.

Lee, B.-C., Yoon, J.-O. & Lee, I. (2009). "Learners' acceptance of e-learning in South Korea: Theories and results". *Computers & Education,* 53**,** 1320-1329.

Lee, J.-K. & Lee, W.-K. (2008). "The relationship of e-Learner's self-regulatory efficacy and perception of e-Learning environmental quality". *Computers in Human Behavior,* 24**,** 32-47.

Lee, J.-W. (2010). "Online support service quality, online learning acceptance, and student satisfaction". *The Internet and Higher Education,* 13**,** 277-283.

Leung, A. C. M., Santhanam, R., Kwok, R. C.-W. & Yue, W. T. (2022). "Could Gamification Designs Enhance Online Learning Through Personalization? Lessons from a Field Experiment". *Information Systems Research,* 0**,** null.

Li, Q., Xu, D., Baker, R., Holton, A. & Warschauer, M. (2022). "Can student-facing analytics improve online students' effort and success by affecting how they explain the cause of past performance?". *Computers & Education,* 185**,** 104517.

London, J. J., Li, S. & Sun, H. (2022). "Seems Legit: An Investigation of the Assessing and Sharing of Unverifiable Messages on Online Social Networks". *Information Systems Research,* 33**,** 978-1001.

Mardini, G. H. & Mah'd, O. A. (2022). "Distance learning as emergency remote teaching vs. traditional learning for accounting students during the COVID-19 pandemic: Cross-country evidence". *Journal of Accounting Education,* 61**,** 100814.

Mcgill, T. J. & Klobas, J. E. (2009). "A task–technology fit view of learning management system impact". *Computers & Education,* 52**,** 496-508.

Melzer, P. & Schoop, M. (Year) Published. "Personalising the is classroom – insights on course design and implementation". 25th European Conference on Information Systems (ECIS), June 5-10 2017 Guimarães, Portugal. 1391-1405.

Mitra, S. (2023). "How Are Students Learning in a Business Statistics Course? Evidence from Both Direct and Indirect Assessment". *INFORMS Transactions on Education,* 23**,** 95-103.

Møgelvang, A., Vandvik, V., Ellingsen, S., Strømme, C. B. & Cotner, S. (2023). "Cooperative learning goes online: teaching and learning intervention in a digital environment impacts psychosocial outcomes in biology students". *International Journal of Educational Research,* 117**,** 102114.

Moore, M. G. (1989). "Editorial: Three types of interaction". *American Journal of Distance Education,* 3**,** 1-7.

Nadine Diaz-Infante, Michael Lazar, Samvitha Ram & Ray, A. (2022). Demand for online education is growing. Are providers ready? Available: https://www.mckinsey.com/industries/education/our-insights/demand-for-online-education-is-growing-are-providers-ready#/ [Accessed 06.03.2023].

Pakaja, F. & Wafa, M. (2021). "Social family, parental involvement and intentions: predicting the technology acceptance and interest students learning online". *Interactive Learning Environments***,** 1-16.

Panigrahi, R., Srivastava, P. R. & Panigrahi, P. K. (2021). "Effectiveness of e-learning: the mediating role of student engagement on perceived learning effectiveness". *Information Technology & People,* 34**,** 1840-1862.

Repetti, R. L. & Cosmas, K. A. (1991). "The Quality of the Social Environment at Work and Job Satisfaction 1". *Journal of Applied Social Psychology,* 21**,** 840-854.

Rhode, J. (2009). "Interaction equivalency in self-paced online learning environments: An exploration of learner preferences". *The International Review of Research in Open and Distributed Learning,* 10.

Rodríguez-Ardura, I. & Meseguer-Artola, A. (2016). "What leads people to keep on e-learning? An empirical analysis of users' experiences and their effects on continuance intention". *Interactive Learning Environments,* 24**,** 1030-1053.

Sadurskis, A. 2016. Higher Education in Sweden. *In:* AMFT, A. (ed.). Stockholm, Sweden.

Saleem, S., Feng, Y. & Luqman, A. (2021). "Excessive SNS use at work, technological conflicts and employee performance: A social-cognitive-behavioral perspective". *Technology in Society,* 65**,** 101584.

Sava, J. A. 2023. Main online learning management platforms used by university students.

Schöbel, S. M., Janson, A. & Leimeister, J. M. (2023). "Gamifying Online Training in Management Education to Support Emotional Engagement and Problem-solving Skills". *Journal of Management Education,* 47**,** 166-203.

Shao, Z. (2018). "Examining the impact mechanism of social psychological motivations on individuals' continuance intention of MOOCs". *Internet Research,* 28**,** 232-250.

Shirish, A., Chandra, S. & Srivastava, S. C. (2021). "Switching to online learning during COVID-19: Theorizing the role of IT mindfulness and techno eustress for facilitating productivity and creativity in student learning". *International Journal of Information Management,* 61**,** 102394.

Sprenger, D. A. & Schwaninger, A. (2021). "Technology acceptance of four digital learning technologies (classroom response system, classroom chat, e-lectures, and mobile virtual reality) after three months' usage". *International Journal of Educational Technology in Higher Education,* 18**,** 8.

Statista 2023. Online Education - Worldwide.

Tabachnick, B. G. & Fidell, L. S. (2008). *Using Multivariate Statistics,* Boston, Pearson.

Ter Beek, M., Opdenakker, M. C., Spijkerboer, A. W., Brummer, L., Ozinga, H. W. & Strijbos, J. W. (2019). "Scaffolding expository history text reading: Effects on adolescents' comprehension, self-regulation, and motivation". *Learning and Individual Differences,* 74**,** 12.

Tselios, N., Daskalakis, S. & Papadopoulou, M. (2011). "Assessing the acceptance of a blended learning university course". *Journal of Educational Technology & Society,* 14**,** 224-235.

Waheed, M., Kaur, K. & Kumar, S. (2016a). "What role does knowledge quality play in online students' satisfaction, learning and loyalty? An empirical investigation in an eLearning context". *Journal of Computer Assisted Learning*.

Waheed, M., Kaur, K. & Qazi, A. (2016b). "Students' Perspective on Knowledge Quality in eLearning Context: A Qualitative Assessment". *Internet Research,* 26.

Waheed, M., Klobas, J. E. & Ain, N. (2021). "Unveiling knowledge quality, researcher satisfaction, learning, and loyalty". *Information Technology & People,* 34**,** 204-227.

Wan, Z., Wang, Y. & Haggerty, N. (2008). "Why people benefit from e-learning differently: The effects of psychological processes on e-learning outcomes". *Information & Management,* 45**,** 513-521.

Wang, Y. & Haggerty, N. (2011). "Individual Virtual Competence and Its Influence on Work Outcomes". *Journal of Management Information Systems,* 27**,** 299-334.

Wegener, R. & Leimeister, J. M. (Year) Published. "Peer creation of e-learning materials to enhance learning Success and satisfaction in an information systems course". ECIS Proceedings, June 10-13 2012 Barcelona, Spain. 170.

Wood, R. & Bandura, A. (1989). "Social Cognitive Theory of Organizational Management". *Academy of Management Review,* 14**,** 361-384.

Xing, W. & Wang, X. (2022). "Understanding students' effective use of data in the age of big data in higher education". *Behaviour & Information Technology,* 41**,** 2560-2577.

Yang, C., Chen, A. & Chen, Y. (2021). "College students' stress and health in the COVID-19 pandemic: The role of academic workload, separation from school, and fears of contagion". *PLOS ONE,* 16**,** e0246676.

Yang, C. C. Y. & Ogata, H. (2022). "Personalized learning analytics intervention approach for enhancing student learning achievement and behavioral engagement in blended learning". *Education and Information Technologies*.

Yeh, N.-C., Chuan-Chuan Lin, J. & Lu, H.-P. (2011). "The moderating effect of social roles on user behaviour in virtual worlds". *Online Information Review,* 35**,** 747-769.

Yoo, D. K., Vonderembse, M. A. & Ragu-Nathan, T. (2011). "Knowledge quality: antecedents and consequence in project teams". *Journal of Knowledge Management,* 15**,** 329-343.

Zibak, A., Sauerwein, C. & Simpson, A. (2021). "A success model for cyber threat intelligence management platforms". *Computers & Security,* 111**,** 102466.