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Perspective of Yemeni students on use of online learning: Extending the information systems success model with transformational leadership and compatibility

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Abstract

Purpose – Online learning has evolved into a necessary means of learning because of its capability to enhance the education quality with minimum resources and infrastructure. Nevertheless, while academics have studied the espousal and use of online learning in various settings, the effect of compatibility and transformational leadership (TL) still remains to be seen, with regards to the Yemeni context. The purpose of this paper is to forward the Delone and Mclean Information System (IS) success Model by integrating compatibility and TL constructs as precursors to user contentment and actual use for estimating performance of students.

Design/methodology/approach – The questionnaire technique was utilised for gathering primary data from 448 students in nine state-funded Yemeni universities. The six variables in the recommended framework were gauged utilising current scales. Data analysis was done by deploying structural equation modelling through SmartPLS 3.0.

Findings – The outcomes encompassed three key results: overall quality (data, system and service quality), compatibility and TL have a favourable effect on user satisfaction and actual use; actual use considerably estimates user satisfaction; and user satisfaction and actual use have a favourable effect on performance of students.

Research limitations/implications – Because the research populace comprised students from nine state-funded universities, it did not include administrative and academic staff. Furthermore, as the study was cross-sectional, it studied the variables at a single point of time. Attaining experience in utilising online learning would transform the convictions of students, and this cannot be traced through a cross-sectional scrutiny. Moreover, the research relies upon self-testified measures for ascertaining the recommended research model. The reason behind this is that obtaining objective information regarding performance was not likely because of the privacy concern.

Practical implications – Despite the fact that Yemen is a low-income emerging nation with inadequate resources (World Development Indicators, 2017), it can capitalise on online-based learning that provides the advantage of excellent education and that too with limited supplies (Dokhan and Akkoyunlu, 2016; Yang *et al.*, 2016). Additionally, online learning can enhance administration and communication, empower learning anywhere and anytime, and endorse fairness of education.

Originality/value – This study supplements the existing studies on information systems by blending overall quality, compatibility, TL, actual use and client satisfaction for estimating the effect of online learning among students from nine state-funded Yemeni universities. Moreover, the recommended model's predictive prowess has a higher capability to elucidate and estimate the performance effect as against those acquired from few of the previous studies.

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1. Introduction

Online learning is the utilisation of communication and information technology with regards to education, where it has seen intense research (Aldholay *et al.*, 2018). Since its initiation, it has been recognised with various but comparable terms like "distance learning", "e-learning" and "blended learning". As indicated by Clark and Mayer (2016), online learning is described as conveying directives through the web by utilising digital gadgets such as laptops, desktops, smartphones and tablets. World over, governments are deploying it for endorsing technology in the education domain (Alrajawy *et al.*, 2017; Tenório *et al.*, 2016). Notably, Yemen has to confront troublesome challenges in the education industry. As indicated by The Global Competitiveness Report (2017), the nation is positioned at 116 out of 138 nations as far as the rate of tertiary education enrolment is concerned. Furthermore, there is a gender disparity in tertiary admissions, as per Yemeni Educational Indicators (2015), where female admissions in state-funded universities fall behind male admissions by 50 per cent ($M = 148{,}834$, $F = 78{,}329$). Online learning can assume a noteworthy role in addressing such difficulties, as per UNESCO (2013), by growing the span and parity of education. Worsening the issue is the fact that Yemen is at present amidst a severe civil war. This is negatively influencing university buildings and streets. Considering technology infrastructure (especially mobile) is rapid and less demanding to restore, online learning provides an ideal solution for learners in post-crisis territories. UNESCO (2013) underpins the idea that online learning in strife-prone territories can limit the disruption of the educational practice.

From the perspective of information systems (IS), numerous models and theories have been formulated and recommended for estimating and elucidating user behaviour with regards to technology. Apart from the DeLone and McLean model of information systems success (DMISM) (Delone and Mclean, 1992; DeLone and Mclean, 2003), other renowned models and theories include the diffusion of innovation theory (Rogers, 1995), technology acceptance model (Davis, 1989), theory of planned behaviour (Ajzen, 1985), theory of reasoned action (Ajzen and Fishbein, 1980), unified theory of acceptance and use of technology (Venkatesh *et al.*, 2003) and model of PC utilisation (Chang and Cheung, 2001). Furthermore, empirical research works have thoroughly inspected the espousal and utilisation of new technological advancements (Al-Busaidi, 2013; Islam, 2015; Šumak *et al.*, 2011). However, they have overlooked the assessment of IT utilisation (Islam, 2013). DMISM assesses IT use by looking at the impact of overall quality (data, system and service quality) on client satisfaction and actual use. This then impacts performance and is now broadly deployed to gauge the success of IS (Montesdioca and Maçada, 2015).

As per Hofstede and Minkov (2010), Yemen is a nation which has a significant power distance where people acknowledge hierarchical setup and centralisation is well accepted. According to Elkhani *et al.* (2014) and Rezvani *et al.* (2017a, b), leadership is an essential facilitator in the utilisation of IS. As indicated by the Critical Human Capital Issues Report (2014), one of the primary and vital concerns for high performance entities (as against low-performance entities) is development of leadership. In newer research works on IS, analysts are focusing more accentuation on transformational leadership (TL) as an essential aspect (Jung *et al.*, 2008; Cho *et al.*, 2011; Ömer and Göknur, 2014; Bai *et al.*, 2016; Rezvani *et al.*, 2017a, b). Hofstede and Minkov (2010) classified Yemen as a nation characterised by low individualism attributes (where strong relationships and social impact are high), suggesting that for new technology to be espoused and utilised, it should exhibit compatibility with user principles, convictions and social standards. This concern is pointed out by Shih *et al.* (2008), as a few research works are still not sure of the thought that online learning can indeed enhance the performance of students. According to Islam (2013), online learning

causes a weak impact on performance of students and this might be because of other aspects like compatibility.

Yemen comprises 21 provinces, with just nine state-funded universities in 9 provinces (Aden, Sana'a, Hudaidah, Taiz, Dhamar, Ibb, Amran, Hadramouht, Al-bayda); 12 provinces do not have any state-funded university. Hence, it can be said that the government of Yemen can possibly endorse online learning in the territories which lack a state-funded university with the goal to make education accessible to all provinces and remote zones. In view of this, the government has set up the Yemen Centre for Information Technology in Higher Education (YCIT-HE). This institution is intended to be an authority which endorses IT services in the higher education public entities of Yemen. Al-Absi *et al.* (2017) pointed out that Yemeni students in state-funded universities exceedingly recognised the function of information technology in the education segment. According to Aldowah *et al.* (2015) and Alrajawy *et al.* (2018), the assimilation of conventional and online learning in Yemen faces considerable challenges involving the social, technical and social elements.

It is worth noting here that most research works that employed DMISM were carried in Western nations and hardly any from the perspective of online learning in Yemen, which is characterised by a very different culture. In view of this, this research puts forth an extended DMISM which incorporates two integrated and critical precursors (compatibility and TL) into user satisfaction and actual use. The observations of this investigation might aid in offering critical understandings for policy makers and universities for facing the difficulties they encounter in the higher education domain of Yemen.

2. Theoretical framework

2.1 Overall quality (QUL)

Because of the increasing difficulties and advancements in the domain of IS, experts and researchers are quite eager to enhance the utility and quality of new frameworks to draw on its growth prospect (Wang and Lai, 2014). The overall quality has been looked upon as a second-order construct which incorporates information, service and data quality (Ho *et al.*, 2010; Isaac, Abdullah, Ramayah, Mutahar and Alrajawy, 2017). The results solidly indicate that there is a significant association between actual use of IS, user satisfaction and quality (Flack, 2016). As per Sun *et al.* (2008), the user satisfaction is influenced by overall quality. According to Wang and Liao (2008), quality with regards to technology influences actual use. Furthermore, Petter and McLean (2009) describe system quality as the extent to which the users of a system think that the particular system is convenient to utilise; easy to understand, learn and connect and pleasurable. According to Cheng *et al.* (2013), it is a primary precursor for technology utilisation as well as user satisfaction. Hossain (2016) points out that system quality considerably impacts user satisfaction. According to Abrego-Almazán *et al.* (2017), it influences the actual use. Service quality pertains to the following traits: dependability, tangibles, receptiveness, surety, empathy, usefulness and interactivity (Lin, Fofanah, and Liang, 2011; Pituch and Lee, 2006), and it considerably affects contentment (Oktal *et al.*, 2016) and actual use (Chiu *et al.*, 2016). Quality of information is described as the extent to which users of a system believe that information pertaining to online learning is latest, precise, pertinent, exhaustive and sorted out (Halonen *et al.*, 2009). It is a vital aspect which decides contentment and actual use (Aparicio *et al.*, 2017). Academics have noted its noteworthy effect on user satisfaction (Jung *et al.*, 2015) and actual use (Ramirez-Correa *et al.*, 2017). Thus, the subsequent hypotheses are suggested:

H1. Overall quality significantly impacts user satisfaction.

H2. Overall quality significantly impacts actual usage of online learning.

2.2 Transformational leadership

The function of TL has turned out to be progressively crucial in examining IS success and espousal of technology (Alos-Simo *et al.*, 2017). Generally, TL pertains to encouraging followers to seek higher aims for satisfying self-realising needs (Riggio and Bass, 1997). It is likewise outlined on the basis of four aspects: appeal, individual contemplation, intellectual encouragement and inspirational impetus (Elkhani *et al.*, 2014). For attaining success in the domain of IS, especially online learning, the management of universities can exhibit a high degree of confidence in its utilisation by offering backing, tutoring and facilities. It can render more support by advertising students' online learning favourable experience (Cho *et al.*, 2011).

TL has progressively evolved as one of the critical elements which improve individual performance. This idea has been backed by quite a few research works (Aga *et al.*, 2016; Ding *et al.*, 2017; Ng, 2017; Nguyen *et al.*, 2017). Nonetheless, TL has picked up significance because of its influence in various contexts – for example, in the education (Cetin and Kinik, 2015) and IS domain (Rezvani *et al.*, 2017b). Livingston (2011) and Zhang *et al.* (2018) noted that TL plays a noteworthy part with regards to online learning in the domain of higher education. With regards to this research work, TL is said to play a key part from the context of online learning, wherein lecturers can empower, motivate and stimulate students with regards to implementing better approaches to learn online learning and acknowledge their efforts when deploying the technology. Lecturers can also utilise online learning as a means for teaching and communication to practice leadership skills.

There is an increasing agreement on the need to contemplate on the impact of leadership on the espousal and utilisation of new technologies (Dubelaar *et al.*, 2005). This can be viewed as a contemplation of past studies which noted a considerable impact of leadership on innovation practices (Jung *et al.*, 2008; Gumusluoglu and Ilsev, 2009; Boerner *et al.*, 2007). TL is generally explorative, making it pertinent for the espousal of fresh technology (Sun and Anderson, 2012; Flatten *et al.*, 2015). According to Rezvani *et al.* (2017a, b), TL has a positive association with satisfaction. Ghazali *et al.* (2015) noted that TL considerably impacts system success which has clearly succeeded system utilisation. Thus, the subsequent hypotheses are suggested:

H3. TL significantly impacts user satisfaction.

H4. TL significantly impacts actual usage of online learning.

2.3 Compatibility (CMP)

In the domain of IS, compatibility is termed as a basic precursor for users' espousal of new application or technology (Mutahar *et al.*, 2017; Cheng, 2015; Ozturk *et al.*, 2016). Premkumar (2003) observed it to be a key indicator of espousal of innovation. According to Rogers (1995), compatibility is the extent to which an innovation is seen as being in line with the prevailing ideals, needs and previous experiences of prospective adopters. Notably, the past research works in the internet and education domain has not quite given careful consideration to this aspect (Kit *et al.*, 2005). Wu and Wang (2006) noted that high compatibility triggers better espousal of mobile systems. In this research work, compatibility is described as the extent to which online learning technology gels with the ideals, convictions, and ways of life of students (Ozturk *et al.*, 2016). Islam and Azad (2015) noted that compatibility considerably impacts satisfaction. Cheng (2015) observed that a significant relationship exists between compatibility and utilisation with regards to mobile education in Taiwan. Thus, the subsequent hypotheses are suggested:

H5. Compatibility significantly impacts user satisfaction.

H6. Compatibility significantly impacts actual usage of online learning.

2.4 Actual usage (USE)

As per DeLone and McLean (2016), actual use is the extent to which a person utilises the competences of an IS with regards to recurrence, nature and span of utilisation. In online learning, the actual use additionally echoes the span and frequency of usage (Kim *et al.*, 2007). Furthermore, DeLone and McLean (2016) showed that, of the most vital bearings in technology utilisation, one is the need to evaluate the effect of system use on IS success aspects such as performance. Quite a few research works have inspected the impact of actual utilisation on satisfaction and performance (Hou, 2012). In spite of mixed outcomes, it was ascertained that a significant association exists between actual use and performance and satisfaction (D'Ambra *et al.*, 2013; Isaac *et al.*, 2017b; Makokha and Ochieng, 2014; Ramirez-Correa *et al.*, 2017). Notably, there are some research works that have observed an insignificant relationship (Cho *et al.*, 2015; Wu and Wang, 2006). Unlike other research works that analysed the impact of satisfaction on actual use (Jafari *et al.*, 2011), this research inspects the impact of actual use on satisfaction, as prescribed by Isaac *et al.* (2017a, b) Thus, the subsequent hypotheses are suggested:

H7. Actual usage significantly impacts user satisfaction.

H8. Actual usage significantly impacts performance impact.

2.5 User satisfaction (SAT)

Because user satisfaction is viewed as one of the fundamental determinants while evaluating the success of espousal of new system, it has been extensively deployed as an indicator in the IS domain (Montesdioca and Maçada, 2015). As per Xinli (2015), user satisfaction pertains to the degree to which a consumer sees a system to be helpful and desires to utilise it once more. According to Lin and Wang (2012), user satisfaction is the user's contentment as to the speed of the system, quality, number of functions and design. Furthermore, it has been described as the extent to which students utilising online learning are content with their choice to utilise it and how well it lives up to their anticipations (Roca *et al.*, 2006; Wang, 2008; Wang and Liao, 2008). Various research works have demonstrated that user satisfaction affects performance in different contexts and technology usages. For example, according to Isaac, Abdullah, Ramayah, Mutahar and Alrajawy (2017), user satisfaction considerably impacted the effect of performance. Stefanovic *et al.* (2016) observed a similar significant relation between user satisfaction and clear benefits. Conversely, Daud *et al.* (2011) noted an insignificant relation between user satisfaction and effect of performance. Thus, the subsequent hypothesis is suggested:

H9. User satisfaction significantly impacts performance impact.

2.6 Performance impact (PI)

Researchers of IS have employed the intent to use or actual use as the dependent variable while analysing aspects influencing the espousal of specific technology systems (Cheng *et al.*, 2015; Cheung and Vogel, 2013; Iqbal and Qureshi, 2012). Nonetheless, with quickly evolving technology and the advent of numerous new systems, the emphasis is now on the results of system utilisation with regards to performance improvement to assess and gauge system efficacy (Isaac *et al.*, 2017a, b, c, d; Isaac, Abdullah, Ramayah, Mutahar, and Alrajawy, 2017; Chen, 2013; Montesdioca and Maçada, 2015). Effect of performance is described as the degree to which system use raises the quality of work by aiding to accomplish the task rapidly, enables command over work, enhances job performance, weeds out mistakes and propels efficiency at work (Isaac *et al.*, 2016; Norzaidi *et al.*, 2007). In this research work, the effect of performance is outlined as the

extent to which online learning affects the performance of students with regards to saving of resources, efficiency, capability and knowledge attainment (Isaac, Abdullah, Ramayah, Mutahar and Alrajawy, 2017).

3. Study methodology

3.1 Research framework

For this research work, the hypothesised variable factors and their relations in the framework have been obtained from the existing works on the models and hypotheses which have been recommended in the studies stated above. The recommended expanded framework is depicted in Figure 1. While inspecting the framework, one can observe that overall quality (encompassing system, service and information quality) influences user satisfaction and actual utilisation constructs, and both project performance effect. These relations are attained from DeLone and Mclean (2003), while TL is derived from Ghazali *et al.* (2015) and Rezvani *et al.* (2017a, b). Compatibility is taken from Cheng (2015) and Islam and Azad (2015). The recommended extended framework analyses the relationship between overall quality, TL and compatibility as precursor factors to user satisfaction and actual use which in turn explains performance impact as an output variable among students who used or are still using online learning in nine public universities in Yemen. The proposed model has nine hypotheses to test.

3.2 Study measurements

A 33-item survey was formulated for this research work, and in accordance with the current literature in the domain of IS, a multi-item Likert scale was employed (Lee *et al.*, 2009). The variable factors were gauged by employing the seven-point Likert scale, with 7 being "strongly agree" and 1 being "strongly disagree", with the exception of actual use which was gauged using a five-rank scale. Considering the fact that the participants were Arabic-speakers, it was important that the questionnaire was accurately translated into Arabic from English (Brislin, 1970).

3.3 Data collection

Gathering of data was done by utilising in-person self-administered questionnaire during the period October 2016–April 2017 to students who had utilised or were availing online learning in the main libraries of nine state-funded Yemeni universities. In all, 800 questionnaires were distributed; 464 sets were returned, of which 448 were deemed useful for further analysis. The respondents' demographic profile is depicted in Table I.

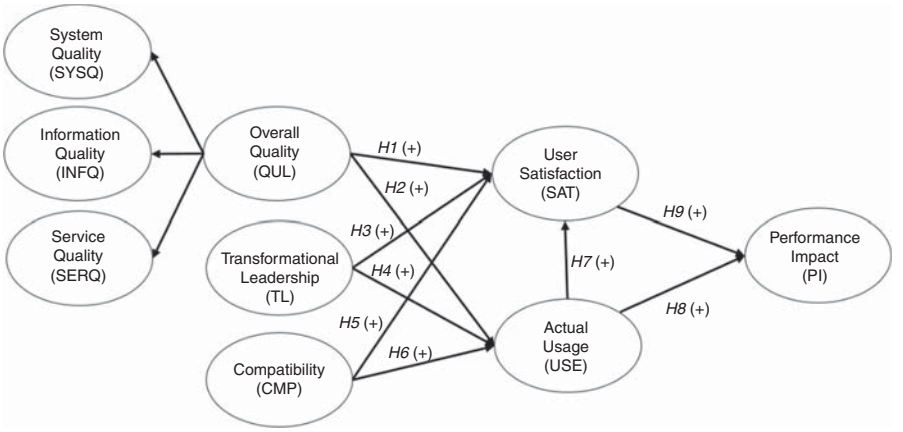

Figure 1.
The proposed integrated framework

Item	Categories	Frequency	Percentage
Gender	1. Male	240	53.5
	2. Female	208	46.4
Marital status	1. Single	379	84.6
	2. Married	53	11.8
	3. Divorced	5	1.1
	4. Widowed	1	0.2
	5. Others	10	2.2
Age	1. Less than 20 years	85	19.0
	2. 20–29 years	343	76.6
	3. 30–39 years	16	3.6
	4. 40–49 years	3	0.7
	5. 50 years and above	1	0.2
Education Background	1. High school	218	48.7
	2. Diploma	51	11.4
	3. Bachelor degree	156	34.8
	4. Master degree	11	2.5
	5. PhD/DBA degree	3	0.7
	6. Others	9	2.0
Faculty	1. Applied science	356	79.4
	2. Social, humanities and art	92	20.5

Table I. Respondents profile

4. Study results

This research work deployed the structural equation modelling-variance based, the partial least squares (PLS) methodology and the SmartPLS 3.0 software for analysing the research model (Ringle *et al.*, 2015). Two-stage analytical approach suggested by Anderson and Gerbing (1988) and Hair *et al.* (2017), beginning with the measurement model evaluation, and then the structural model evaluation. The key reason behind selecting PLS as a statistical approach is that it provides concurrent analysis of the measurement as well as structural model, driving more precise estimates (Barclay *et al.*, 1995).

4.1 Measurement model evaluation

Construct reliability and validity (encompassing convergent and discriminant validity) were deployed for appraising the measurement model. The specific Cronbach's α coefficients were put to test for ascertaining the dependability of each key parameter in the model (construct reliability). The quantities of all distinctive Cronbach's α coefficients ranged from 0.818 to 0.959, going beyond the recommended value of 0.7 (Kannana and Tan, 2005). Furthermore, for checking construct reliability, the composite reality values ranged from 0.905 to 0.965, going beyond 0.7 (Werts *et al.*, 1974; Kline, 2010; Gefen *et al.*, 2000). Hence, as Table II depicts, construct reliability has been met as Cronbach's CR and α were quite error free for each parameter.

Indicator reliability analysis was carried out through factor loadings. When the indicators are quite similar, it is reflected in the construct and indicated by its high loadings (Hair *et al.*, 2017). According to Hair *et al.* (2010), when the values go beyond 0.50, it indicates significant factor loadings. According to Table II, all constructs in this study had factor loadings larger than the recommended value of 0.7, except for the item INFQ5 that was eliminated from the scale due to low loading.

The average variance extracted was deployed for scrutinising the convergent validity that signifies the extent to which a measure has positive correlation with the other measures of the same construct. All the average variance extracted values ranged from 0.713 to 0.846, going beyond the recommended value of 0.50 (Hair *et al.*, 2010).

Hence, all constructs have conformed to the convergent validity adequately, as depicted in Table II.

The extent to which the constructs differentiate between concepts or measure various constructs is exhibited by discriminant validity. Fornell–Larcker were deployed to scrutinise the discriminant validity of the measurement model as shown in Table III. It was observed that the square root of the AVEs on the diagonals (shown in italic) is larger compared to the correlations between constructs (corresponding row and column values), indicating a robust relationship between the conceptions and their respective markers as against the other conceptions in the model (Fornell and Larcker, 1981; Chin, 1998a, b). As per Hair *et al.* (2017), this signifies reasonable discriminant validity. Moreover, the exogenous constructs exhibit a correlation of under 0.85 (Awang, 2014). Thus, the discriminant validity of all constructs was fulfilled to a satisfactory extent.

This research work evaluates discriminant validity by means of HTMT. The discriminant validity exhibits a problem when the HTMT value is larger than the $HTMT_{0.90}$ value of 0.90 (Gold *et al.*, 2001), or the $HTMT_{0.85}$ value of 0.85 (Kline, 2010). All values (Table IV) were lower compared to the suggested value of 0.85, signifying that discriminant validity has been determined.

4.2 Structural model assessment

The structural model can be put to test by calculating β, R^2 and the corresponding *t*-values through a bootstrapping process with a resample of 5,000 (Hair *et al.*, 2017).

4.2.1 Direct effect hypotheses. Figure 2 and Table V show the evaluation of the structural model, depicting the outcomes of the hypothesis tests. Overall quality, compatibility, TL and actual use of online learning significantly project satisfaction of users. Thus, *H1*, *H3*, *H5* and *H7* are accepted with ($\beta = 0.283, t = 5.858, p < 0.001$), ($\beta = 0.173, t = 4.692, p < 0.001$), ($\beta = 0.200, t = 5.145, p < 0.001$) and ($\beta = 0.308, t = 7.381, p < 0.001$), respectively. Similarly, overall quality, TL and compatibility significantly project the actual utilisation of online learning. Thus, *H2*, *H4* and *H6* are supported ($\beta = 0.411, t = 7.761$, p < 0.001), ($\beta = 0.124, t = 3.213, p < 0.01$) and ($\beta = 0.219, t = 4.086, p < 0.001$), respectively. These are in line with the actual use of online learning and user satisfaction that is observed to be significantly affecting performance impact. Thus, *H8* and *H9* are accepted with ($\beta = 0.380, t = 9.850, p < 0.001$) and ($\beta = 0.479, t = 13.258, p < 0.001$), respectively.

Overall quality, compatibility, TL and actual use of online learning elucidated 60 per cent of the variance in user satisfaction. Overall quality, compatibility and TL elucidate 41 per cent of the variance in actual utilisation of online learning. Furthermore, actual use of online learning and user satisfaction elucidate 61 per cent of the variance in performance impact. The R^2 values attained a satisfactory degree of explanatory power as suggested by Cohen (1988) and Chin (1998a, b), signifying a substantial model. Based on the criteria of Gefen and Rigdon (2011), the outcome of f^2 (Table V) shows that two relationships with medium effect sizes, while the rest with small effect sizes.

4.2.2 Importance-performance map analysis. Importance-performance matrix analysis (IPMA) was used as a *post hoc* PLS process in this research, with the organisational competence used as the resultant construct. As per Hair *et al.* (2017), IPMA gives an approximation of the overall effects related to the significance of predecessor parameters in influencing the target construct (superiority of the organisation); the mean latent parameter scores relate with their performance, while the calculation for the values of the index (performance scores) was performed by rescaling the latent parameters scores which varied from 0 (lowest performance) up to 100 (highest performance). IPMA improves the outcomes of PLS assessment (Ringle and Sarstedt, 2016) since it focuses on the average value of latent constructs and their indicators (the dimension of performance) besides performing the path

Table II. Measurement model assessment

First-order constructs	Second-order construct	Item	Indicators	Loading (> 0.5)	M	SD	α (> 0.7)	CR (> 0.7)	AVE (> 0.5)
System quality (SYSQ)		SYSQ1	Easy to use	0.871	4.773	1.601	0.848	0.908	0.767
		SYSQ2	Flexible	0.885					
		SYSQ3	Understandable	0.871					
Information quality (INFQ)		INFQ1	Up-to-date	0.857	5.088	1.447	0.870	0.911	0.719
		INFQ2	Accurate	0.823					
		INFQ3	Relevant	0.850					
		INFQ4	Comprehensive	0.863					
		INFQ5	Organised	Deleted					
Service quality (SERQ)		SERQ1	Responsiveness	0.894	4.824	1.504	0.875	0.923	0.800
		SERQ2	Functionality	0.915					
		SERQ3	Interactivity	0.874					
	Overall Quality (QUL)	SYSQ	System quality	0.866	4.930	1.327	0.926	0.906	0.763
		INFQ	Information quality	0.925					
		SERQ	Service quality	0.822					
Transformational leadership (TL)		TL1	Intellectual stimulation	0.838	4.319	1.474	0.865	0.908	0.713
		TL2	Inspirational motivation	0.883					
		TL3	Individualised consideration	0.847					
		TL4	Idealised influence	0.810					
Compatibility (CMP)		CMP1	Compatible with values	0.875	4.460	1.493	0.843	0.905	0.761
		CMP2	Compatible with lifestyle	0.873					
		CMP3	Compatible with needs	0.868					
User satisfaction (SAT)		SAT1	Satisfied with the decision	0.924	4.679	1.559	0.915	0.946	0.845
		SAT2	Meet the expectations	0.927					
		SAT3	Overall satisfaction	0.921					
Actual usage (USE)		USE1	Frequency of usage	0.922	4.286	1.223	0.818	0.916	0.846
		USE2	Duration of use	0.918					
Performance impact (PI)		PI1	Time saving	0.860	4.747	1.382	0.959	0.965	0.732
		PI2	Effort saving	0.871					
		PI3	Cost saving	0.817					
		PI4	Improves performance	0.870					
		PI5	Enhances effectiveness	0.871					
		PI6	Eliminate errors	0.852					
		PI7	Realise future target	0.852					
		PI8	Acquire new knowledge	0.862					
		PI9	Acquire new skills	0.862					
		PI10	Come up with innovative ideas	0.838					

Notes: AVE, average variance extracted; M, Mean; α, Cronbach's α; SD, standard deviation; CR, composite reliability

Factors	1 CMP	2 PI	3 QUL	4 SAT	5 TL	6 USE
1. CMP	*0.872*					
2. PI	0.593	*0.856*				
3. QUL	0.607	0.661	*0.873*			
4. SAT	0.615	0.728	0.667	*0.924*		
5. TL	0.467	0.476	0.448	0.519	*0.844*	
6. USE	0.525	0.693	0.599	0.654	0.410	*0.920*

Table III.
Fornell–Larcker assessment

Note: The square root of the average variance extracted are represented diagonals and the other values represent the correlations

Factors	1 CMP	2 PI	3 QUL	4 SAT	5 TL	6 USE
1. CMP						
2. PI	0.658					
3. QUL	0.688	0.703				
4. SAT	0.699	0.776	0.725			
5. TL	0.546	0.522	0.503	0.583		
6. USE	0.633	0.782	0.689	0.755	0.487	

Table IV.
HTMT assessment

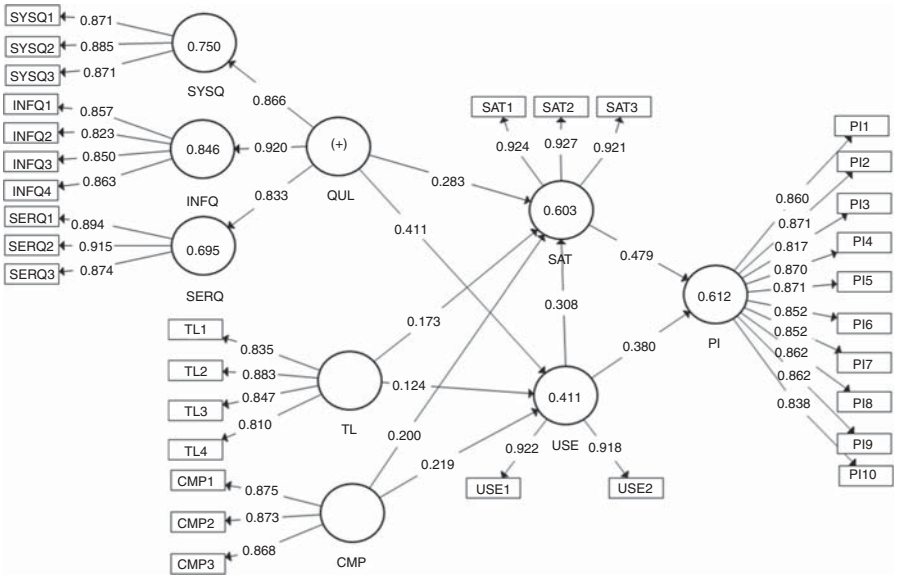

Figure 2.
PLS algorithm results

Notes: SYSQ, system quality; INFQ, information quality; SERQ, service quality; QUL, overall quality; TL, transformational leadership; CMP, Compatibility; SAT: user satisfaction; USE, actual usage; PI, performance impact

Hypothesis	Relationship	Std. β	SE	t-value	Decision	R^2	f^2
H1	QUL → SAT	0.283	0.048	5.858***	Supported	0.60	0.103
H2	QUL → USE	0.411	0.053	7.761***	Supported	0.41	0.171
H3	TL → SAT	0.173	0.037	4.692***	Supported		0.055
H4	TL → USE	0.124	0.038	3.213**	Supported		0.019
H5	CMP → SAT	0.200	0.039	5.145***	Supported		0.056
H6	CMP → USE	0.219	0.053	4.086***	Supported		0.047
H7	USE → SAT	0.308	0.042	7.381***	Supported		0.141
H8	USE → PI	0.380	0.039	9.850***	Supported	0.61	0.213
H9	SAT → PI	0.479	0.036	13.258***	Supported		0.339

Notes: QUL, overall quality; TL, transformational leadership; CMP, compatibility; SAT, user satisfaction; USE, actual usage; PI, performance impact. **$p < 0.01$; ***$p < 0.001$

Table V. Structural path analysis result

coefficients assessment (the significance dimension). The outcomes for total effects (for significance) and index values (for performance) of the IPMA of the resultant construct are shown in Table VI.

The scores for overall effects and values of index were outlined on a priority map (refer to Figure 3). It is worth noting that actual online learning use is a significant factor in estimating the performance effect because of its comparatively higher significance value in comparison to other parameters. User fulfilment is another important aspect in determining the performance effect. For the antecedent parameters, the overall quality is the important factor.

Nonetheless, the performance of actual use aspect was less than other parameters (TL, user satisfaction, overall quality and compatibility). As per Hair *et al.* (2017), IPMA's

Latent constructs	Total effect of the construct actual usage of online learning (importance)	Index values (performance)
Overall quality (QUL)	0.353	66.04
Transformational leadership (TL)	0.148	55.28
Compatibility (CMP)	0.211	57.73
User satisfaction (SAT)	0.479	61.28
Actual usage (USE)	0.528	54.77

Table VI. IPMA assessment

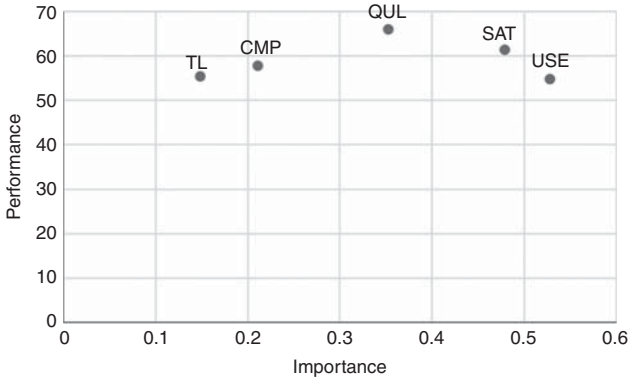

Figure 3. IPMA (priority map) for performance impact

objective is to determine the predecessors which have a comparatively high significance for the target parameter (i.e. those having a strong overall effect) but also a comparatively low performance (i.e. low mean latent parameter scores). The factors underlying these parameters represent prospective areas of betterment that may need high attention.

Even though the parameter TL performance is comparatively intermediate, it has little significance in influencing the performance effect. All in all, in order to enhance the performance effect, administrative activity should concentrate on improving the performance of actual use and user fulfilment.

5. Discussion

On the basis of extended DMISM, this research gives a better understanding about the part played by compatibility and TL in the course of adoption and use of online learning by students from nine Yemeni public universities, and emphasises relevant repercussions and recommendations for university administration and policy makers to understand the consequences of online learning. Furthermore, there are detailed discussions that follow.

The research discovered that the net quality has a substantial positive impact on user fulfilment aspect which suggests that higher quality of online learning with respect to flexibility, easiness, accuracy, up-to-date, comprehensiveness, relevance, interactivity, functionality and responsiveness will entail more students of the view that it is meeting their expectations and in turn feel fulfilled. These findings are consistent with earlier studies (Abrego-Almazán *et al.*, 2017; Chiu *et al.*, 2016; Tam and Oliveira, 2016).

Additionally, the outcomes also revealed that the total quality has a substantial positive impact on actual use aspect, suggesting that higher quality of online learning with respect to flexibility, easiness, accuracy, up-to-date, comprehensiveness, relevance, interactivity, functionality and responsiveness will entail higher duration and frequency of the use of online learning by the students. This is in line with prior studies (Althunibat, 2015; Dokhan and Akkoyunlu, 2016; Wang and Lai, 2014).

The outcomes also confirmed that TL considerably affects user fulfilment and actual use, meaning that it is more likely that students feel fulfilled and use online learning when higher management incites their intellect and inspires them by appreciating their effort in online learning use and its significance. This outcome is in accordance with previous studies regarding the TL's role (Alos-Simo *et al.*, 2017; Cho *et al.*, 2011). In case of compatibility (Ainin *et al.*, 2015; Aldás-Manzano *et al.*, 2009; Islam and Azad, 2015; Koenig-Lewis *et al.*, 2010), the outcome confirmed the substantial impact of compatibility in user fulfilment and actual use, suggesting that if students view online learning as in line with their principles, needs and lifestyles, they will feel more satisfied with it and will use it more.

The outcomes confirm that total quality is the principal key antecedent that can play a significant role as regards student fulfilment and actual use, which is followed by compatibility and finally TL. As per the assessment of importance-performance map, even though TL trails behind with respect to importance, in fact it performed excellently in the model. This suggests that with respect to Yemeni public universities, TL can contribute to online learning adoption.

With respect to the impact of actual usage on user fulfilment, the outcomes showed that actual use has a substantial impact on user fulfilment, and it is in line with the earlier studies (Stefanovic *et al.*, 2016; Isaac, Abdullah, Ramayah, Mutahar and Alrajawy, 2017; Norzaidi, 2008), and described by the concept that when actual online learning use by Yemeni public universities students increases, there is an increase in their satisfaction.

With respect to the impact on performance effect by actual use and user fulfilment, respectively, it was proved that user fulfilment and actual usage significantly estimate performance impact, which is consistent with previous studies (Hou, 2012; Islam, 2015;

Kim *et al.*, 2015) and corroborates both hypotheses. It can also be understood by the statement that when Yemeni public universities students increase the duration and frequency of usage of online learning and have initial satisfaction with it, it results in an improvement in their performance with respect to three aspects: efficiency (complete task rapidly, easily and by saving money), knowledge attainment (acquire new information and skills, think innovatively, facilitate learning) and efficiency (academic productivity and learning performance), while enhancing reasonably the fourth aspect which is competence (reduce errors and achieve future targets). On the other hand, Wu and Wang (2006) mentioned that actual use has no substantial effect on perceived advantage. Khayun and Ractham (2011) also suggested that there is no correlation among actual use and performance effect, and Cho *et al.* (2015) concluded that actual use does not determine the performance effect. These inconsistent results may be justified by different research settings and parameters that are meant to determine actual usage.

6. Implications

6.1 Research implications

Online learning use has been studied at length with respect to adoption, and, in this research, we provide an insight into a model that can be developed after its use. Besides successfully expanding the success information system model of Delone and Mclean, it has been put into operation for a new context and setting, that is online learning in the educational domain of Yemen. Moreover, this study has endorsed a second-order model of total quality with the objective to increase the power of justifying user fulfilment and actual use, which involves three first-order parameters (information quality, service quality and system quality). The information success model of Delone and Mclean has been expanded by adding compatibility and TL parameters with the aim to create a firm model for use in new contexts. Moreover, in this research, 61 per cent of the performance effect variance was justified. The model's predictive power, which involves compatibility and TL, has a greater ability to predict and explain performance impact in comparison to models from certain previous studies, in which performance impact variance described was 46 per cent (Khayun and Ractham, 2011), 42 per cent (Xinli, 2015), 40 per cent (Wang and Liao, 2008) and 37 per cent (Hou, 2012). At last, this study offers evidence that the suggested model can be more efficient in explaining performance effect, especially with respect to the context of online learning compared to other models in the earlier literature.

6.2 Practice implication

As the objective of this research is to determine the antecedents and the results of usage of online learning, its outcomes play an important role in solving the problems of higher education domain of Yemen in two aspects. First, since Yemen is an enormous country having 21 governorates and only few of them possess public institutions for higher education with a huge number of students, learning online can be a feasible option. Second, Yemen's on-going war has influenced the accessibility and infrastructure of the already present few public institutions for higher education, for which the option of online learning can become a solution in these difficult times.

The results of this research can also be useful as a guide for YCIT-HE which was set up as an authority that facilitates the IT services in the universities of Yemen for students, academicians and administrative staff by emphasising on the important aspects and the positive impact of novel technology in solving several issues which are faced by the sector of higher education. It supports and promotes the implementation of the master plan in higher education at the organisational as well as national level (Al-Madhagy, 2013).

Yemen scored badly (11.2 out of 100) in the Global Innovation Index (2017) indicator for ICT use, as mobile devices only have a rate of subscription of 67.98 per cent for every 100 people (World Development Indicators, 2017) in the nation. Several governments have positively expanded educational prospects by adapting technology already owned by the people, instead of offering new gadgets (UNESCO, 2013). There is a chance for the government of Yemen to encourage online learning via mobile devices, since several studies have confirmed the advantages of online learning like saving of efforts and time, improvement in learning efficiency, accessible accurate and up-to-date knowledge with greater responsiveness, availability of multimedia content and interactive communication facility (Almaiah *et al.*, 2016; Domingo and Garganté, 2016; Isaac *et al.*, 2017b, c).

Even though Yemen is considered a low-income developing nation with few resources (as per World Development Indicators, 2017), it can make the most of online learning which provides the benefit of education of high quality with few resources (Dokhan and Akkoyunlu, 2016; Yang *et al.*, 2016). Also, online learning can enhance communication and management, enable anywhere and anytime learning and foster equity of education.

This research demonstrates that TL and compatibility significantly estimate gratification and actual use, which subsequently explains 61 per cent of variance in the performance. Therefore, it is crucial for university administration to concentrate on such antecedents that benefit from the gains of online learning. The inferences of this study are not just limited to institutions for higher education since learning is an important part of any individual. For instance, with KMS (knowledge management systems), online learning is crucial for supporting the phases of KMS. The effective online learning use can enhance competence of the organisation. As such, this study is imperative for worldwide companies which utilise online learning partially, since the aspect of user compatibility influences their performance of learning. Even inside the institution, online learning policies have to be planned for individual users on the basis of their specific needs and characteristics.

The results of this research can be a guideline for the domain of higher education universities in Yemen to develop effective and successful plans to enhance the performance, and their administrative needs to encourage and support students for online learning use by providing recognition to its significance. Moreover, it emphasises the domains that university administration needs to focus on with IS tools that will play an important role in greater student registration, solve infrastructure issues and enhance the quality of academic outcomes. These three aspects represent Yemen's major challenges in the domain of higher education. The inferences of the significant results of this study offer several benefits, not just to students of higher education, but also to the professionalism of higher education universities and the overall economy, since students in this research generally consented that online learning use helped enhance knowledge acquisition, offered saving of resources and improved efficiency and competence. These findings should inspire the Yemeni Government to focus on the significance of the impact of innovative technology in solving the various problems which are faced by the higher education domain, and provide substantive encouragement in the implementation of the master plan in higher education at both the organisational and the national level.

7. Future directions and Limitations

Although this research provides new and useful insights for both theory and practice, the results should be considered with caution as they face constraints in three aspects. First, as the study sample comprised students belonging to nine public institutions, it excluded academicians and administrative staff. Another aspect is that the study was cross-sectional. While having experience in the online learning use will change the beliefs of the students, it cannot be traced using cross-sectional research. The last aspect is that the research relied on

self-reported evaluations for testing the proposed model of research since obtaining objective data regarding performance was not viable because of privacy issues that could nullify the significance of the results to other contexts.

Moreover, the researchers could modify the result through performance of the organisation instead of individual performance, and since there is a chance of regulating role of tradition existing in regards to individualism/collectivism, this is a possible domain to be explored by the researchers. Moreover, a compare group assessment on the basis of the study major such as social and applied studies in context of online learning could bring innovative insights. Besides, examining the relationship among TL and student achievement is a possible area for future researchers to study. At last, since the technology is advancing rapidly, it could be advantageous to confirm the results in longitudinal settings so as to explore how technological progress influences the use of online learning.

8. Conclusion

The continuing advancement of online technology is having a significant impact on education technology as it is shaping the way future learning will be conducted. In trying to solve the problems faced by the Yemeni higher education sector in terms of growing student population, weak infrastructure, low-quality education and limited resources (Isaac *et al.*, 2016), this research investigated the part played by compatibility and TL as antecedents in DMISM among students from nine public universities in Yemen. The results revealed that the proposed framework was successful in demonstrating the constructs of the impact of online learning on student academic performance. Moreover, the research also revealed that both compatibility and TL play an important role in predicting user satisfaction and actual online learning use. Hence, practitioners should focus on such factors to maximise performance standards. These findings significantly support Yemeni government initiatives in the higher education sector to create an enjoyable environment in which students are more likely to use online learning, enhancing their academic professionalism and ultimately the quality of their working life. The implications of this study from the perspective of research and practitioners have been deliberated, and limitations and some directions for future research have been addressed.

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