Education Tech Research Dev
https://doi.org/10.1007/s11423-019-09705-z

DEVELOPMENT ARTICLE

Evaluating students experiences using a virtual learning environment: satisfaction and preferences

Nazire Burcin Hamutoglu[1] · Orhan Gemikonakli[2] · Ibrahim Duman[3] · Ali Kirksekiz[4] · Mubin Kiyici[5]

Abstract
Virtual learning environments (VLEs) are web-based software systems that enable students to interact with their teachers and classmates, access learning resources without restriction of time and place, and use cutting-edge Information and Communication Technologies. Nevertheless, VLEs are costly to develop and maintain. Clearly, many features of VLEs may not be as useful to learners as designers and stakeholders might think, resulting in waste of resources. With this possibility in mind, the purpose of this study was to evaluate the effectiveness of the features of the VLE employed at Middlesex University. To that end, first, a scale with 11 items and 3 sub-dimensions was developed and tested through exploratory and confirmatory factor analyses to identify student perceptions of the (1) benefit, (2) satisfaction, and (3) guidance, aiming at identifying student views on how beneficial the system was, whether they were satisfied with it, and how they perceived the guidance provided through it, respectively. Next, the scale was administered to a sample of 278 students to determine whether the perceptions differed depending on campus location, and grade level. Finally, questions were also asked to pinpoint the features of the VLE that the students found most useful and beneficial. Data were analysed through ANOVA, correlation, and rank analyses. Results show that the students' perception of the VLE did not significantly differ based on campus location or grade level. Two features of the VLE—lecture capture and key concept videos—were the most beneficial resources for the students, whereas "lecture capture with PowerPoint slides and audio only," discussion forums, and chat rooms, were not preferred. The students were not much enthusiastic to have access to blogs, audio/video conferencing facilities, wikis, or chat either.

Keywords Higher education · Usefulness · Satisfaction · Benefit · Guidance · Virtual learning environment

✉ Nazire Burcin Hamutoglu
nazire.hamutoglu@ahievran.edu.tr; bhamutoglu@sakarya.edu.tr

Extended author information available on the last page of the article

Published online: 22 August 2019

Introduction

Virtual learning environments (VLEs) are web-based systems that enable students to interact with teachers and classmates, access learning resources anytime and anywhere, and use cutting-edge Information and Communication Technologies (ICTs) (Bergen et al. 2012; Dillenbourg et al. 2002; Martins and Kellermanns 2004). Along with the developments in ICTs, the role of VLEs in educational activities has become increasingly important (Walker et al. 2014). Today, to support students and lecturers in the process of teaching and learning, almost all universities in the developed countries own some form of VLE such as Moodle or Blackboard (Bergen et al. 2012; Cassidy 2016). Browne et al. (2006) have stated in their longitudinal study that although there is a clear evidence that VLEs are increasingly popular in higher education, the use suffers from the lack of widespread change in pedagogic practices. Approaching to the problem from a different perspective, Khlaisang and Songkram (2019) have stated that using VLE systems can help improve the demand for higher education in the twenty-first century, especially knowledge acquisition, and cognitive skills development—one of the challenge of educating the digital generation. Nevertheless, VLEs are costly to develop and maintain in terms of time and budget. Considering that, many features of VLEs may not be as useful to learners as designers and stakeholders might think, which results in waste of valuable resources and money.

A VLE called "My Learning" is used by Middlesex University throughout its three campuses as well as at partner institutions. Based on our experiences and observations, we have the impression that many students are unable to benefit from the features of the VLE in the most effective way. This impression has led to the conduct of this research study.

We argue in this study that VLEs can be made more efficient (1) by taking into account how their users perceive them, and in connection with that, (2) by identifying the features of VLEs that are most useful to their users. To that end, the most useful features of the VLE were identified by referring to student *opinions about the features* in light of their *perceptions* of the VLE—namely their perceptions of benefit from, satisfaction with, and guidance provided by the VLE. The following section expand on the literature in these subjects.

Relationship between student perceptions and features of VLE

Benefit

The 'one size fits all' approach does not work when it comes to the use of VLEs in higher education. Students may not benefit from all features presented to them in a VLE. Warburton (2009) underlines the problem of standardization for integrating technologies and resources into virtual environments. One of the findings discussed is the students' perseverance in printing out online materials when they are able to access them anytime online (Pagram and Cooper 2011).

According to the Cognitive Theory of Multimedia Learning (Mayer 2009), human brain has a limited capacity of auditory and visual channels for processing information. Students' being exposed to many features in VLEs may lead to cognitive overload and hinder cognition and learning. A large number of components and options in the learning environment can direct attention towards different paths and distract students (Mayer and Moreno 2002; Murray 2001; Paas et al. 2003; Rogers, 2001; Sweller, 2004), adversely affecting the

learning experience in VLEs. In this respect, removal of, or disabling the least beneficial features of VLEs can help eliminate this adverse effect.

Satisfaction

Measuring students' satisfaction in using VLEs can help administrators and system developers identify the features most useful to students, and determine strengths and weaknesses of VLEs in order to refine them in the light of students' needs and expectations (Kember and Ginns 2012; Westbrook 2006; Zerihun et al. 2012). Herzberg's Two-Factor Theory suggests that the presence of certain features in a VLE can prevent student dissatisfaction, motivate them to learn, and provide the foundations for innovation in technology-enhanced learning (Reed and Watmough 2015). According to Herzberg et al. (1967), hygiene factors—that are usually related with extrinsic variables, and stem from politics, quality of leadership, relationships, job security and compensation—make people unsecure and uncomfortable, and thus, dissatisfied. On the other hand, motivators, or satisfiers—in relation to intrinsic factors involving responsibility, job satisfaction, recognition, achievement, opportunity for growth and advancement—lead to people's satisfaction. Youn et al. (2005) applied this theory into education and identified four satisfiers (*learning content itself, instructor's teaching methods/styles, instructor's subject matter expertise, and types of learning activities*) and two dissatisfiers (*instructional directions/expectations, and instructors' participation level)* within the context of an e-learning environment.

Student satisfaction is an essential component of quality online education (Bourne and Moore 2003), and there is a positive relationship between satisfaction and experience (Arbaugh and Duray 2002). Conrad (2002) claims that experience is likely to reduce user anxiety in online systems. Studies link student satisfaction to the features they prefer to have in VLEs (Frokjaer et al. 2000; Maki et al. 2000; Williams 1996). While student dissatisfaction can be related to the unavailability of some resources in VLEs, it may be reduced by ensuring the use of the standard features in VLEs, such as handbooks, contact information for staff, access to previous modules, information on assessment, and further reading, which are favoured by both students and teachers (Reed and Watmough 2015). Assoodar et al. (2016) have emphasized the significance of learner, instructor, course, technology, design and the environment to improve the satisfaction of learners. Chua and Montalbo (2014) have evaluated students' satisfaction with the use of VLEs as a support technology in teaching. According to their findings, VLEs are effective as supportive tools to supplement traditional classroom instruction as revealed by satisfied students.

Various studies emphasize that learners' satisfaction in the use of VLEs affects their future use of such technologies (Cheng 2011; Lin 2012; Šumak et al. 2011; Sun et al. 2008; Toni Mohr et al. 2012). It is apparent that students expect to use VLEs to support their studies (Bee 2013), and they increasingly rely on the use of VLEs to support their studies (Reed and Watmough 2015). Meeting student demands may prevent the feeling of dissatisfaction and enhance both teaching and learning.

Guidance

Many studies reveal clues about student perceptions of teacher guidance in VLEs. Studies emphasize that students do need such guidance in VLEs. This is because students tend to prefer functionalities and tools that support studying independently, such as self-study and self-assessment, and they prefer the opportunity to consult experts rather than learning

collaboratively as part of communities (Berlanga et al. 2010). In this respect, Naveh et al. (2010) have discussed the importance of responsiveness of course staff in VLEs. Al Ghamdi et al. (2016) have emphasized communication and interaction between tutors and students through a VLE in a distance learning course. They have reported a significant correlation between the overall adopted teacher immediacy (verbal and non-verbal) and overall online participation and satisfaction of students in the distance education course. Moreover, contact information for staff (Graven et al. 2006; Reed and Watmough 2015) and support (Lee et al. 2011) are features that have stood out in many studies that students expected to find in VLEs. These suggest that teacher guidance is something that has to be maintained in order to improve the effectiveness of VLEs.

Features of VLEs

There are a number of studies in the literature examining features of VLEs that students appreciate. Some examples are presented here. Graven et al. (2006) have shown in a longitudinal study that the vast majority of staff and students favour the introduction of minimum standards. They have identified specific features that should be incorporated into a VLE, for example handbooks, contact information for staff, access to previous modules, assessment information, and further reading. The National Student Survey data showed that students wanted records of lectures, improved feedback, and up-to-date information on changes to timetabled activities in a VLE as well as more computers to access online resources (Reed and Watmough 2015).

Naveh et al. (2010) has underlined the importance of content completeness, content currency, ease of navigation, ease of access, and course staff responsiveness in VLEs. Chua and Montalbo (2014) have suggested focusing on the learner interface, learning community, content, and usefulness of VLEs. Akritidou and Tsiatsos (2008) have emphasized designing personalized VLEs to support learners' different needs and preferences.

Attention must be paid to the use of audio-visual materials on VLEs too. Rienties et al. (2016) have reported that several VLEs provide online help with step-by-step instructions for users to follow in the form of instructional audio-visual recordings that are shared either on VLEs or on other well-known platforms such as YouTube. Goldman et al.(2014) have claimed that a combination of audio-visual materials and text serve better to learners than the practice of offering them individually. Nevertheless, there are also studies showing the effectiveness of videos (e.g., short YouTube clips) on their own (Giesbers et al. 2013; Holmes et al. 2013).

Many studies have attempted to compare the effectiveness of lecture-capture (published online to promote students' studies by enabling them to watch lectures again) to face-to-face instruction (Roberts 2015). Williams et al. (2012) have presented certain positive effects of lecture capture on student performance when used to support face-to-face teaching. Figlio et al. (2010) compared live-only and Internet instructions and found modest evidence that the former dominates the latter. Williams et al. (2012) report that using lecture capture as a supplement to face-to-face instruction improves learning; however, using it as a substitute does not provide any benefit.

It has been claimed that learners can be more motivated to participate in lessons if VLEs provide tools for self-assessment on the teaching and learning process, contain interesting course materials, and provide faster means for response to their questions (Berlanga et al. 2010; Dutton et al. 2004; Mayorga-Toledano and Fernández-Morales 2004). Dutton et al. (2004) argue that using VLEs for chat conversations, discussions, and communications

during a school semester has no effect on student preferences over the use of traditional approaches in teaching and learning. They suggest that the cultural context of higher education constrains the role of innovation in ICTs. Furthermore, Oblinger and Oblinger (2005) suggest that technology is an essential component of convenient services for students' integration to campus experience. While campus-based studies may still be preferred by students despite the introduction of VLEs, such systems can still be used to support campus-based activities.

All in all, VLEs are useful but expensive tools. They can be made more efficient by taking into account student perceptions and student opinions about their features. In light of the above discussion, the following research questions were investigated in this study.

1. How do students perceive their experience of using the VLE of Middlesex University?
    a. How satisfied are they with the VLE?
    b. What is the level of benefit they perceive they get from the VLE?
    c. What is their perception of teacher guidance they receive through the VLE?
2. What are the features of the VLE that are most useful to the students in their opinion in terms of satisfaction, benefit, and guidance? Do the opinions depend on grade level (year of study) and campus location?

Method

This study was carried out at Middlesex University—a multi-campus, international institute offering academic programmes for foundation year, undergraduate, and postgraduate studies using the VLE platform "My Learning." The VLE is a Moodle-based system, and is used to enhance traditional teaching and learning practices. One characteristic of the university is its multiple campuses, each based in a different country. It must be noted that distance learning has a minor role in this characteristic, too. Hence, it is also important to study the similarities/differences of student perceptions to ensure that students across all campuses have similar experiences—an important aspect of quality assurance.

Data collection, sample characteristics, and measures

The study was conducted in two stages and each stage involved its own sample group (Samples 1 and 2, respectively) as shown in Table 1. Table 1 also shows the details of the research questions and analyses corresponding to the stages. In the *first stage*, a scale that was suitable for the settings of the Middlesex University was developed to answer the first research question. In the process of the development of the scale, a link to an online questionnaire form constituting the scale was made available on the student portal of the VLE from June to September 2015.

The participants of the first stage of the study (Sample 1) included the students who volunteered to participate in the study. They had at least 1 year of experience in using My Learning. The questionnaire was open to 667 students in the system, but 425 students responded to the questionnaire. Data from 22 students whose answers were not suitable due to missing information were excluded, and the analyses were carried out on the data of the remaining 403 students. The information regarding the demographics of this first group is presented in Table 2.

Table 1 Procedures for conducting the study

Stage	Research question	Sample	Data	
	# Purpose		Collection	Analysis
Stage 1	1. To develop and test a scale of perception	Sample 1	June–September 2015	EFA
		Sample 2	2015–2016 academic year	CFA, convergent and divergent validity
Stage 2	1. To assess student perceptions using the scale: Benefit Satisfaction Guidance	Sample 2	2015–2016 academic year	ANOVA (based on campus location and grade level)
	2. To identify most useful features in relation to perceptions, based on Benefit Satisfaction Guidance Grade level	Sample 2	2015–2016 academic year	Pearson correlation between rated of features and developed scale Spearman's rank correlation between ranked features and developed scale

Table 2 The demographic features of the participants of the first stage

Characteristics	*n*	%
Faculty (College)		
Art and Design	2	0.5
Business School	180	44.7
Erasmus	3	0.7
Health and Education	107	26.6
Law	33	8.2
Media and Performing Arts	22	5.5
Science and Technology	43	10.7
Work Based Learning	13	3.2
Total	403	100
Grade (year of study)		
1st year	173	42.9
2nd year	88	21.8
3rd year	101	25.1
4th year	11	2.7
5th year (postgraduate)	24	6.0
Exchange program studies	6	1.5
Total	403	100
Campus		
Hendon	359	89.1
Dubai	12	3.0
Malta	5	1.2
Mauritius	8	2.0
Distance education	11	2.7
Other (Franchising)	8	2.0
Total	403	100

The questionnaire was formed from an item pool and was finalized according to expert views on content, and face validities. The three experts consulted were faculty members and each had a doctoral degree in (1) assessment and evaluation, (2) psychology, or (3) language. Based on feedback, 11 of the 19 items of the survey were used for Exploratory Factor Analysis (EFA). The questionnaire had 5-point Likert-type items with options ranging from 1 = "Strongly Disagree" to 5 = "Strongly Agree." The obtained data, first set of data was collected to check the EFA, and second data set was collected for confirmatory factor analysis (CFA), was used reliability and validity of the developed scale.

In the *second stage* of the study, data were collected from the students studying at Middlesex University in the 2015–2016 academic year (Sample 2) by using the scale developed in the first stage. In addition, the students were presented with the features of the VLE as shown in Table 3 and asked "Please rank in order of preference the resources you would find most useful to support your learning (A: Discussion forums and chat rooms; B: Videos [YouTube, Ted Talks, Vimeo, Kahn Academy]; C:Audio recordings/ Podcasts; D: Key concept videos [short 5–10 min videos dealing with the key concepts in a lecture]; E: Lecture Capture [PowerPoint slides and audio only]; F: Lecture Capture [PowerPoint slides and video]; G: Self tests [quizzes]; H: Online submission of assessments and online feedback on assessments; I: Use of social media such as Twitter,

Table 3 The features of the VLE presented to the participants to be ranked

Symbol	Feature
A	Discussion forums and chat rooms
B	Videos (YouTube, Ted Talks, Vimeo, Kahn Academy)
C	Audio recordings/Podcasts
D	Key concept videos (short 5–10-min videos dealing with the key concepts in a lecture)
E	Lecture Capture (PowerPoint slides and audio only)
F	Lecture Capture (PowerPoint slides and video)
G	Self tests (quizzes)
H	Online submission of assessments and online feedback on assessments
I	Use of social media such as Twitter, Facebook, and Instagram to support learning
J	Online live interactive seminars/workshops

Facebook, and Instagram to support learning; J: Online live interactive seminar/workshops)" where they were given the options to rank from 1 to 10. They were also asked to rate those features through the question "What aspects of My Learning do you find most useful? (1. Blogs and reflective diaries, 2. Kortext e-books, 3. Reading lists, 4. Discussion and chat, 5. Online quizzes/self-tests, 6. Online assessment feedback, 7. Online assessment submission, 8. Assessment information, 9. Lecture/seminar/workshop/lab slides and associated learning materials, 10. Module Handbook, Key module contacts, general programme and module information)" where they were given the Likert-type options: from 1 = "Not useful at all," to 5 = "Very useful." These questions were asked to answer the second research question of the study.

The questionnaire was open to 531 students in the system, but 301 students responded to it. Data from 23 students whose answers were not suitable due to missing information were excluded, and the analyses were carried out on the data of the remaining 278 students. The demographic features regarding this group are presented in Table 4.

Table 4 The demographic characteristics of the participants of the second stage

Characteristics	*n*	%
Grade		
0 (foundation year)	9	3.2
1st year	118	42.4
2nd year	80	28.8
3rd year	45	16.2
4th year	5	1.8
5th year (postgraduate)	21	7.6
Total	278	100
Campus		
Hendon	189	68.0
Dubai	42	15.1
Mauritius	15	5.4
Distance education	32	11.5
Total	278	100

Data analysis

The validity and reliability of the developed scale were verified through EFA, CFA, divergent and convergent validity, and Cronbach's alpha and composite coefficient values. EFA was used to confirm the structural validity of the scale through principal component analysis with Varimax (25) rotation in the SPSS 23 software. CFA was used to test the factor structure. For reliability analysis, the Cronbach alpha internal consistency and composite coefficient values were assessed.

Assumptions for analyses

Extreme values, normality, multiple collinearity, and linearity assumptions were examined before the EFA and CFA. After exclusion of the 22 outliers in the first stage and 23 outliers in the second stage from the dataset (Hair et al. 2006), the linearity assumption was met based on the kurtosis and skewness values ($-2.5 < \text{Skewness/Kurtosis} < +2.5$; Mertler and Vanatta 2005), and the data had a normal distribution (Tabachnick and Fidell 2007). The stated skewness and kurtosis values also met the assumptions of normality for the parametric tests on grade level and campus (ANOVA).

Results

The findings of the study are presented in this section based on the stages of the conduct of the study while giving references to the research questions.

Stage 1—scale development and testing

The findings related to the development of the perception scale are presented under this heading.

Exploratory factor analysis

In order to verify a factor structure, it is recommended to obtain an eigenvalue of 1 (see Fig. 1) at the minimum and a factor load of .3 at the minimum for each item in the analysis; it is also necessary that each item falls under a single factor, or if an item falls under more than one factor, the difference between such items is at least .10 (Creswell 2009). In the EFA, the Kaiser–Meyer–Olkin measure of sampling adequacy was .85. As this value was greater than .70, the data in the first stage were considered to be suitable for factor analysis (Bryman and Cramer 1999). Similarly, the result of the Bartlett's test of sphericity was 1763.95 ($p < .001$). The results of the EFA are seen in Table 5.

The EFA showed that the scale with 11 items had a three-factor structure (Table 5). BENEFIT represents the student perceptions underlining that the VLE was beneficial. SATISFACTION means the students were satisfied with their experience in the VLE. And, GUIDANCE emphasizes the need for guidance on how to use the VLE. The

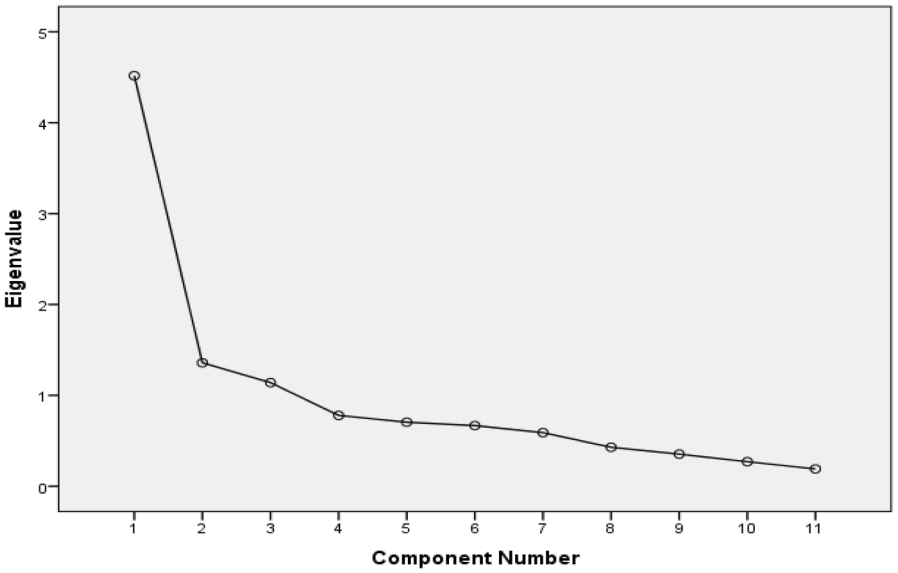

Fig. 1 Scree-plot showing the factor structure in the first stage

factor loadings varied between .57 and .88. These three factors of the scale explained 63.78% of the total variance. This analysis was followed by the CFA.

Confirmatory factor analysis

Principal components analysis was performed on the data set collected during the *second stage*. The three factors, BENEFIT, SATISFACTION, and GUIDANCE that were determined in the EFA were subject to CFA. A CFA model (Model 1) was tested, but it was found not to have a good model fit based on certain fit indices, especially RMSEA, GFI, and AGFI. Therefore, the modification indices were analysed, and as a result, possible modifications between E5 and E6, E5 and E7, E7 and E8, E4 and E5, E4 and E6, E2 and E3, E1 and E2 were found to contribute to χ^2 greatly.

Following the modifications, a second CFA model (Model 2) was tested (Fig. 2). The new fit indices were as follows: $\chi^2 = 54.716$ ($df = 34$, $p < .000$), $\chi^2/\text{sd} = 1.609$, RMSEA = .047, SRMR = .0391, GFI = .967, AGFI = .936, CFI = .984, IFI = .984, NNFI = .959. Regarding these values, Kline (2005) have stated that a χ^2/sd value lower than three and an RMSEA value below .08 indicate a good fit. Byrne (1998), on the other hand, have stated that an SRMR value lower than .1 is necessary for a good fit. In addition, IFI, CFI, NFI, and NNFI values greater than .9 have been emphasized to indicate a good model fit. Tabachnick and Fidell (2007), however, have stated that an AGFI value of .8 or greater and a GFI value of .85 or greater would indicate a good fit. Therefore, all indices indicated a good fit and confirmed the structural validity of the scale. Figure 2 shows the path diagram of the final CFA (Model 2).

Table 5 The factor loadings, explained variance, items, and sub-dimensions of the scale

FACTOR/Items	Factor loading	Cronbach alpha
BENEFIT		.61
1. My learning is a good way to communicate course information	.81	
2. Revision material and assessment preparation material should be made available through My Learning courses	.34	
3. Having learning materials and assignment submission made available to me through My Learning allows flexibility in the way I study (e.g., study at any time). (explained variance: 19.81%)	.44	
SATISFACTION		.90
4. My Learning is easy to access	.66	
5. My Learning is easy to navigate	.65	
6. My Learning is easy to use	.68	
7. I am satisfied with using My Learning to access module content (e.g., lecture notes, online submission and other learning resources)	.83	
8. Overall, I am satisfied with My Learning. (explained variance: 28.87%)	.95	
GUIDANCE		.62
9. I would find an online course showing me how to use My Learning useful	.64	
10. I would like my module leader to demonstrate how to use My Learning during class	.59	
11. My learning training should be provided during library sessions. (explained variance: 15.10%)	.56	
OVERALL		.82
Explained total variance: 63.78%		

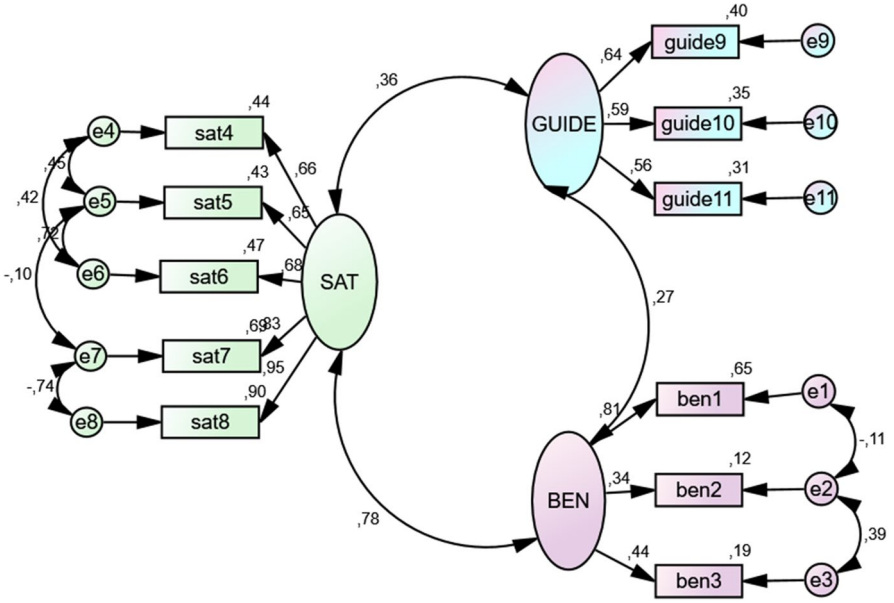

Fig. 2 Path diagram of the final confirmatory factor analysis

Convergent and divergent validities

Convergent and divergent validities were investigated for the construct validity of the three-factor structure of the scale. Average variance extracted (AVE) values were examined and found to be .81 for BENEFIT, .92 for SATISFACTION, and .83 for GUIDANCE. The fact that all these values are higher than .50 confirms the convergent validity of the scale (Bagozzi and Youjae 1988). For the divergent validity, it was investigated whether square roots of AVE were above the inter-construct correlations and .70 (Fornell and Larcker 1981). It was also found that the scale had divergent validity. Table 6 shows the divergent validity values.

Reliability

The Cronbach's Alpha internal consistencies and composite coefficients were .61 and .89 for BENEFIT, .90 and .98 for SATISFACTION, and .62 and .94 for GUIDANCE, respectively. The Cronbach's Alpha value for the overall scale was .82. A reliability coefficient lower than .60 refers to very poor reliability, a coefficient between .60 and .70 refers to

Table 6 Divergent validity values

	BENEFIT	SATISFACTION	GUIDANCE
BENEFIT	.901		
SATISFACTION	.469	.961	
GUIDANCE	.664	.452	.913

acceptable reliability, and a coefficient higher than .80 refers to good reliability (Fraenkel and Wallen 2006). Thus, it can be said that the factors had acceptable to good reliability.

Stage 2—assessment of student perceptions and determination of VLE features

The participants' perceptions of the VLE were investigated considering various variables based on the data collected from Sample 2. The findings of the analyses are summarised under this heading.

One Way ANOVA was carried out to reveal whether the student perceptions determined through the scale varied depending on campus location and grade level. Table 7 shows the results of the analysis. As can be seen from this table, there were no significant differences between the perceptions ($p > .05$).

The participants' perception of the usefulness of particular features (see Table 8) that were available in the VLE were examined in relation with the scale scores. The results of the correlation analyses (Fig. 3) indicate that most of the features of the VLE were significantly correlated with the overall scale score and the scores of its sub-dimensions ($p < .05$). Berlanga et al. (2010) report, for example, that students would be motivated with interesting course materials and self-assessment on progress and skills. This compares positively with the findings on Features 4 (Online assessment submission) and 8 (Reading lists) of the present study shown in Fig. 3. Moreover, Heaton-Shrestha et al. (2007) have emphasized that 'content' areas in VLEs containing lecture notes and handouts are all useful. According to Wells et al. (2008), one of the strongest predictors of overall perception of VLEs is 'the availability of lecture notes' (given that 35% of all hits on the VLE they studied were related to the content area). Furthermore, the findings of Kim et al. (2005) showing that informative feedback from the instructor is positively correlated with satisfaction confirm the correlation between Feature 5 (Discussion and chat) and SATISFACTION shown in Fig. 3. However, GUIDANCE did not have any significant correlation with Feature 2, *Kortext e-books,* and neither with Feature 7, Online assessment feedback. BENEFIT had no correlation with Blogs and reflective diaries.

The participants were asked to rank the features shown in Table 3 from 1 to 10 in the order of usefulness to them. Their responses were analyzed in terms of both cumulative distribution of the rankings and average weighted scores (AWSs).

Figure 4 shows the cumulative distribution of the participants' preferences for each feature. The features ranked first are close to the upper portion of the figure and indicate the features that were perceived to be the most useful to the participants. Accordingly, Feature F, *Lecture Capture* (*PowerPoint slides and video*), was perceived to be the most useful feature. As shown on the graph in the figure, approximately 15% of the participants ranked Feature F as the top feature. As the graph progresses cumulatively, clearly, some 26% of participants ranked F either as their first choice or the second while 38% ranked it as the first, second, or third choice. This trend continues cumulatively making Feature F the one perceived to be the most useful feature by the participants.

The results can be interpreted in various ways and can provide insights into the selection of features depending on the number of features to be supported in VLEs:

- If it is only possible to support a single feature of a VLE, then this would obviously be Feature F—Lecture Capture (PowerPoint slides and video). This is because it was ranked first by 15.5% of the participants, a higher percentage than that of any other feature ranked first.

Table 7 Results of ANOVA based on campus and grade level

Variable				Campus					Grade				
	N	*M*	*sd*	*SS*	*df*	*MS*	*F*	*p*	*SS*	*df*	*MS*	*F*	*p*
BENEFIT	278	12.75	1.57										
Among groups				8.98	3	3.00	1.21	0.31	15.06	5	3.01	1.22	.3
Within groups				677.38	274	2.47			671.32	272	2.47		
Total				686.37	277				686.37	277			
SATISFACTION	278	19.30	3.86										
Among groups				92.45	3	30.82	2.10	0.10	71.37	5	14.27	.96	.44
Within groups				4029.77	274	14.71			4050.85	272	14.89		
Total				4122.22	277				4122.22	277			
GUIDANCE	278	10.77	2.10										
Among groups				18.40	3	6.13	1.39	0.25	26.148	5	5.23	1.18	.32
Within groups				1209.40	274	4.41			1201.65	272	4.42		
Total				1227.80	277				1227.80	277			
OVERALL	278	42.82	5.68										
Among groups				200.97	3	66.99	2.10	.10	158.34	5	31.67	.98	.43
Within groups				8745.31	274	31.92			8787.94	272	32.31		
Total				8946.27	277				8946.27	277			

N number, *M* mean, *sd* standard deviation, *SS* sum of squares, *df* degrees of freedom, *MS* mean squares, *F* analysis of variance, *p* probability

Table 8 The features of the VLE presented to the participants to be rated

Symbol	Feature
1	Blogs and reflective diaries
2	Kortext e-books
3	Assessment information
4	Online assessment submission
5	Discussion and chat
6	Online quizzes/self-tests
7	Online assessment feedback
8	Reading lists
9	Lecture/seminar/workshop/lab slides and associated learning materials
10	Module Handbook, Key module contacts, general programme and module information

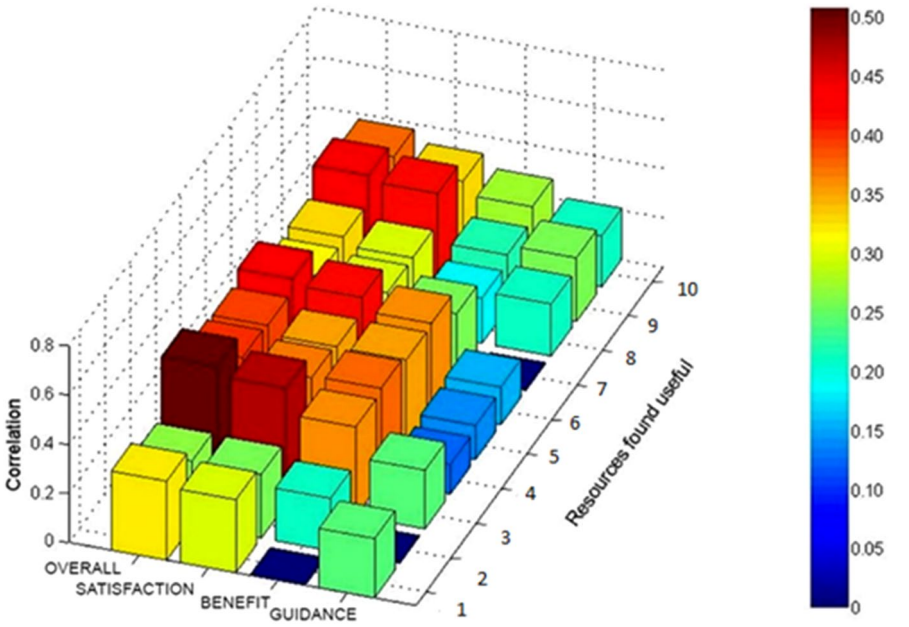

Fig. 3 Pearson correlations between the participants' perceptions of VLE features and scale scores (also see Table 3). (*1*) Blogs and reflective diaries, (*2*) Kortext e-books, (*3*) assessment information, (*4*) online assessment submission, (*5*) discussion and chat, (*6*) online quizzes/self-tests, (*7*) online assessment feedback, (*8*) reading lists, (*9*) lecture/seminar/workshop/lab slides and associated learning materials. (*10*) Module Handbook, key module contacts, general programme and module information

- If three features are to be provided, then F, D, and B would be the features of choice.
- If five features are to be provided, then F, D, E, B, and J would be the features of choice.
- If six features are to be provided, however, the participants' preference becomes interesting. Features F, E, D, B, H and G are recommended, but not J, so that the majority of participants are satisfied, as shown in Fig. 4.

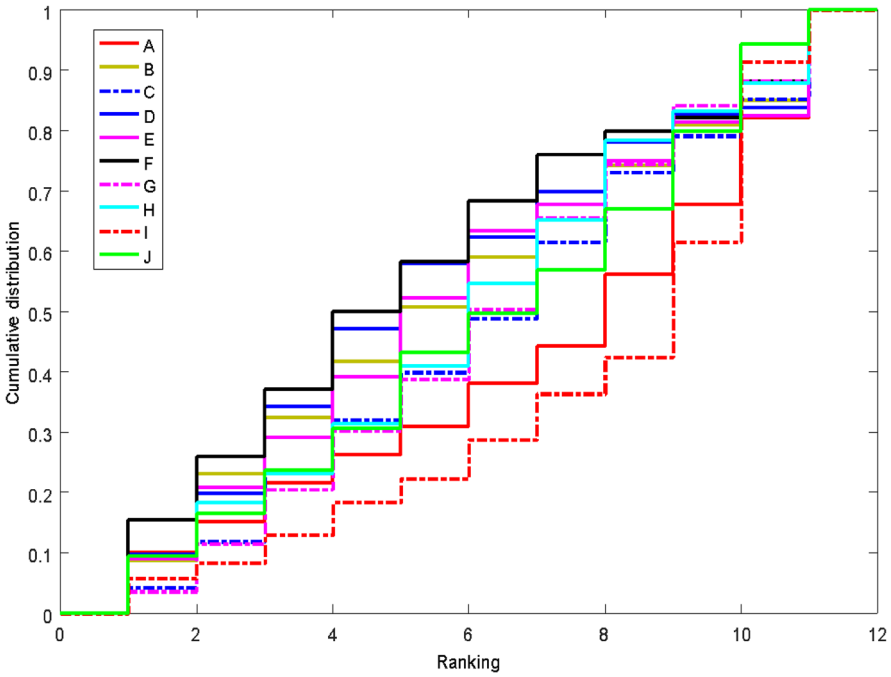

Fig. 4 Cumulative distribution of the rankings of the participants' perceptions of VLE features (also see Table 3). (*A*) Discussion forums and chat rooms; (*B*) videos (YouTube, Ted Talks, Vimeo, Kahn Academy); (*C*) audio recordings/Podcasts; (*D*) key concept videos (short 5–10 min videos dealing with the key concepts in a lecture); (*E*) lecture capture (PowerPoint slides and audio only); (*F*) lecture capture (PowerPoint slides and video); (*G*) self tests (quizzes); (*H*) online submission of assessments and online feedback on assessments; (*I*) use of social media such as Twitter, Facebook, and Instagram to support learning; (*J*) online live interactive seminar/workshops

The low ranking of Feature A is not surprising. Berlanga et al. (2010) has shown that discussion groups are appreciated as the first choice by only 2% of students. The study of Wells et al. (2008) has supported this claim in that the usefulness and availability of discussion forums were not considered a significant positive feature by the participants in their study. Heaton-Shrestha et al. (2007) also claimed that discussion areas and virtual chat rooms were not used by their students. It should be noted that ranking 11 only indicates that the particular resource attracted no interest from participants.

Spearman's rank correlation

Spearman's rank correlation analysis was carried out in SPSS for each grade level (year of study) to reveal the statistical dependence between combinations of the elements of two variable sets: the features {A, B, C, D, E, F, G, H, I, J} and the scale {BENEFIT, SATISFACTION, GUIDANCE, OVERALL}. In doing so, the ranking score of each feature (i.e., 1–10) was used, whereas a formula (overall rank score = (a − b)/5) was used to determine overall rank scores for the second variable set (the scale) as shown in Table 9. In the formula, a and b represent the maximum and minimum scale scores

Table 9 Rank scores for the scale based on relative criteria

Variable	Rank				
	1	2	3	4	5
BENEFIT	7–8	9–10	11	12–13	14–15
SATISFACTION	8–11	12–14	15–18	19–21	22–25
GUIDANCE	5–6	7–8	9–10	11–12	13–15
OVERALL	23–29	30–35	36–42	43–48	49–55

(overall score and sub dimension scores), respectively. The ranks 1–5 originate from the 5-point Likert-type options, where 1 represents the lowest rank score and 5 represents the highest rank score.

Figure 5 shows the Spearman's rank correlation analysis results between the features and the scale in terms of the total score for each grade level (i.e. year of study) and all grade levels combined (i.e., grade levels 0–5). Only the significant results are shown.

The correlation coefficient ρ shows the following:

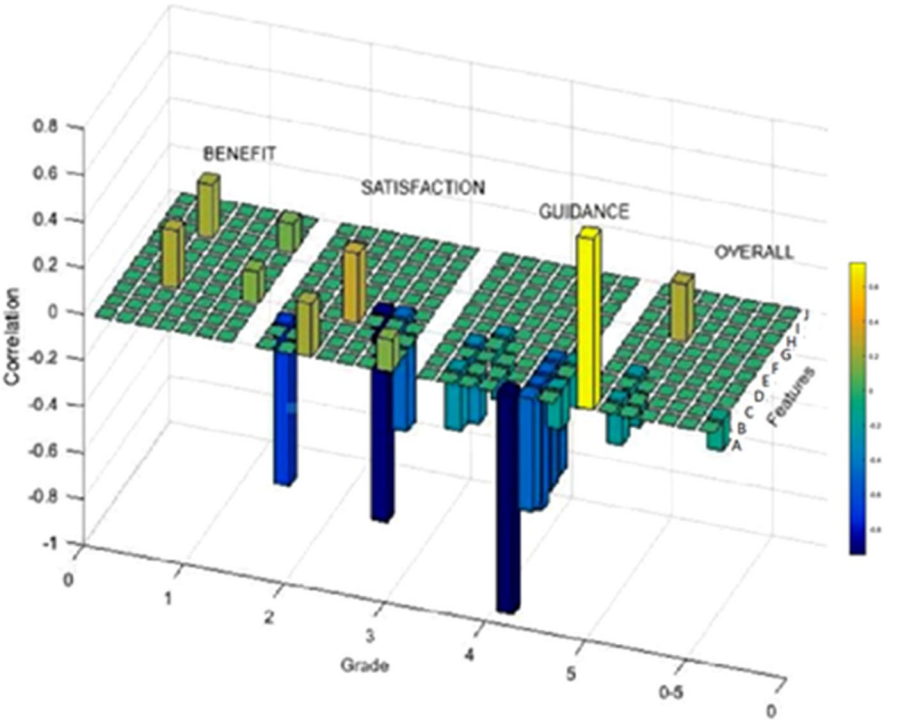

Fig. 5 AWS-based Spearman's rank correlation analysis results between the features and the scale in terms of the total score for each grade level and all grade levels combined. (*A*) Discussion forums and chat rooms; (*B*) videos (YouTube, Ted Talks, Vimeo, Kahn Academy); (*C*) audio recordings/Podcasts; (*D*) key concept videos (short 5–10 min videos dealing with the key concepts in a lecture); (*E*) lecture capture (PowerPoint slides and audio only); (*F*) lecture capture (PowerPoint slides and video); (*G*) self tests (quizzes); (*H*) online submission of assessments and online feedback on assessments; (*I*): use of social media such as Twitter, Facebook, and Instagram to support learning; (*J*) online live interactive seminar/workshops

- Feature A, "Discussion forums and chat rooms," was positively correlated with *SATISFACTION* ($p < .05$) for the grade level 2 and all grade levels combined. Again, it was positively correlated with the *OVERALL* scale score considering the foundation year ($p < .05$). The perceptions in the grade levels 4 and 5 showed a negative correlation with *GUIDANCE*.
- Feature B, "Videos (YouTube, Ted Talks, Vimeo, Kahn Academy)," was negatively correlated with *GUIDANCE* for the grade levels 1 ($p < .01$), all grade levels combined ($p < .01$), and grade level 5 ($p < .05$). Furthermore, it was negatively correlated with the *OVERALL* scale score considering the grade level 1 and all grade levels combined ($p < .05$).
- Feature C, "Audio recordings/Podcasts," was negatively correlated with *SATISFACTION* for the foundation year and with *GUIDANCE* for the grade level 5 ($p < .05$).
- Feature D, "Key concept videos (short 5–10-min videos dealing with the key concepts in a lecture)," was positively correlated with *BENEFIT* ($p < .05$) and negatively correlated with *GUIDANCE* ($p < .01$) for all grade levels combined. It was also positively correlated with *BENEFIT* for the grade level 2 and with *SATISFACTION* for the grade level 3 ($p < .05$), and negatively correlated with *GUIDANCE* for the grade levels 1 ($p < .01$) and 5 ($p < .05$) and with the *OVERALL* scale score for the grade level 1 ($p < .05$).
- Feature E, "Lecture Capture (PowerPoint slides and audio only)," was negatively correlated with *SATISFACTION* for the grade levels 4 and 5, and with *GUIDANCE* for the grade level 2 and all grade levels combined ($p < .05$).
- Feature G, "Self-tests (quizzes)," was positively correlated with the *OVERALL* scale score for the grade level 2 ($p < .05$).
- Feature H, "Online submission of assessments and online feedback on assessments," was positively correlated with *BENEFIT* for the grade level 2 and all grade levels combined ($p < .05$).

Discussion

Research question 1

This paper has evaluated the quality of learning processes and the features offered in a VLE, the VLE utilized in Middlesex University, based on student views. To achieve this, a scale was developed, and tested for validity and reliability. Although there are instruments in the literature to measure student perceptions of VLEs (such as Awang et al. 2018; Chua and Montalbo 2014; Hamutoglu et al. 2018; Mai and Muruges 2018; Ogba et al. 2012; Santana-Mancilla et al. 2019), none of them was suitable, in terms of psychometric features, for investigating the research questions of this study. The present scale was developed to meet this need.

One of the important findings of the study was that the student perceptions were similar across the grade levels. Although as stated by Lee et al. (2001), "the success of any virtual learning environment depends on the adequate skills and attitudes of learners" (p. 231), and grade level should be taken into consideration while investigating VLEs, the results of the present study may seem contradictory to the findings of Hamutoglu et al. (2018). This can be explained with the fact that the study was carried out at the end of the academic year (i.e., after even the most junior students had completed a whole academic year and

had some experience in the use of a VLE). In line with this, similar studies reveal that having experience in using a system improves students' satisfaction with the system. For example, Idemudia and Negash (2012), Lee (2010) and Liaw et al. (2007) have pointed out that the student–course interaction improves students' virtual learning experience. Similarly, Ahmed and Morley (2010) have shown that student experiences can be inconsistent across higher education institutions, but student views in their study did not differ significantly from one campus to another ($p > .05$). This supports the idea that although university campuses are physically separated and have cultural differences, a university's enforcement of its policies works successfully in ensuring compatible experiences. This is achieved through the use of the same teaching, learning and assessment materials, and strictly following quality assurance measures at all campuses.

Research question 2

Pearson's correlation analyses highlight the participants' perceptions in terms of the usefulness of particular features available in the VLE. Some of the features were significantly correlated with BENEFIT, SATISFACTION and OVERALL scale scores. These features should be promoted to improve VLEs. Nevertheless, almost all features were significantly correlated with all scale scores. The only exceptions were Feature 2 (Kortext e-books), Feature 7 (online assessments feedback), and Feature 1 (blogs and reflective diaries). The former two did not correlate with GUIDANCE. This indicates that the students did not find guidance on these useful. And, Feature 1 (blogs and reflective diaries) did not correlate with BENEFIT. The findings of Berlanga et al. (2010) are on par with this. They show that blogs are not as highly appreciated as other resources in VLEs. The students were not enthusiastic to have access to blogs (15%), audio/video conferencing facilities (24%), wikis (28%), and chat (31%) according to the study of Berlanga et al. (2010). Considering the results of our study on Feature 1 (blogs and reflective diaries), it can be said that the students did not perceive blogs and reflective diaries in a VLE to be beneficial. This is a feature that should either be reshaped (e.g., lecturers can participate in blogs), replaced with some other features, or removed. In fact, Isbulan (2015) has discussed that lecturers' interaction with students in their own environments would improve students' perception of usefulness of a feature. This supports the potential of lecturers' increased participation in blogs.

Student rankings of the features can be useful in decision making in terms of allocating resources effectively. For example, Feature F, "Lecture Capture (PowerPoint slides and video)," seems to be preferred more than any other feature across all grade levels; hence it seems to be a must. However, this may not always be for a good reason with regard to students' academic performance (Figlio et al. 2010; Roberts 2015). According to Williams et al. (2012), lecture capture provided no benefit over face-to-face instruction in fully online courses, but when it was used in a hybrid course to enhance instruction in specific course modules, it improved learning outcomes. Based on these, it is possible to say that most students had a tendency to review only what was covered in class and expected to achieve good grades by doing so.

Perhaps the most significant finding of the Spearman's ranking correlation test was that Features A (*discussion forums and chat rooms*) and E (*Lecture Capture—PowerPoint slides and audio only*) were appreciated by those who did not find guidance on the use of VLE useful. However, it was not preferred by those who would find the guidance useful. From these findings, it can be concluded that Feature A improves satisfaction with the

use of the VLE. Moreover, the increased use of Features D (*key concept videos—short 5–10-min videos dealing with the key concepts in a lecture*) and H (*online submission of assessments and online feedback on assessments*) were seen beneficial by the participants. The use of Features D, E (*Lecture Capture—PowerPoint slides and audio only)*, and B (*videos —YouTube, Ted Talks, Vimeo, Kahn Academy*) reduced the participants' need for guidance. Finally, Feature B appears to fulfill the majority of the functions of the VLE by itself, showing the participants' trust in the potential of online videos (e.g. YouTube) for education.

The scale that was developed in this study to evaluate student perceptions has shown to be an effective instrument. The findings can be useful in enhancing teaching and learning, with an emphasis on student satisfaction. For sustainability purposes, it is of particular importance to explore expectations and needs of students and teachers within the framework of educational technology when integrating educational technology into the curriculum, classroom settings or processes of teaching and learning. This study sheds light on how VLEs can be improved without sacrificing sustainability. Nevertheless, the study provides a different approach to student perceptions for evaluating virtual learning environments, and we believe that it can guide future studies on the topic.

Conclusion

This paper presents an evaluation of students' perceptions of the use of a VLE in a higher education setting. To achieve this, a scale was developed, and tested for validity and reliability. The resulting scale has 11 items in three dimensions: benefit, satisfaction, and guidance.

Although there are many features offered in virtual learning environments widely used in higher education, some of these features are more preferable than the others. Such student preferences have been investigated for a multi-campus university, Middlesex University. The findings of the present study have shown that the five most preferred VLE features are:

- Lecture Capture (PowerPoint slides and video)
- Key concept videos (short 5–10-min videos dealing with the key concepts in a lecture)
- Lecture Capture (PowerPoint slides and audio only)
- Videos (YouTube, Ted Talks, Vimeo, Kahn Academy)
- Use of social media such as Twitter, Facebook, and Instagram to support learning

VLEs are commonly used in higher education. The availability of the wealth of features may lead to an expensive investment in terms of budget and maintenance. To avoid this and enable institutions to invest into most preferred features, it is essential to obtain students views of VLEs. This study offers an instrument for assessing student preferences and presents findings from its use. Such an approach would be useful to make informed decisions on which features to prioritise in a VLE for increased student satisfaction. This recommendation parallels the study of Browne et al. (2006) considering pedagogical practices. Additionally, the instrument provides the opportunity to do a cost–benefit analysis to better understand implementation issues and plan the process of teaching and learning for the provision of equal opportunities for all. Finally, it is worth to note that while educating the digital generation is a challenge in the twenty-first century (Khlaisang and Songkram

2019), the developed instrument and the pedagogical approach (i.e., satisfaction and preferences) used in this study can shed a light for future studies to evaluate the impact of using VLEs on improving student skills in higher education institutions.

Recommendations, limitations, and future studies

Administration and maintenance of a VLE system is expensive and time-consuming. Besides, it is difficult for administrators, students and tutors to foresee how satisfying the system will be. A needs analysis is the way to find common grounds for the satisfaction of all stake holders. MacLeod et al. (2018) has recommended conducting needs assessments and identifying key features to be developed and offered to maximize the effectiveness.

An educational institute that is interested in following the latest standards in education, and hence, would like to use virtual environments as part of its teaching and learning activities may end up making a more expensive investment than necessary to cover as many features as possible in the absence of guidance on what media and features to employ (e.g. images, audio, video, tables, conferencing, etc.). This study offers an instrument for assessing student preferences and presents findings from its use. Such an approach would be useful to make informed decisions on the features to have in a VLE for increased student satisfaction. This recommendation parallels the study of Browne et al. (2006) considering pedagogical practices. Additionally, the instrument provides the opportunity to do a cost–benefit analysis to better understand implementation issues and plan the process of teaching and learning for the provision of equal opportunities for all. Finally, it is worth to note that while educating the digital generation is a challenge in the twenty-first century (Khlaisang and Songkram 2019), the developed instrument and the pedagogical approach (i.e., *satisfaction and preferences)* used in this study can shed a light for future studies to evaluate the impact of using a VLE on improving student skills in higher education institutions.

While we believe that our study provides significant contribution to the relevant literature, there were certain limitations to acknowledge. It is fair to say that certain aspects of this study can be generalized, whereas certain others are specific to the institution concerned and cannot be generalized. In addition to this, the participants of the study consisted of students only. It would be complementary to also assess perceptions of other parties (e.g., lecturers and administrators). Moreover, the data in this study were collected only from the students who were using a VLE established in a single university. Due to the possibilities, some elements that could have affected the results such as the students' technology competences were not taken into consideration. As students' satisfaction increases, their perception of benefits may also increase. Getting help with the use of a VLE can also affect their satisfaction and perceptions of benefit. Therefore, in a VLE environment that provides more experience or have more help options, it may be possible that students use more tools which were not used here, in the present study. It will be useful for future studies to take this into account.

Identifying the minimum standards for a VLE through the assessment of students' needs and expectations may improve their satisfaction. This may lead to better informed investments, reducing costs due to fruitless investments on unpopular means. Future studies may focus on preferences of teachers, instructors, academicians, and administrators as well as integrating into analyses the cost of features such as instructional materials, feedback, handbooks and so forth.

Funding This study is not funded by any company or scholarship.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

References

Ahmed, J., & Morley, G. (2010). VLE a blessing or a curse: VLE use by HE academic staff. Global Learn Asia Pacific 2010—Global Conference on Learning and Technology. Retrieved from http://eprints.hud.ac.uk/8901/.

Akritidou, M., & Tsiatsos, T. (2008). *Implementing a PLE: A VLE-based approach*. Conference ICL2008, 24–26, Villach, Austria.

Al Ghamdi, A., Samarji, A., & Watt, A. (2016). Essential considerations in distance education in KSA: Teacher immediacy in a virtual teaching and learning environment. *International Journal of Information and Education Technology, 6*(1), 17–22.

Arbaugh, J. B., & Duray, R. (2002). Technological and structural characteristics, student learning and satisfaction with web-based courses: An exploratory study of two online MBA programs. *Management and Learning, 33*(3), 331–347.

Assoodar, M., Vaezi, S., & Izanloo, B. (2016). Framework to improve e-learner satisfaction and further strengthen e-learning implementation. *Computers in Human Behavior, 63,* 704–716.

Awang, H., Aji, Z. M., & Osman, W. R. S. (2018, September). Measuring virtual learning environment success from the teacher's perspective: Scale development and validation. In *AIP Conference Proceedings* (Vol. 2016, No. 1, p. 020028). AIP Publishing.

Bagozzi, R. P., & Youjae, Y. (1988). On the evaluation of structural equation models. *Journal of Academy of Marketing Science, 16*(1), 74–94.

Bee, T. (2013). *Making the most out of IT: Report to TELWG*. Liverpool: University of Liverpool.

Bergen, A., French, L., & Hawkins, L. (2012). Teaching and learning in a digital world: A developmental evaluation of virtual learning environments in the Upper Grand and York Region District School Boards. Retrieved from http://www.cesinstitute.ca/.

Berlanga, A. J., Eshuism, J., Hermans, H., & Sloep, P. B. (2010). Learning networks for lifelong learning: An exploratory survey on distance learners' preferences. In L. Dirckinck-Holmfeld, V. Hodgson, C. Jones, M. de Laat, D. McConnell, & T. Ryberg (Ed), In *Proceedings of the 7th international conference on networked learning 2010* (pp. 44–51). Lancaster: Lancaster University.

Bourne, J., & Moore, J. C. (Eds.). (2003). *Elements of quality online education: Practice and direction (Vol. 4)*. Needham: Olin College-Sloan-C.

Browne, T., Jenkins, M., & Walker, R. (2006). A longitudinal perspective regarding the use of VLEs by higher education institutions in the United Kingdom. *Interactive Learning Environments, 14*(2), 177–192.

Bryman, A., & Cramer, D. (1999). *Quantitative data analysis with SPSS release 8 for windows*. New York: Routelge.

Byrne, B. M. (1998). *Structural equation modeling with Lisrel, Prelis, and Simplis: Basic concepts, applications, and programming*. Mahwah, NJ: Lawrence Erlbaum Associates.

Cassidy, S. (2016). Virtual learning environments as mediating factors in student satisfaction with teaching and learning in Higher Education. *Journal of Curriculum and Teaching, 5*(1), 113–123.

Cheng, K. W. (2011). The gap between e-learning managers and users on satisfaction of e-learning in the accounting industry. *Journal of Behavioral Studies in Business, 3,* 1–9.

Chua, C., & Montalbo, J. (2014). Assessing students' satisfaction on the use of virtual learning environment (VLE): An input to a campus-wide e-learning design and implementation. *Information and Knowledge Management, 3*(4), 108–116.

Conrad, D. L. (2002). Engagement, excitement, anxiety, and fear: Learners' experiences of starting an online course. *American Journal of Distance Education, 16*(4), 205–226. https://doi.org/10.1207/S15389286AJDE1604_2.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches*. Los Angeles: University of Nebraska-Lincoln.

Dillenbourg, P., Schneider, D., & Synteta, P. (2002). Virtual learning environments. In A. Dimitracopoulous (Ed). In *Proceedings of the 3rd Hellenic Conference Information and Communication Technologies in Education*, (pp. 3–18).

Dutton, W. H., Cheong, P. H., & Park, N. (2004). The social shaping of a virtual learning environment: The case of a university-wide course management system. *Electronic Journal of e-learning, 2*(1), 69–80.

Figlio, D., Rush, N., & Yin, L. (2010). *Is it live or is it Internet? Experimental estimates of the effects of online instruction on student learning*. Cambridge MA: National Bureau of Economic Research.

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

Fraenkel, J. R., & Wallen, N. E. (2006). *How to design and evaluate research in education* (6th ed.). New York: McGraw-Hill.

Frokjaer, E., Hertzum, M., & Hornbaek, K. (2000). Measuring usability: Are effectiveness, efficiency, and satisfaction really correlated? In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems (CHI '00).* ACM, New York, NY, USA, 345–352.

Giesbers, B., Rienties, B., Tempelaar, D. T., & Gijselaers, W. H. (2013). Investigating the relations between motivation, tool use, participation, and performance in an e-learning course using web-videoconferencing. *Computers in Human Behaviour, 29*(1), 285–292. https://doi.org/10.1016/j.chb.2012.09.005.

Goldman, R., Pea, R., Barron, B., & Derry, S. J. (2014). *Video research in the learning sciences*. Mahwah, NJ: Erlbaum.

Graven, O. H., Helland, M., & MacKinnon, L. (2006). The influence of staff use of a virtual learning environment on student satisfaction. In *2006 7th International Conference on Information Technology Based Higher Education and Training* (pp. 423–441). ITHET.

Hair, J. F., Black, B., Babin, B., Anderson, R. E., & Tahtam, R. L. (2006). *Multivariate data analysis*. Upper Saddle River: Prentice Hall.

Hamutoglu, N. B., Gemikonakli, O., Savasci, M., & Gultekin-Sezen, G. (2018). Development of a scale to evaluate virtual learning environment satisfaction. *International Journal of Assessment Tools in Education, 5*(2), 201–222.

Heaton-Shrestha, C., Gipps, C., Edirisingha, P., & Linsey, T. (2007). Learning and e-learning in HE: The relationship between student learning style and VLE use. *Research Papers in Education, 22*(4), 443–464.

Herzberg, F., Mausner, B., & Block Synderman, B. (1967). *The motivation to work* (2nd ed.). New York: Wiley.

Holmes, V., Clark, W., Burt, P., & Rienties, B. (2013). Engaging teachers (and students) with media streaming technology, the case of Box of Broadcasts. In L. Wankel & P. Blessinger (Eds.), *Increasing student engagement and retention using mobile applications: Smartphones, Skype and texting technologies* (Vol. 6D, pp. 211–240). Bingley, UK: Emerald Publishing Group.

Idemudia, E. C., & Negash, S. (2012). An empirical investigation of factors that influence anxiety and evaluation ın the virtual learning environment. In *Proceedings of the Southern Association for Information Systems Conference*, Atlanta, GA, USA.

Isbulan, O. (2015). *Review and development of teacher candidates' educational Facebook usage according to Technology Acceptance Model, (Unpublished doctoral dissertation)*. Institute of Educational Sciences, Sakarya: Sakarya University.

Kember, D., & Ginns, P. (2012). *Evaluating teaching and learning: A practical handbook for colleges, universities and the scholarship of teaching*. Abingdon: Routledge.

Khlaisang, J., & Songkram, N. (2019). Designing a virtual learning environment system for teaching twenty-first century skills to higher education students in ASEAN. *Technology, Knowledge and Learning, 24*(1), 41–63.

Kim, K. J., Liu, S., & Bonk, C. J. (2005). Online MBA students' perceptions of online learning: Benefits, challenges, and suggestions. *The Internet and Higher Education, 8*(4), 335–344.

Kline, R. B. (2005). *Principles and practice of structural equation modelling* (2nd ed.). New York: The Guilford Press.

Lee, M. C. (2010). Explaining and predicting users' continuance intention toward e-learning: An extension of the expectation–confirmation model. *Computers & Education, 54*(2), 506–516.

Lee, J., Hong, N. L., & Ling, N. L. (2001). An analysis of students' preparation for the virtual learning environment. *The Internet and Higher Education, 4*(3), 231–242.

Lee, S. J., Srinivasan, S., Trail, T., Lewis, D., & Lopez, S. (2011). Examining the relationship among student perception of support, course satisfaction, and learning outcomes in online learning. *The Internet and Higher Education, 14*(3), 158–163.

Liaw, S. S., Huang, H. M., & Chen, G. D. (2007). Surveying instructor and learner attitudes toward e-learning. *Computers & Education, 49*(4), 1066–1080.

Lin, W. S. (2012). Perceived fit and satisfaction on web learning performance: IS continuance intention and task-technology fit perspectives. *International Journal of Human-Computer Studies, 70*(7), 498–507.
MacLeod, J., Yang, H. H., Zhu, S., & Li, Y. (2018). Understanding students' preferences toward the smart classroom learning environment: Development and validation of an instrument. *Computers & Education, 122,* 80–91.
Mai, M. Y., & Muruges, G. R. (2018). Primary school science teachers' attitude towards using virtual learning environment (VLE) in teaching science. *European Journal of Education, 1*(3), 155–162.
Maki, R. H., Maki, W. S., Patterson, M., & Whittaker, P. D. (2000). Evaluation of a web-based introductory psychology course: I. Learning and satisfaction in on-line versus lecture courses. *Behaviour research methods, instruments, & computers, 32*(2), 230–239.
Martins, L. L., & Kellermanns, F. W. (2004). A model of business school students' acceptance of a web-based course management system. *Academy of Management Learning & Education, 3*(1), 7–26.
Mayer, R. E. (2009). *Multimedia learning* (2nd ed.). Cambridge: Cambridge University Press.
Mayer, R. E., & Moreno, R. (2002). Aids to computer-based multimedia learning. *Learning and Instruction, 12*(1), 107–119.
Mayorga-Toledano, M. C., & Fernández-Morales, A. (2004). Learning tools for Java-enabled phones: An application for actuarial studies. *Learning with Mobile Devices,* 95–98. Retrieved January 5, 2018 from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.97.4405&rep=rep1&type=pdf#page=104.
Mertler, C. A., & Vanatta, R. A. (2005). *Advanced and multivariate statistical methods* (3rd ed.). Glendale, CA: Pyrzcak Publishing.
Murray, T. (2001). Characteristics and affordances of adaptive hyperbooks. In *WebNet* (pp. 899–904).
Naveh, G., Tubin, D., & Pliskin, N. (2010). Student LMS use and satisfaction in academic institutions: The organizational perspective. *Internet and Higher Education, 13,* 127–133.
Oblinger, D. D., & Oblinger, J. L. (2005). Educating the net generation educause. Retrieved from. http://www.educause.edu/educatingthenetgen.
Ogba, I. E., Saul, N., & Coates, N. F. (2012). Predicting students' attitudes towards advertising on a university virtual learning environment (VLE). *Active Learning in Higher Education, 13*(1), 63–75.
Paas, F., Tuovinen, J. E., Tabbers, H., & Van Gerven, P. W. (2003). Cognitive load measurement as a means to advance cognitive load theory. *Educational Psychologist, 38*(1), 63–71.
Pagram, J., & Cooper, M. (2011). E-learning: An examination of the use and preferences of students using online learning materials. In *Proceedings of ICCE* (pp. 712–716).
Reed, P., & Watmough, S. (2015). Hygiene factors: Using VLE minimum standards to avoid student dissatisfaction. *E-learning and Digital Media, 12*(1), 68–89.
Rienties, B., Giesbers, B., Lygo-Baker, S., Ma, H. W. S., & Rees, R. (2016). Why some teachers easily learn to use a new virtual learning environment: A technology acceptance perspective. *Interactive Learning Environments, 24*(3), 539–552.
Roberts, J. C. (2015). Evaluating the effectiveness of lecture capture: Lessons learned from an undergraduate political research class. *Journal of Political Science Education, 11*(1), 45–60. https://doi.org/10.1080/15512169.2014.985104.
Rogers, P. (2001). *Designing instruction for technology enhanced learning*. London: IRM Press.
Santana-Mancilla, P. N., Montesinos-López, O. A., Garcia-Ruiz, M. A., Contreras-Castill, J. J., & Gaytan-Lugo, L. S. (2019). Validation of an instrument for measuring the technology acceptance of a virtual learning environment. *Acta Universitaria, 29,* e1796. https://doi.org/10.15174/au.2019.1796.
Šumak, B., Heričko, M., Pušnik, M., & Polančič, G. (2011). Factors affecting acceptance and use of Moodle: An empirical study based on TAM. *Informatica, 35*(1), 91–100.
Sun, P. C., Tsai, R. J., Finger, G., Chen, Y. Y., & Yeh, D. (2008). What drives a successful e-Learning? An empirical investigation of the critical factors influencing learner satisfaction. *Computers & Education, 50*(4), 1183–1202.
Sweller, J. (2004). Instructional design consequences of an analogy between evolution by natural selection and human cognitive architecture. *Instructional Science, 32,* 9–31.
Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). New York: Allyn and Bacon.
Toni Mohr, A., Holtbrügge, D., & Berg, N. (2012). Learning style preferences and the perceived usefulness of e-learning. *Teaching in Higher Education, 17*(3), 309–322.
Walker, R., Voce, J., Nicholls, J., Swift, E., Ahmed, J., Horrigan, S., et al. (2014). *Survey of technology enhanced learning for higher education in the UK*. Oxford: UCISA.
Warburton, S. (2009). Second Life in higher education: Assessing the potential for and the barriers to deploying virtual worlds in learning and teaching. *British Journal of Educational Technology, 40*(3), 414–426.

Wells, P., De Lange, P., & Fieger, P. (2008). Integrating a virtual learning environment into a second-year accounting course: Determinants of overall student perception. *Accounting & Finance, 48*(3), 503–518.
Westbrook, V. (2006). The virtual learning future. *Teaching in Higher Education, 11*(4), 471–482.
Williams, M. D. (1996). Learner-control and instructional technologies. In D. H. Jonassen (Ed.), *Handbook of research of educational communications and technology* (pp. 957–983). New York: Macmillan.
Williams, A., Birch, E., & Hancock, P. (2012). The impact of online lecture recordings on student performance. *Australasian Journal of Educational Technology, 28*(2), 199–213.
Youn, S., Chyung, Y., & Vachon, M. (2005). An investigation of the profiles of satisfying and dissatisfying factors in e-learning. *Performance Improvement Quarterly, 18*(2), 97–113.
Zerihun, Z., Beishuizen, J., & Van Os, W. (2012). Student learning experience as an indicator of teaching quality. *Educational Assessment, Evaluation and Accountability, 24*(2), 99–111.

Nazire Burçin Hamutoğlu is a Research Assistant (Ph.D) at Kırsehir Ahi Evran University, Faculty of Education, the Department of Computer and Instructional Technologies. She has been at Middelesex University in United Kingdom as an Academic Visitor for 6 months. She published more than 50 research papers in refereed journals and conference proceedings.

Orhan Gemikonakli is a Research Professor in Telecommunications. He is a member of the IET, and a Chartered Engineer. His research is in network security, and performability modelling of complex systems. He published more than 90 research papers in refereed journals and conference proceedings. He serves on various Conference Programme Committees and Editorial Boards. His Web-page: http://www.mdx.ac.uk/aboutus/staffdirectory/Orhan_Gemikonakli.aspx.

Ibrahim Duman is a Research Assistant at Hakkari University, and a Ph.D student at Sakarya University Faculty of Education, the Department of Computer and Instructional Technologies.

Ali Kirksekiz is an instructor at University of Applied Science, Karasu Vocational Highschool, Department of Computer Technologies and a Ph.D student at Sakarya University, Faculty of Education, the Department of Computer and Instructional Technologies.

Mubin Kiyici is an Associate Professor and Head of the department of Computer and Instructional Technologies, at Sakarya University, Faculty of Education. His research is in digital literacy, online learning platforms, and robotics. He published more than 70 research papers in refereed journals and conference proceedings.

Affiliations

Nazire Burcin Hamutoglu[1] · Orhan Gemikonakli[2] · Ibrahim Duman[3] · Ali Kirksekiz[4] · Mubin Kiyici[5]

Orhan Gemikonakli
o.gemikonakli@mdx.ac.uk

Ibrahim Duman
ibrahimduman@hakkari.edu.tr

Ali Kirksekiz
alik@subu.edu.tr

Mubin Kiyici
mkiyici@sakarya.edu.tr

[1] Faculty of Education, Computer Education and Instructional Technology, Kırsehir Ahi Evran University, Kirsehir, Turkey

[2] Middlesex University, London NW4 4BT, UK

[3] Faculty of Education, Computer Education and Instructional Technology, Hakkari University, Hakkari, Turkey

[4] Department of Computer Technologies, Karasu Vocational Highschool, University of Applied Science, Sakarya, Turkey

[5] Faculty of Education, Computer Education and Instructional Technology, Sakarya University, Sakarya, Turkey