Impact of 'Mode of Delivery using Text' on E-Learning in the Digital Age

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In recent times, higher education institutions are trying to boost students' online learning performance through utilization of Information and Communication Technologies (ICTs). Developments in computing, information storage, software, and networking are all deemed as significant tools for teaching and learning, which are also altering the paradigms of class room teaching. In current study, we investigated how delivery modes/media particularly text plus graphics are important to the domain of e-learning, and why delivery modes are an important aspect of pedagogy. The study encompassed the media richness theory, the cognitive theory of multimedia learning, and considered how the extended SERVQUAL model (i.e. ELQ model) constructs in context of certain delivery modes influenced students' learning. Research, from a sample of 475 university students, revealed their preference for effective utilization of delivery modes in line with different dimensions of the ELQ model. The results are deemed to provide useful assistance to higher education community that how text plus graphics delivery modes can be related to the development of students' performance in on-line learning environment.

Key Words E-learning, Delivery modes, E-Learning Quality (ELQ) model, Higher Education Institutions (HEIs)

Introduction to Delivery Media

Online curriculum designers are always investigating ways and methods of designing effective online learning programs since demand for online education and training programs is considerably increasing (Marasi, Jones, & Parker, 2022; Moloney & Oakley, 2010). For an online learning program to be effective, the literature implies that choice of media is vital (Samoylenko et al., 2022). Course designers tend to believe that richer media fetches better results, so they often use more audio and video-based content rather than plain text (Hassani et al., 2022; Pal et al., 2019). Interestingly, there is limited research validating the assumption that richer medium guarantees better learning outcomes.

There are many studies which focus on the participants' experience about e-learning programs using Technology Acceptance Model (TAM) (Cheng, 2011; Liu, Liao, & Pratt, 2009). Factors related to individuals like internet self-efficacy, learning goal orientation, and cognitive absorptions have a positive correlation with perceived usefulness, ease of use along with factors

related to interactivity, content quality, response and functionality have been reported in the literature (Cheng, 2011). In one study, Liu et al. (2009) further studied user concentration and technology acceptance of e-learning with respect to different media for e-learning program, namely text, audio, and video. Their study concluded that richness of the content positively influences user concentration but found mixed results for perceived usefulness. The mixed outcomes suggest a possible interaction between media choice and other variables in influencing not only perceived usefulness but learning effectiveness of e-learning programs.

Literature Review

The emerging trend and extensive utilisation of e-learning and information communication technologies have highlighted the importance of e-learning methodology and media choice being used (Maatuk et al., 2022; Pal et al., 2019). 'Streaming' media is quite a new media for e-learning (Liu, Liao, & Pratt, 2009). Streaming media gives the user the liberty of playing video or audio instead of waiting for the download to complete then watching or hearing it, as a result, it helps in crafting a more collaborative learning experience and environment (Rahmawati & Soekarta, 2021).

In an e-learning system, one can use several combinations of video / audio / graphics / animation / text. Media selection is very crucial while planning to develop an e-learning system because of the cost of the non-textual material (Timmerman & Kruepke, 2006; Sun & Cheng, 2007); with literature implying the time and cost for the development of e-learning material being five times greater than that required to develop conventional lecture material (Weiser & Wilson, 1999).Selection of multimedia presentation has an influence on the perceived usefulness as suggested in literature material (Liu, Liao & Pratt, 2009). Arbaugh (2005b) looked at student's perceived learning and satisfaction with e-learning, and investigated the notion of media variety on e-learning effectiveness and concluded, among other things, that using a variety of media positively influences learning effectiveness. It is, therefore, necessary to perform additional work to investigating types of media-presentation and its relationship with quality perception of users and ultimate student satisfaction.

Objectives of the study

The current study aims to check users' quality perception when different media is used for e-learning delivery. The theoretical framework is proposed in the current study to determine user's satisfaction with web-based learning. It will help in looking from the perspective of both learner and e-learning system user. Acceptance of the web-based streaming media for e-learning is tested through use of SERVQUAL (Service quality model). SERVQUAL is extensively used and accepted by many researchers to measure user's satisfaction. The current research is motivated and directed to provide answers to the question, "Does the learner's

e-learning satisfaction is influenced by the different ways in which e-learning material is presented?"

Theoretical Background

The current study is established using two concepts from the literature media richness theory and conceptual framework of quality SERVQUAL model.

The Cognitive Theory of Multimedia Learning (CTML)

In (1997) Mayer proposed a concept called "Cognitive theory of multimedia learning", sometimes also known as ''multimedia principle'', stating that "using pictures with words can result in more profound learning instead of using only words". Following are fundamental supposition of this theory: (i) all human being have to hear and visual distinct channels to process information (Dual-Coding theory), (ii) there is a limited capability for each channel, and (iii) learning is a process in which prior knowledge is used to strain, organize, select, and incorporate information. It also underlines the importance and influence of visualisation being used for delivery of education on the human information processing and ultimate learning (Gress, Fior, Hadwin & Winne, 2010; Martinez et al., 2007).

Media Richness Theory (MRT)

Daft and Lengel (1986) proposed a theory that "capacity to process rich information" can help improve user concentration. Media Richness Theory (MRT) aims to help in the selection of right technology to minimise obscurity in different business situations. MRT also states that, for certain environments, lean media communicates effectively, but in case of uncertain environments richer media is required for effective communication (Daft & Lengel, 1986). Rapid developments, and more sophisticated technology available to users means it is required to assess media richness theory constantly. Some of the business studies testing media richness theory (Lim & Benbasat, 2000; Matarazzo & Sellen, 2000; Yeung & Lu, 2004; Otondo, Van Scotter, Allen & Palvia, 2008) integrate audio, video, or web technologies. Most of these supported media richness theory; results showed that while communicating tasks video (rich media) is more efficient than the text (lean media).

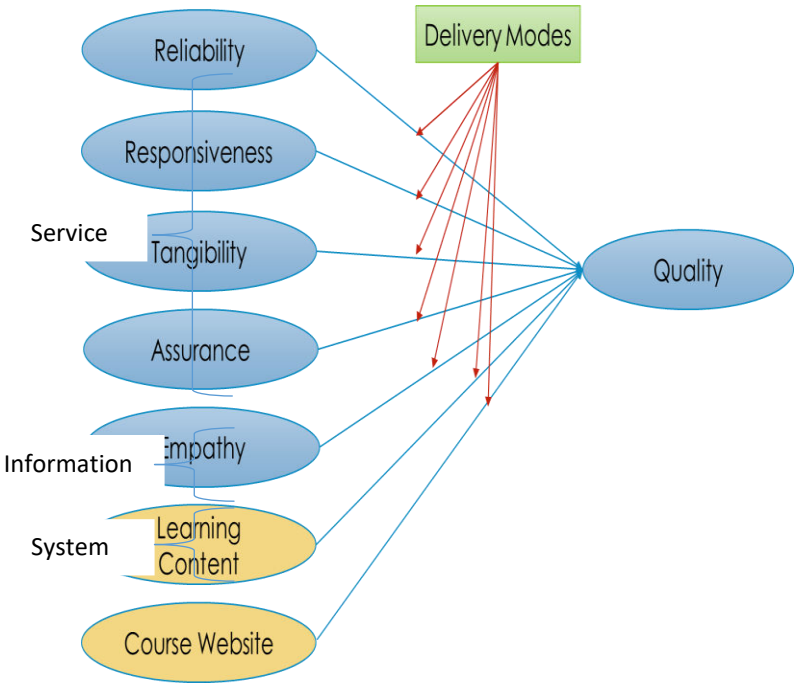
The Research Model

It is argued that the suitability of the representation of learning material has a direct effect on the learner's comprehension process, with learning being very much impacted by the individual's specific comprehension of the learning material (Burns, Clift, & Duncan, 1991). From the perspective of media richness theory, the medium used when representing learning material has its own usage cost and transmission capacity for information, and thus needs to be selected carefully. An improper choice of media channel is not only unbeneficial to the student learning performance, but also can be costly; both in cost and time of generation, in terms of required bandwidth/technology required to deliver the learning content, but also in

terms of cognitive load required to process and assimilate information. For example, it is expensive to use high richness media such as animation to present the learning material with a low level of uncertainty. Similarly, too much unnecessary multimedia elements in learning material will distract a learner's attention and have no significant positive effect on learning (Gillani & Relan, 1997; Bartsch & Cobern, 2003).

The current study has empirically tested th E-Learning Quality Model (ELQ) as the research model shown in Figure 1. The model includes the service quality model (SERVQUAL) at its base. This model, created by Uppal et al (2017), proposed an extension to the SERVQUAL, keeping in mind the e-learning system users. These users, assess e-learning systems on two aspects, i.e. information and system. Therefore, the success of e-learning is dependent on two factors; the way content is presented to the learner/user (information), and learner's/users' perceived usefulness of the system (course website).

Figure 1: ELQ - Research model – Adopted to consider effect of Delivery modes



To consider the component aspects of quality, our research hypotheses states that, when e-learning system delivers information using a range of different media (text and graphics/text, graphics and sound/text, graphics and video):

H1: "Reliability" is positively associated with students' perception of e-learning quality.

H2: "Assurance" is positively associated with students' perception of e-learning quality.

H3:"Tangibility" is positively associated with students' perception of e-learning quality.

H4: "Empathy" is positively associated with students' perception of e-learning quality.

H5:"Responsiveness" is positively associated with students' perception of e-learning quality.

H6: "Learning Content" is positively associated with students' perception of e-learning quality.

H7: "Course Website" is positively associated with students' perception of e-learning quality.

The influence and importance of media on learning are considered by varying the media richness. Use of multiple and combination of media rather than single media is very common, so we suggest three distinctive modes of presenting e-learning: only text, text with audio, and video with associated audio. Streaming both audio and video at the same time can help in meeting and exceeding learner/user expectations of advanced system technology. We believe that user intention towards e-learning system is affected by the delivery modes/presentation in two ways. Primarily users' perceived value and ultimate satisfaction towards e-learning system are effected thorough type of presentation used in the delivery of e-learning content. Secondly, a user is most likely to use the e-learning again if he/she is satisfied with the service, information and/or system.

Research Methodology

We carried out the empirical testing of the research model by designing an experiment, where we gave three types of learning material to the students for the duration of a semester, followed by data collection through a questionnaire. First, the students were given text-only material, secondly, they were given text material with audio and finally they were given learning material with text, audio, and video.

Research Study

We used a survey instrument to collect data on perceptions of quality and satisfaction from the learning material that is provided to students. This data is collected from a random sample of 475 undergraduate and graduate students in the business school of two universities in Lahore (Pakistan). This had a limitation, i.e. using perceptions of learning satisfaction rather than actual learning measures.

Sampling and Data collection

Our survey targeted a random sample of 475 students. After obtaining approval for this study and after making prior arrangement with instructors to deliver learning material to students in a planned manner. The undergraduate course 'Supply Chain Management' was used to run this experiment. For the first four weeks, learning material was made available to students through powerpoint slides, which were primarily text-based. For the next four weeks, students were provided slides with text and audio, and for the last four weeks, students were provided learning material in the form of video lectures where the instructor could be seen with the slides.

After the completion of the course in three and half months, we requested students to respond to our survey regarding their perception of quality for the delivered course. The purpose of our research and the different parts of the survey instrument were

explained to the students. They were also informed that their participation was completely voluntary. In the survey instrument, the following scale was used: 1=Very Important, 2=Important, 3= Neither Important nor Unimportant, 4= Unimportant and 5= Very Unimportant. On average, students took 20 min to complete our survey instrument.

Analysis and Findings: Delivery through Text plus Graphics

Reliability and Validity

To check the reliability of the scale we conducted Cronbach Alpha (Cronbach, 1951; Nunnully, 1978) to measure internal consistency. The Cronbach Alpha for all questionnaire items is 0.879. The extracted factors' Cronbach alpha values for our quality factors are shown in Table 1. All alpha (α) values are greater than (>) 0.70, which implies factors are highly correlated and interchangeable (Jarvis et al., 2003).

Table 1: Scale Reliability values

Factor Label	**Number of Items**	**Cronbach's alpha (α)**
Assurance	5	0.967
Reliability	5	0.914
Responsiveness	5	0.965
Empathy	5	0.961
Tangibility	4	0.940
Learning Content	9	0.984
Learning Quality	4	0.932
Course Website	6	0.925

Terms measuring the same construct exhibited high construct loadings, i.e. suggesting adequate convergent validity. According to Hair et al. (2010), the minimum threshold value recommended for a sample size of 475 is 0.350. Since all loaded values were above 0.50, it confirms that the factors had sufficient discriminant validity, and no unexpected cross-loading occurred (see Table 2).

After testing the scale reliability, convergent and divergent validity was tested. Convergent validity can be established if two indicators correspond to each other. Divergent validity is the degree to which two dissimilar constructs can be easily differentiated.

Table 2: Discriminant and convergent validity

CR	**Constructs**	**LC**	**LQ**	**ASS**	**EMP**	**RESP**	**REL**	**TAN**	**CW**
0.98	**Learning**	**0.93**							

4	**Content**	**5**							
0.922	**E-learning Quality**	0.461	**0.865**						
0.968	**Assurance**	0.302	0.362	**0.927**					
0.960	**Empathy**	0.255	0.230	0.203	0.910				
0.967	**Responsiveness**	0.225	0.259	0.518	0.241	**0.925**			
0.915	**Reliability**	0.450	0.415	0.425	0.284	0.386	**0.827**		
0.943	**Tangibles**	0.496	0.465	0.223	0.212	0.241	0.604	**0.897**	
0.924	**Course Website**	0.025	0.115	0.044	0.128	0.077	0.033	-0.007	**0.820**

Exploratory Factor Analysis (EFA)

To see if the observed variables adequately correlated, i.e. met reliability and validity criteria, we conducted an EFA using Principal Component Analysis, with Promax rotation (see table 3).

We selected Promax for two reasons: firstly because our sample size was adequately large, i.e. n=475; secondly, since Promax is suitable when multiple factors are correlated. Some of the questions needed to be dropped, as they did not load well. The eight factors that were extracted in the pattern matrix (table 3) were, however, used for further analysis. The cumulative variance of the seven factors was 81.46%, and all extracted factors had eigenvalues above 1.0. All the commonalities for each variable were significantly high, i.e. all were above 0.300 with most being above 0.800.

Table 3: Pattern Matrix[a]

Extraction Method: Maximum Likelihood. Rotation Method: Promax with Kaiser Normalisation.

a. Rotation converged in 7 iterations.

	Factor							
	1	2	3	4	5	6	7	8
ASU Text 1	.943							
ASU Text 2	.838							
ASU Text 3	.821							
ASU Text 4	.970							
ASU Text 5	.975							
EMP Text 1		.919						

EMP Text 2		.877						
EMP Text 3		.884						
EMP Text 4		.949						
EMP Text 5		.934						
RSP Text 1			.880					
RSP Text 2			.882					
RSP Text 3			.962					
RSP Text 4			.932					
RSP Text 5			.950					
RAL Text 1				.816				
RAL Text 2				.743				
RAL Text 3				.793				
RAL Text 4				.834				
RAL Text 5				.870				
LC Text 1					.932			
LC Text 2					.905			
LC Text 3					.872			
LC Text 4					.958			
LC Text 5					.956			
LC Text 6					.929			
LC Text 7					.927			
LC Text 8					.956			
LC Text 9					.924			
TAN Text 1						.852		
TAN Text 2						.858		
TAN Text 3						.809		
TAN Text 4						.921		
ELQ Text 1							.899	
ELQ Text 2							.873	
ELQ Text 3							.880	
ELQ Text 4							.856	
CW Text 1								.661
CW Text 2								.675
CW Text 3								.886
CW Text 4								.823
CW Text 5								.895
CW Text 6								.956

The Kaiser-Meyer-Olkin and Bartlett's test for sampling adequacy was significant, showing that the chosen variables were sufficiently correlated (see table 4).

Table 4: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.883
Bartlett's Test of Sphericity	Approx. Chi-Square	7287.190
	Df	903
	Sig.	.000

Fitness of Results

The ELQ model, to the best of our knowledge, is the first that has been tested to measure the perception of e-learning quality, including the dimensions of 'Learning Content' and 'Course Website'. Seven hypotheses were tested as independent variables, i.e. the original five SERVQUAL dimensions, plus the additional dimensions - 'Learning Content' and 'Course Website'. At the P <0.05 level, three dimensions were identified to positively relate to student's perception of quality; i.e. Learning Content, Tangibility, and Assurance. Empathy, Reliability, Course Website and Responsiveness were not found to be significant. Regression weights are given in table 5. Our research accordingly confirms hypotheses H2, H3, and H6; proving Assurance, Tangibility and Learning Content using ELQ model, are positively associated with the perception of e-Learning quality.

Table 5: Regression Weights

			Estimate	**S.E.**	**C.R.**	**P**
E-Learning Quality	←	Learning Content	.179	.060	2.981	.003**
E-Learning Quality	←	Tangibility	.226	.079	2.852	.004**
E-Learning Quality	←	Reliability	-.023	.096	-.241	.809
E-Learning Quality	←	Responsiveness	-.006	.054	-.106	.916
E-Learning Quality	←	Assurance	.220	.069	3.207	.0001***
E-Learning Quality	←	Empathy	.001	.059	.009	.992
E-Learning Quality	←	Course Website	.072	.095	.753	.451
* P≤ 0.05, ** P ≤ 0.01, *** P ≤ 0.001, **** P ≤ 0.0001						

All fitness values are within acceptable criteria limits, depending on the test, hence implying a good model fit (see table 6). Chi-square/df equaled 1.775; where a value between 2.0 and 5.0 is considered acceptable (Hau 2010). Our RMSEA value is 0.075, and our CFI and NFI values are

0.989 and 0.977 respectively; demonstrating the goodness of fit, thus supporting the results and validating the proposed model.

Table 6: Goodness of Fit Statistics

Index	Value	Criterion
Chi – Square /Df	1.775	2.0 – 5.0
RMSEA	0.075	0 – 0.1
CFI	0.989	0 ~ 1
NFI	0.977	0 ~ 1

Conclusion

In recent past, higher education institutions are advancing students' online learning performance through utilization of Information and Communication Technologies (ICTs). Similarly, developments in Information Technology and digital platforms have brought significant changes in tools and delivery modes, which facilitate modes of learning and teaching, ultimately leading towards emergence of varieties of new learning approaches for traditional as well as digital learning setting. Our findings show that when it comes to the perception of quality for e-learning, if the e-learning system is provided in the text format, which includes text and graphics, it has a positive correlation with 'learning content', 'tangibility' and 'assurance'. This means students, associate the e-learning system quality with the media and delivery mode in which the learning content is provided. So, learning content is perceived to be of higher quality, if it is presented in text and graphics. Secondly, use of text is perceived as being tangibly effective. Thirdly, learners are more assured of the quality of learning, when e-learning is delivered with text and graphics.

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