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Comparative Analysis Of Different Comparative Analysis of Different Content Delivery Modes in E-learning Settings: A Quantitative Evaluation in Tertiary Education Sector

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Abstract

At present, advances in technological development have not only altered modern lifestyles but also transformed the way in which we teach and learn. In education sector, dynamic improvements have been witnessed in the context of innovative educational delivery methods in order to boost education process particularly for accessing courses and related activities. In the current study, we examined quantitatively, how delivery modes/media type is important to the domain of e-learning, and why delivery modes are deemed as a significant aspect of pedagogy. This study has applied theoretical underpinning of the media richness theory, the cognitive theory of multimedia learning, and considered how the extended SERVQUAL model (i.e. ELQ model) constructs are related to this study. Data were gathered from 475 university students, which exhibited their preference and inclination of utilizing multiple delivery modes in line with different dimensions of the ELQ model. Results, obtained through Structural Equation Modelling (SEM), revealed that students associate e-learning system quality with the media format in which the learning content is provided. When the learning content is provided in full audio/video, they perceive it to be of better quality since it lowers their cognitive load, ultimately leading towards improved students' performance in e-learning setting.

Keywords Collaborative Learning, Course Delivery, Delivery Modes, Online Learning, E-Learning Quality (ELQ) model

1. Introduction

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 for course delivery (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) (Liu, Liao, & Pratt, 2009; Cheng, 2011). 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.

2. Delivery Modes of E-learning

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.

The current study aims to check users' quality perception when different media is used for e-learning course 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?"

3. Theoretical background

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

3.1 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 supposals 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). Visualisation can be exceptionally suitable for teaching a topic which is tough to teach otherwise image, like the neural networks, atomic structures or the solar system (Fischer et al., 2002). Visualisation can also be used to describe the concept of look and feel of a website, where look refers fonts, colors, visual design, and shapes of site (Roberts, 2022)whereas feel refers as the familiar features that help when navigating through the hyperlinks, menus, tools and check boxes (Stoiber et al., 2022).

A study on the concept of credibility and aesthetics by Robins and Holmes (2008) stated that there is high judgments of credibility when there is high aesthetic treatment. A study by Chikasha et al. (2010), in context of African communities, is conducted exploring the critical issues related to the incorporation of multimedia on e-learning. It was concluded, in the findings, that use of audio with visuals improved the learning result, minimised cognitive load and increased satisfaction.

3.2 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 advantage of rich media is that it uses multiple channels, which more effectively helps in explaining complex tasks. Media choice is dependent on its communication capability (Yeung & Lu, 2004). MRT has also emphasised in a number of studies related to education (Kozma, 1991; Clark, 1991), which means that different types of learning material may be used with different types of media. So for reading a conceptual paper, written text may be the best. However, to be able to most effectively understand a case study a video clip may be most suitable.

Clark (1994), however, says learner's success is not inclined by media selection; instead the same achievement can get from differed media types. Which means depending on the preference of the learner, if the same material is presented in different media, i.e. text, audio or video, the same performance may be expected.

If the above argument is accepted, it can be said that the availability of choices for media is useful for supporting user satisfaction. This also infers that users may feel that they have choices when it comes to media selection and some users may have a preference for a certain type of media. Therefore, having learning material available in multiple media types seems useful.

The aim of almost all studies conducted so far concerning media richness theory relates to check the success of learning. Some recent studies added the concept of intent, used with MRT, to check learner satisfaction. Rich media can benefit learners, can, therefore, be used in courses having uncertain and confusing material; on the other hand, learners attain no substantial advantage in both satisfaction and scores in courses that have low numerical content (Sun & Cheng, 2007). Otondo et al. (2008) found that audio and video (rich media) are closely related to learner satisfaction, however, the leaner achievement related to the medium text.

Users select media based on their previous experience, and their perceived satisfaction with media, rather than the information processing capability of the media itself. Accordingly, different media combinations (presentation types) represent different levels of media richness, which could then be associated with the perceived satisfaction of the e-learning experience. Streaming media, the real-time playing of audio/video over the Internet, is common to e-learning (Elshaer & Sobaih, 2022). Advances in technology have enabled the incorporation of streamed audio and video into e-learning environments, and the subsequent study of the influence of that streaming media has been looked at by a number of researchers. This research is, however, the first to assess the influence of different media (herein referred to as delivery modes) on a user's quality perception of e-learning system; considering 'service', 'information' and 'system' dimensions.

MRT has been widely used to investigate suitability among task and media characteristics and for describing issues effecting media richness like task satisfaction, decision quality and time (Kahai & Cooper, 2003; Mennecke, Valacich & Wheeler, 2000; Purdy, Nye & Balakrishnan, 2000), system design for organisations (Daft & Lengel, 1983; 1986), marketing, conflict management (Klein, 2003), and extrapolation and explanation of the media choice and usage in organizations (Allen & Griffeth, 1997; Daft, Lengel & Trevino, 1987). In short, the media richness theory has been applied in a wide variety of issues with success in both theoretical analyses and empirical studies.

Prior research on media richness indicates that text as a presentation type might be primarily suitable for communication of factual information; whereas multimedia presentations could communicate both factual and abstract information. There are limited empirical studies investigating the influence of streaming media on learner performance and satisfaction. This research is designed to fill that gap. Hence, the following hypothesis was tested:

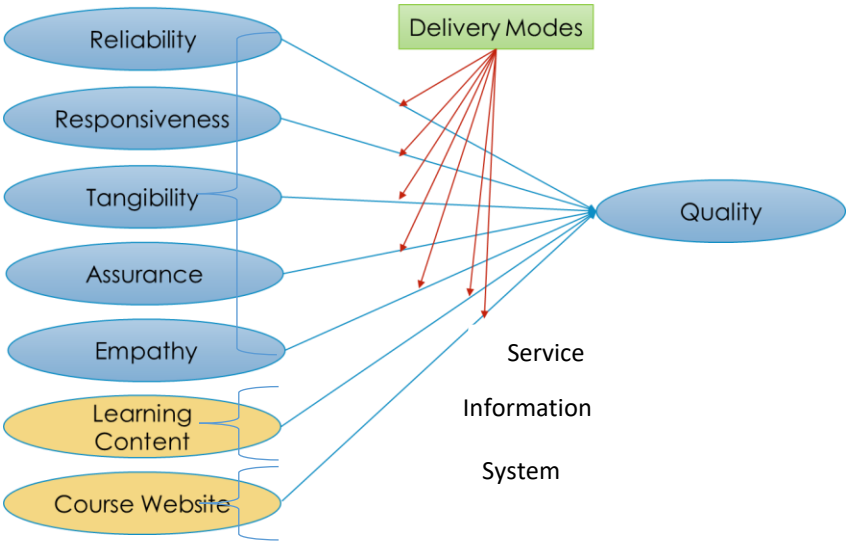
H1: Student perception of e-learning quality is influenced by the type of media in which the information is presented.

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 the 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.

5.1 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.

5.2 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. On average, students took 20 min to complete our survey instrument. The survey instrument is attached in Appendix C.

5.3 Variables

Our independent variables are reliability, assurance, tangibility, empathy, responsiveness, website and learning content. The moderating variable of media choice was operationalised at three levels as follows:

- **Text, plus graphics**: This would include graphs, charts and still pictures in addition to text, equivalent to printed material or slides.
- **Text, Graphics, plus sound**: This would add sound/audio annotation to printed materials or slides.
- **Text, graphics, video (full-motion) or animation**: This would include full-motion or animated illustration of the contents of the learning program, as distinct from showing only the instructor.

Our dependent variable is the perception of quality. In the survey instrument, we asked each participant to read the questionnaire statements and provide feedback on each statement for each

of the learning types. 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.

Analysis and Findings

6.1 Delivery through Text plus Graphics

6.1.1 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
0.984	**Learning Content**	**0.935**							

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 f	0.604	**0.897**	
0.924	**Course Website**	0.025	0.115	0.044	0.128	0.077	0.033	-0.007	**0.820**

6.1.2 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

6.1.3 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

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, it has a correlation with learning content. This means students, associate the e-learning system quality with the media in which the learning content is provided. Secondly, use of text is perceived as being tangibly effective. This means if e-learning system is provided in the text format learning content quality, tangibility quality, and assurance the learners' is positively increased.

6.2-Delivery through Text, Graphics plus Sound

6.2.1 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 7. All alpha (α) values are greater than (>) 0.70, which implies factors are highly correlated and interchangeable (Jarvis et al., 2003).

Table 7: Scale Reliability

Factor Label	Number of Items	Cronbach's alpha (α)
Assurance	5	0.970
Reliability	5	0.968
Responsiveness	5	0.972
Empathy	5	0.974
Tangibility	4	0.961
Learning Content	9	0.987
Learning Quality	4	0.947
Course Website	6	0.969

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 (Table 8). After testing the scale reliability, convergent and divergent validity was tested.

Table 8: Discriminant and convergent validity

CR	Constructs	ASU	LC	RES	REL	EMP	LQ	TAN	CW
0.965	**Assurance**	0.921							
0.985	**Learning Content**	0.103	0.950						
0.973	**Responsiveness**	0.140	0.213	0.937					
0.969	**Reliability**	0.236	0.381	0.354	0.928				
0.974	**Empathy**	0.269	0.349	0.535	0.561	0.940			
0.948	**E-learning Quality**	0.026	0.136	0.024	0.277	0.056	0.906		
0.962	**Tangibles**	0.014	0.232	0.350	0.327	0.341	0.169	0.929	
0.968	**Course Website**	0.057	-0.064	0.143	-0.072	0.034	-0.219	0.066	0.915

6.2.2 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 9). We selected Promax for two reasons, first because our sample size was adequately large, i.e. n=475. Secondly, since Promax is suitable when multiple factors are correlated. The seven factors that were extracted in the pattern matrix (table 9) were, however, used for further analysis. The cumulative variance of the seven factors was 77.68%, 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 9: 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	.962							
ASU Text 2	.850							

ASU Text 3	.965							
ASU Text 4	.906							
ASU Text 5	.965							
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 (table 10).

Table 10: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.832
Bartlett's Test of Sphericity	Approx. Chi-Square	9421.616
	Df	903
	Sig.	.000

6.2.3 Fitness of Results

The ELQ model, to the best of our knowledge, is the first that SERVQUAL has been tested to measure the perception of e-learning quality, including the additional dimensions of 'Learning Content' and 'Course Website'. Seven hypotheses were tested as independent variables, i.e. the original five SERVQUAL dimensions, plus the proposed dimensions - 'Learning Content' and 'Course Website'. At the P <0.05 level, two dimensions were identified as impacting student's perception of quality; i.e. Reliability and Course Website. Regression weights are given in table 11. Interestingly, however, results show that use of text and audio had a negative impact on quality perception of the course website. Our research accordingly confirms hypotheses H1, yet disproves H7; since the use of audio and text, measured using the e-Learning quality (ELQ) model, had a negative impact on student perception of quality.

Table 11: Regression Weights

			Estimate	**S.E.**	**C.R.**	**P**
E-Learning Quality	←	Learning Content	-0.011	0.075	-0.152	0.879
E-Learning Quality	←	Tangibility	0.108	0.065	1.656	0.098
E-Learning Quality	←	Reliability	0.259	0.077	3.349	.001***
E-Learning Quality	←	Responsiveness	-0.245	0.154	-1.594	0.111
E-Learning Quality	←	Assurance	-0.013	0.057	-0.223	0.823
E-Learning Quality	←	Empathy	-0.145	0.082	-1.775	0.076
E-Learning Quality	←	Course Website	-0.143	0.063	-2.257	.024*
* 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 12). Chi-square/df equaled 2.89; where a value between 2.0 and 5.0 is

considered acceptable (Hau 2010). Our RMSEA value is 0.069, and our CFI and NFI values are 0.990 and 0.986 respectively; demonstrating the goodness of fit, thus supporting the results and validating the proposed model.

Table 12: Goodness of Fit Statistics

Index	Value	Criterion
Chi – Square /Df	1.170	2.0 – 5.0
RMSEA	0.035	0 – 0.1
CFI	1.170	0 ~ 1
NFI	0.990	0 ~ 1

Our findings show that when it comes to the perception of quality for e-learning if the e-learning system provides content via both text and audio format, it has a positive correlation on 'Reliability'; but has a negative correlation on the perception of the course website. This means that students perceive the reliability of service improves if the service is not only provided in the text but also in audio. This means if a service is required by a student and with an e-mail or text message if an audio message or call is also made, the reliability of the service would be perceived to have improved. The association with the 'Learning Content' is not significant in this case. This may be because if the text is given as learning material and audio is provided, there may be a disconnect between the audio and the text. If students cannot see who is providing the audio for the text, they do not see it as an important or significant aspect of the perception of quality. They do not think, in this format, the quality of the content improves. This means students, want to see the teacher when he/she is delivering the learning content.

6.3 Text, Graphics, and Video Analysis

6.3.1 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 13. All alpha (α) values are greater than (>) 0.70, which implies factors are highly correlated and interchangeable (Jarvis et al., 2003).

Table 13: Scale Reliability

Factor Label	Number of Items	Cronbach's alpha (α)
Assurance	5	0.981

Reliability	5	0.969
Responsiveness	5	0.981
Empathy	5	0.982
Tangibility	4	0.969
Learning Content	9	0.988
Learning Quality	4	0.954
Course Website	6	0.978

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 (table 14).

Table 14: Discriminant and convergent validity.

CR	Constructs	CW	ASR	EMP	RES	TAN	LQ	LC	REL
0.980	**Course Website**	0.943							
0.980	**Assurance**	-0.045	0.952						
0.982	**Empathy**	-0.112	0.602	0.958					
0.981	**Responsiveness**	-0.126	0.589	0.672	0.954				
0.969	**Tangibles**	0.002	0.434	0.353	0.290	0.941			
0.958	**E-learning Quality**	-0.160	0.256	0.217	0.233	0.156	0.922		
0.987	**Learning Content**	0.052	0.216	0.149	0.102	0.207	0.201	0.946	
0.974	**Reliability**	-0.108	0.302	0.249	0.244	0.160	0.044	0.057	0.939

After testing the scale reliability, convergent and divergent validity was tested.

Table 15: Pattern Matrix[a]

Extraction Method: Principal Component Analysis.
Rotation Method: Promax with Kaiser Normalization.
Rotation converged in 6 iterations.

	Factor							
	1	2	3	4	5	6	7	8
ASU Text 1	.962							
ASU Text 2	.940							
ASU Text 3	.886							
ASU Text 4	.993							
ASU Text 5	.953							
EMP Text 1		.982						
EMP Text 2		.913						
EMP Text 3		.884						
EMP Text 4		.971						
EMP Text 5		.975						
RSP Text 1			.945					
RSP Text 2			.926					
RSP Text 3			.958					
RSP Text 4			.991					
RSP Text 5			.926					
RAL Text 1				.992				
RAL Text 2				.927				
RAL Text 3				.912				
RAL Text 4				.934				
RAL Text 5				.987				
LC Text 1					.983			
LC Text 2					.935			
LC Text 3					.988			
LC Text 4					.989			
LC Text 5					.895			
LC Text 6					.967			
LC Text 7					.944			
LC Text 8					.945			
LC Text 9					.985			
TAN Text 1						.991		
TAN Text 2						.974		
TAN Text 3						.889		

TAN Text 4						.971		
ELQ Text 1							.985	
ELQ Text 2							.881	
ELQ Text 3							.927	
ELQ Text 4							.995	
CW Text 1								.955
CW Text 2								.934
CW Text 3								.932
CW Text 4								.947
CW Text 5								.978
CW Text 6								.977

6.3.2 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 15). We selected Promax for two reasons, first because our sample size was adequately large, i.e. n=475. Secondly, Promax is suitable when multiple factors are correlated. The seven factors that were extracted in the pattern matrix (Table 15) were, however, used for further analysis. The cumulative variance of the eight factors was 90.398%, 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.

The Kaiser-Meyer-Olkin and Bartlett's test for sampling adequacy was significant, showing that the chosen variables were sufficiently correlated (Table 16).

Table 16: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.847
Bartlett's Test of Sphericity	Approx. Chi-Square	11518.113
	Df	903
	Sig.	.000

6.3.3 Fitness of Results

The ELQ model, to the best of our knowledge, is the first that has been used to measure the perception of e-learning quality, including the additional 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. Responsiveness, Learning Content and Course Website. Whereas other

4 variables were not found to be significant. Regression weights are given in table 17. Our research accordingly confirms hypotheses H5, H6, and H7; proving Responsiveness, Learning Content and Couse Website measured using ELQ model, are positively associated with the perception of e-Learning quality.

Table 17: Regression Weights

			Estimate	S.E.	C.R.	P
E-Learning Quality	←	Learning Content	0.393	0.126	3.108	.002**
E-Learning Quality	←	Tangibility	0.043	0.087	0.495	0.621
E-Learning Quality	←	Reliability	0.046	0.144	0.317	0.751
E-Learning Quality	←	Responsiveness	0.279	0.136	2.049	.040*
E-Learning Quality	←	Assurance	0.152	0.106	1.442	0.149
E-Learning Quality	←	Empathy	0.107	0.124	0.865	0.387
E-Learning Quality	←	Course Website	-0.197	0.09	-2.196	0.028*
* 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 18). Chi-square/df equalled 2.89; where a value between 2.0 and 5.0 is considered acceptable (Hau 2010). Our RMSEA value is 0.069, and our CFI and NFI values are 0.990 and 0.986 respectively; demonstrating the goodness of fit, thus supporting the results and validating the proposed model.

Table 18: Goodness of Fit Statistics

Index	Value	Criterion
Chi – Square /Df	.420	2.0 – 5.0
RMSEA	0.035	0 – 0.1
CFI	1.000	0 ~ 1
NFI	0.997	0 ~ 1

4. Conclusion

The findings reveal that when it comes to the perception of quality for e-learning, if the e-learning system in provided in the audio/video format, it has a positive correlation with responsiveness, learning content and course website. This means students, associate the e-learning system quality with the media format in which the learning content is provided. When the learning content is provided in full audio/video, they perceive it to be of better quality. This supports the 'multimedia principle' proposed by Mayer (1997).

Secondly, if the course website components are available in multimedia, the perception of quality also improves. Similarly, one of the dimensions of SERVQUAL; responsiveness also seems to improve, if provided in multimedia. This means, if in an e-learning system, the responses to the learner are provided in multimedia, they perceive it to be of high quality. Like if instead of an e-mail message or a text message, if a learner is called and spoken to, they perceive the quality of the service to be better.

Therefore, through chapter discussion and conducted experiments, to investigate different delivery media/modes, it has been found that different delivery media/modes have a different impact on student perception of quality. Therefore, when designing and developing e-learning system, educators and providers must consider these aspects for better system success.

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