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Does e-learning service quality influence e-learning student satisfaction and loyalty? Evidence from Vietnam

Long Pham[1,2], Yam B. Limbu[3*], Trung K. Bui[4,5], Hien T. Nguyen[6,7] and Huong T. Pham[8,9]

* Correspondence: limbuy@montclair.edu
[3]Department of Marketing, Feliciano School of Business, Montclair State University, 1 Normal Ave, Montclair, NJ 07043, USA
Full list of author information is available at the end of the article

Abstract

Prior studies on e-learning service quality were conducted mainly in developed countries; however, little effort has been made in emerging countries. This study examines the relationships among e-learning service quality attributes, overall e-learning service quality, e-learning student satisfaction, and e-learning student loyalty in the context of Vietnam, an emerging country. Survey data collected from 1232 college students were analyzed by means of exploratory factor analysis, confirmatory factor analysis, and structural equation modeling using SPSS 25 and SmartPLS 3.0. The results indicated that e-learning service quality was a second-order construct comprising of three factors, namely, e-learning system quality, e-learning instructor and course materials quality, and e-learning administrative and support service quality. The e-learning system quality was the most important dimension of overall e-learning service quality, followed by e-learning instructor and course materials quality, and e-learning administrative and support service quality. In addition, the overall e-learning service quality was positively related to e-learning student satisfaction, which in turn positively influences e-learning student loyalty. Also, overall e-learning service quality has a direct effect on e-learning student loyalty. Implications for colleges and universities are discussed.

Keywords: E-learning service quality, E-learning student satisfaction, E-learning student loyalty, Vietnam

Introduction

The relationship between student loyalty and the factors that lead to loyalty have been studied extensively in the traditional educational environment where interactions between students and instructors take place directly in physical classrooms on campus (Martinez-Arguelles & Batalla-Busquets, 2016). However, advances in information and communication technology (ICT) are changing all industries and sectors (Jun & Cai, 2001); higher education is no exception (Chow & Shi, 2014). E-learning is becoming increasingly popular in high education (Tsai, Shen, & Chiang, 2013; Wu, 2016) as the applications of ICT continue to provide a variety of teaching and learning options for faculty and students (Sarabadani, Jafarzadeh, & ShamiZanjani, 2017). E-learning can be seen as an innovative approach to the delivery of educational services through electronic forms of information that enhance knowledge, skills, and other outcomes of learners (Fazlollahtabar & Muhammadzadeh, 2012). In other words, e-learning is the

use of modern ICT and computers connected to the Internet to provide teaching and learning contents (Beqiri, Chase, & Bishka, 2010).

E-learning can bring about many benefits for both universities and students (Bhuasiri, Xaymoungkhoun, Zo, Rho, & Ciganek, 2012). For universities, firstly, e-learning helps universities save substantial costs related to the investment in physical teaching and learning infrastructures (Arbaugh, 2005). Secondly, e-learning helps universities become more digitized and contribute to the formation of a digital and knowledgeable society where learning and knowledge sharing can be conducted in a simple and fast way at anytime in anywhere with the help of Internet enabled technologies (Taylor, 2007).

Thirdly, e-learning helps universities integrate further into the global educational environment (Lee, 2010). In particular, international cooperation and links in the field of teaching can take place beyond the boundaries of one country; for example, joint training programs in which domestic students are not required to go to a university abroad to study, but are able to receive full academic services provided by the foreign university.

For students, e-learning provides them an additional choice of learning style in addition to traditional learning (Hollenbeck, Zinkhan, & French, 2006). E-learning is not limited by time and space as it can take place at home, at work, or anywhere via computers or mobile devices connected to the Internet and the university's e-learning system (Bhuasiri et al., 2012; Kilburn, Kilburn, & Cates, 2014). This is particularly convenient for students who are learning and working at the same time (Wisloski, 2011). Finally, with e-learning, students can completely control the pace and rhythm of their studies as they are not required to attend physical classes on campus (Bhuasiri et al., 2012).

More and more universities are implementing student caring strategies in the same way as businesses are taking care of their customers (Stodnick & Rogers, 2008). In other words, today's students are seen as customers of universities and universities need effective measures to retain their loyalty (Martinez-Arguelles & Batalla-Busquets, 2016). Previous studies in the field of traditional business, e-business, and traditional education suggested a chain model of service quality, satisfaction, and loyalty where service quality affects satisfaction, and in turn, satisfaction affects loyalty (Jiang, Yang, & Jun, 2013; Jun, Yang, & Kim, 2004; Parasuraman & Grewal, 2000). The authors of the current study raise two important questions: (1) Can this chain model be applied to the e-learning environment? and (2) What is the role of e-learning service quality factor in this chain model?

Researchers have long examined the factors that lead to student loyalty in the traditional learning environment (Parves & Ho Yin, 2013). Few research efforts are focused on how key elements of e-learning service quality affect e-learning student loyalty through the intermediary role of e-learning student satisfaction (Martinez-Arguelles, Callejo, & Farrero, 2013). The authors of this study argue that not all e-learning service quality attributes impact overall e-learning service quality in the same manner. It is therefore imperative to discover what among e-learning service quality attributes are the most important ones that have impacts on overall e-learning service quality, and to evaluate the relationship between overall e-learning service quality, e-learning student satisfaction, and e-learning student loyalty.

It should be noted that previous studies on e-learning service quality were conducted mainly in developed countries, resulting in various e-learning service quality attributes (Dursun, Oskaybas, & Gokmen, 2014; Machado-Da-Silva, Meirelles, Filenga, & Filho,

2014; Martinez-Arguelles et al., 2013). A handful of studies on e-learning service quality were conducted in emerging countries, especially Vietnam – an emerging country with a great deal of economic and educational successes since its economic reforms in 1986 (Harman & Nguyen, 2010). Vietnam's higher education system is increasingly integrated into the international education system (Welch, 2010). Another important question that arises is whether e-learning service quality attributes that are extracted in developed countries can be applied to Vietnam? The present study contributes to the literature by answering this question.

The purpose of this study is to examine the relationships among e-learning service quality attributes, overall e-learning service quality, e-learning student satisfaction, and e-learning student loyalty in the context of e-learning in Vietnam. More specifically, the current study aims to (1) identify key e-learning service quality attributes; (2) examine the relationship between extracted e-learning service quality attributes and overall e-learning service quality; (3) explore the relationship between overall e-learning service quality and e-learning student satisfaction; and (4) investigate the relationship between e-learning student satisfaction and e-learning student loyalty.

Literature review

An emerging strategy for enhancing the quality of service in higher education that attracts a significant public interest is a student-centered approach (Stodnick & Rogers, 2008). The core idea of this strategy is to consider students as customers and universities must try their best to provide the best educational services for students (Stodnick & Rogers, 2008), which will make students satisfied and loyal to their university (Martinez-Arguelles & Batalla-Busquets, 2016).

Although there are still some debates over what constitutes quality of service in different sectors and areas, most scholars and practitioners agree that quality of service is defined by the difference between the customer's service expectations and experiences (Gronroos, 1990). Parasuraman, Zeithaml, and Berry (1985) were among the first pioneers to pinpoint service quality attributes in the traditional business environment. They identified ten components of service quality: tangibles, reliability, responsiveness, competence, courtesy, credibility, security, access, communication, and understanding the customer.

Parasuraman, Zeithaml, and Berry (1988) condensed these ten factors into the seminal SERVQUAL scale, which includes the appearance of facilities, equipment, and personnel, collectively referred to as "tangibles"; the willingness to help customers and provide fast services, collectively referred to as "responsiveness"; the ability to perform the committed services correctly and trustfully referred to as "reliability"; the knowledge and courtesy of staff and their ability to bring about trust and confidence, collectively referred to as "assurance"; and the accessibility, easy to contact, and always strive to understand the customers and their needs, collectively referred to as "empathy". The SERVQUAL and its modified variants have been used to measure service quality in many studies, although it also raised debates about if it is the most appropriate instrument to measure service quality.

In the area of higher education, service quality is defined as the difference between the students' higher education service expectations and experiences (Stodnick & Rogers, 2008). SERVQUAL has been used to measure service quality in the traditional learning environment. Cuthbert (1996) was among the first researchers to investigate

the applicability of SERVQUAL to measure the quality of higher education services perceived by students. The author reported a low reliability coefficient for each SERVQUAL factor. The author ran a factor analysis of SERVQUAL items and extracted seven factors which were not the same as the original five factors of SERVQUAL. The study concluded that SERVQUAL might not be suitable for measuring the quality of higher education services.

Hughey, Chawla, and Khan (2003) used SERVQUAL to measure the quality of service of computer labs in universities. After running the exploratory factor analysis, three factors were extracted, namely, staffing, services, and professionalism. In addition, other variables such as gender, academic standing and time spent in the labs were also analyzed to see whether these variables affected the quality of service experienced by students. The results showed that female students scored higher in services and professionalism than male students. The results also showed that junior students rated the lab staffing factor higher than senior students.

O'Neill (2003) used SERVQUAL to measure the quality of university orientation programs. The author asked the students to evaluate the quality of these orientation programs as soon as the orientation was completed and 1 month later. The results showed that SERVQUAL was initially expressed by only one factor, but then expressed by three factors. Sahney, Banwet, and Karunes (2004) used SERVQUAL to measure the quality of higher education services in India. After running the factor analysis, the authors concluded that SERVQUAL was expressed as one factor. However, both studies did not examine the relationships between SERVQUAL items and student outcomes; for example, student satisfaction. A study by Dado, Petrovicova, Riznic, and Rajic (2011) used SERVQUAL to examine the quality of higher education services in Serbia who indicated that there was a significant gap between student expectations and experiences. Legcevic, Mujic, and Mikrut (2012) used SERVQUAL to examine the quality of higher education services in Croatia; the results showed that for every element of SERVQUAL, the student expectations were always higher than the student experiences.

SERVQUAL has been a popular measurement scale to evaluate service quality in many different traditional service environments characterized by direct interactions between customers and employees of service providers. With advances in the Internet, ICT technologies, and the growth of e-commerce and e-services, the SERVQUAL turns out to be inappropriate for evaluating and measuring e-service quality characterized by interactions between customers and websites of service providers. As a result, a number of studies attempted to develop e-service quality measurement scales. For example, Loiacono, Watson, and Dale (2000) developed WebQual, an e-service quality measurement scale which consists of 12 items: trust, response time, ease of understanding, information fit-to-task, tailored communications, intuitive operations, visual appeal, innovativeness, emotional appeal, consistent image, relative advantage, and inline completeness.

Yoo and Donthu (2001) developed an e-service quality measure called "SITEQUAL" for evaluating website quality that includes four factors – security, processing speed, ease of use, and aesthetic design. Jun and Cai (2001) identified 17 dimensions that are grouped into three categories for measuring e-service quality – online system quality, product service quality, and customer service quality. Zeithaml, Parasuraman, and Malhotra (2002) constructed a framework that can be utilized to measure e-service

quality, consisting of 11 factors: security/privacy, assurance/trust, responsiveness, personalization, efficiency, reliability, flexibility, access, ease of navigation, site aesthetics and price knowledge. Wolfinbarger and Gilly (2003) advanced e-TailQ scale, including four factors to evaluate e-service quality. These four factors are customer service, website design, security, and reliability. DeLone and McLean (2003) constructed an updated information system success model with factors determining the success of information systems such as service quality, system quality, and information quality.

Based on exploratory and confirmatory factor analysis, Han and Baek (2004) developed a four-factor scale for measuring e-service quality. These factors are tangibles, reliability, responsiveness, and empathy. Yang, Jun, and Peterson (2004) identified credibility, security, attentiveness, reliability, access, and ease of use as important dimensions for measuring e-service quality.

Based on the literature review, content analysis, and exploratory and confirmatory factor analyses, Parasuraman, Zeithaml, and Malhotra (2005) developed a framework for measuring e-service quality, which includes E-S-Qual as a core online service quality scale (efficiency, privacy, fulfillment, and system availability) and E-RescS-Qual as an online recovery service quality scale (contact, compensation, and responsiveness).

More and more universities are implementing student caring strategies in the same way as businesses are taking care of their customers (Stodnick & Rogers, 2008). Today's students are seen as customers of universities and universities must provide the best e-learning service quality to their students (Martinez-Arguelles & Batalla-Busquets, 2016). Previous studies in the field of e-service quality provide a logical point of departure for future research in e-learning service quality.

In the US, Shaik, Lowe, and Pinegar (2006) indicated two dimensions of online distance learning programs, namely, instructional service quality and management and administrative services. The instructional services mostly refer to classroom experiences with the instructor and information on the learning website of the university, while the management and administrative services mostly refer to services of help-desk, advisors, administrative staff, and university management. Lin (2007a) used DeLone and McLean's (2003) information systems success model to find the factors that lead to the success of e-learning systems in Taiwan and found that three factors, namely, system quality, information quality, and service quality had impacts on the success of e-learning systems.

Peltier, Schibrowsky, and Drago (2007) suggested six factors that can be used to measure teaching quality in the e-learning setting in the US; they are: interactions between students and students, interactions between instructors and students, lecture delivery quality, course content, course structure, and instructor support and mentoring. Among these six factors, course content is the most powerful factor in determining the online learning experience's perceived quality, and the quality of interactions between instructors and students and interactions between students and students were not directly related to perceived overall quality of the course.

Wang, Wang, and Shee (2007) developed and validated a multi-factor model based on previous research on the success of information systems to evaluate the success of an e-learning system in Taiwan. The results indicated three factors - system quality, information quality, and service quality, determining the e-learning system's success. Lee (2010) studied the quality of online education support services, the acceptance of

online learning, and student satisfaction based on perceptions of Korean and American students. The results showed that the quality of online support services correlated well with online learning acceptance and student satisfaction for both Korean and American students. Martinez-Arguelles et al. (2013) developed a scale to measure e-learning service quality in Spain and found four factors - core business (teaching), facilitative or administrative services, support services, and user interface.

Limited studies investigated the impact of perceived e-learning service quality on student satisfaction and loyalty. For example, according to Martinez-Arguelles and Batalla-Busquets (2016), e-learning service quality in Spain comprises the quality of instructional services (teaching service or core service) and non-instructional services (administrative services, additional or complementary services, and user interface). In addition, the results indicated that each of these services has a statistically significant impact on perceived e-learning service quality, satisfaction, and loyalty.

Al-Samarraie, Teng, Alzahrani, and Alalwan (2017) utilized the technique of Fuzzy Decision Making Trial and Evaluation Laboratory to analyze the data collected from 38 students and nine instructors based on an interview survey. The authors identified information quality, task-technology fit, system quality, utility value, and usefulness as key factors that are very likely to have impacts on users' e-learning continuance satisfaction.

Ozkan and Koseler (2009) proposed a conceptual e-learning assessment model in UK consisting of six factors, namely, supportive issues, instructor attitudes, learner perspective, content quality, service quality, and system quality. This framework was statistically tested for content validity, reliability, and criterion-based predictive validity. The results indicated that the proposed model was suitable for the evaluation of student satisfaction.

Goh, Leong, Kasmin, Hii, and Tan (2017) investigated students' e-learning experiences in association with learning outcomes and satisfaction in Malaysia. The authors considered three learning experiences – course design, interaction with the instructor, and interaction with peer students as determinants of learning outcome and satisfaction. They indicated that interaction with peer students was the most powerful in predicting learning outcomes and satisfaction.

In summary, based on the theoretical foundations of e-service quality in the field of e-commerce (e.g., DeLone & McLean, 2003; Han & Baek, 2004; Jun & Cai, 2001; Parasuraman et al., 2005; Yang et al., 2004), a handful of studies were conducted to develop e-learning service quality measurement scales in higher education. These measurement scales have different factors, but revolve around important ones such as tangibles, reliability, responsiveness, empathy, ease of use, accuracy, security/privacy, contents, and timeliness. These factors can be grouped into three categories - information system quality, information quality, and service quality (Lin, 2007b; Wang et al., 2007).

Although such scales contribute significantly to the measurement and assessment of e-learning service quality, they were developed in the e-learning environment in developed countries in the West (e.g., Spain, US or UK), or countries in Asia but with a higher level of economic development than Vietnam (e.g., Korea, Taiwan). Therefore, the current study fills this research gap by developing and validating an e-learning measurement scale in a comprehensive and systematic manner in the context of Vietnam.

Conceptual framework and hypothesis development

Based on the review of previous relevant studies discussed above, the authors propose and empirically test a theoretical model (see Fig. 1) that consists of four sequential factors: e-learning service quality attributes, overall e-learning service quality, e-learning student satisfaction, and e-learning student loyalty. We next discuss relevant literature and derive hypotheses.

E-learning service quality dimensions and overall e-learning service quality

Studies in the field of traditional services and online services have laid the solid foundation for the notion that not all service quality attributes have the same level of impact on overall service quality perceived by customers (Jiang et al., 2013). The key point is to find out which service quality attributes among a number of service quality attributes are paramount in shaping overall service quality and delivering the highest level of satisfaction for customers so that businesses can focus and allocate their resources on the paramount service quality attributes to result in the highest service performance.

In the traditional service environment, there are many studies using the SERVQUAL scale of Parasuraman et al. (1988) to evaluate the relative importance of service quality attributes. Rosen and Karwan (1994) used SERVQUAL in four different traditional service environments and found that "understanding the customer" attribute was the most important service quality attribute for restaurants; the "assurance" and "reliability" attributes were the most important service quality attributes for health care; the "reliability" and "tangibles" attributes were the most important service quality attributes for lecture teaching; and the "assurance" attribute was the most important service quality attribute for bookstores. Johnston (1995) indicated that "responsiveness" was the most important at the industry level. Jayasuriya (1998) found that the two attributes "responsiveness" and "assurance" were the most important in quality assessment.

In the online service environment, many studies indicated that service quality attributes are of different importance in shaping overall online service quality. Liu and Arnett (2000) argued that four factors, namely, information quality, system use, system design quality, and playfulness determined the success of websites in the e-commerce context. Sohn (2000) found that trust, interactivity, ease of use, contents of web pages and functional websites, reliability, and the speed of delivery were the six most important service quality attributes perceived by customers.

Jun and Cai (2001) argued that responsiveness, reliability, and accesses were the most important online banking service quality attributes. In the opinion of Polatoglu and Ekin (2001), reliability, access, and savings had a strong influence on online banking service quality. Pikkarainen, Pikkarainen, Karjaluoto, and Pahnila (2006) found that

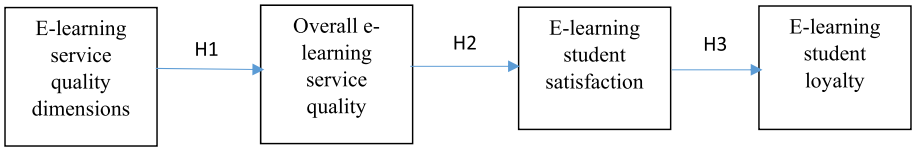

Fig. 1 Conceptual model

content, ease of use, and accuracy played the most important role in measuring the level of satisfaction of online banking customers. Yang and Jun (2008) conducted a survey of the quality of online services perceived by Internet purchasers and Internet non-purchasers. The six service quality attributes perceived by Internet purchasers were reliability, access, ease of use, personalization, security, and credibility. The seven service quality attributes perceived by Internet non-purchasers were security, responsiveness, ease of use, reliability, availability, personalization, and access. Considering the relative importance of service quality attributes to overall online service quality, the authors argued that the "reliability" attribute was the most important for Internet purchasers, while the "security" attribute was the most important for Internet non-purchasers.

Few studies on the quality of e-learning services also showed that e-learning service quality attributes played different roles in shaping overall e-learning service quality. Peltier et al. (2007) found that course content was the most important factor determining the quality of e-learning experience. Yang, Cai, and Zhou (2005) developed a five-factor scale to measure service quality of information displayed on web portals. Five factors included usability, usefulness of content, adequacy of information, accessibility, and interaction. Of these five factors, usability contributed the most to the formation of the second-order factor (overall service quality). Roca, Chiu, and Martinez (2006) found that among the three attributes of information quality, system quality and service quality, e-learning service's information quality had the greatest impact on user satisfaction. Miyazoe and Anderson (2010) studied the relationship between course design and interaction and satisfaction. The authors found that information quality was the most important factor. Reisetter, LaPointe, and Korcuska (2007) found that course content, feedback from and access to the instructor were the most important attributes affecting the quality of e-learning services.

Selim (2007) argued that instructors' attitude towards interactive learning was the most important success factor compared to other factors such as control of technology, teaching style, students' computer competencies, interactive collaboration, course content, design, access, infrastructure, and support. Boyd (2008) concluded that faculty's feedback played the most important role when students in online classes do not meet faculty directly. Boyd (2008) found that students' perceptions of timeliness and quality of instructor feedback had a significant impact on the perceived success of the course.

Martinez-Arguelles et al. (2013) based on the literature review on perceived service quality developed an instrument to measure e-learning service quality. This measurement scale consisted four dimensions with 24 items namely core business (teaching), facilitative or administrative services, support services and user interface. Among these four dimensions, core business (teaching) seemed to be the most important in determining the overall e-learning service quality. Martinez-Arguelles and Batalla-Busquets (2016) stated that among four e-learning service quality attributes, namely, teaching, administrative services, additional services, and the virtual learning environment (user interface), teaching had the strongest impact on overall e-learning service quality.

While numerous e-learning service quality attributes have been extracted by various e-learning service researchers, it is worthwhile to validate these results in terms of what attributes constitute overall e-learning service quality and whether each e-learning service quality attribute contributes differently to overall e-learning service quality.

Moreover, so far, very few studies have examined what constitutes e-learning service quality in Vietnam, which represent a nonwestern emerging country. The authors also believe that e-learning service quality attributes identified in developed countries should be tested to see if they can be applied in emerging countries and among many e-learning service quality attributes which attributes play the most important role in shaping overall e-learning service quality in this new research setting. Therefore, we hypothesize the following:

H1: *E-learning service quality dimensions have different contributions to overall e-learning service quality in Vietnam*

Overall e-learning service quality and e-learning satisfaction

Customer satisfaction refers to a customer emotional response to the experience relating to a particular transaction with an organization (Boulding, Kalra, Staelin, & Zeithaml, 1993). In the era of widespread development of ICT and e-commerce, online satisfaction may be defined as the customer's overall assessment on the quality of services or products offered in the online marketplace (Anderson & Srinivasan, 2003). There is a great deal of evidence supporting the relationship between service quality and customer satisfaction in the online service environment (Jun et al., 2004; Parasuraman et al., 2005; Pikkarainen et al., 2006; Yang et al., 2004).

In today's e-learning environment, students are viewed as customers and student satisfaction is always one of the university's most important goals (Lee, 2010). In order to obtain student satisfaction, universities must first understand e-learning service quality attributes perceived by students, then necessary actions are implemented to enhance overall e-learning service quality with the aim of bringing about e-learning student satisfaction. There are many attributes that shape overall e-learning service quality in previous studies. These attributes include course design (Kuo, Walker, Schroder, & Belland, 2014; Moore & Kearsley, 1996); interactions between students and instructors (Bolliger, 2004; Lee, Srinivasan, Trail, Lewis, & Lopez, 2011; Paechter, Maier, & Macher, 2010; Sher, 2009); interactions between students and students (Broadbent & Poon, 2015; Hussin, Bunyarit, & Hussein, 2009; Paechter et al., 2010; Sher, 2009); technology-related (Masrom, Zainon, & Rahiman, 2008; Pituch & Lee, 2006; Selim, 2007); and support and administrative services (Castan & Martinez, 2006; Howell & Wilcken, 2005; Levy, 2007; Weaver, 2008). Each service quality attribute makes different contribution to overall e-learning service quality, and in turn, overall e-learning service quality affects e-learning student satisfaction. Thus, the following hypothesis is advanced:

H2: *Overall e-learning service quality is positively related to e-learning student satisfaction in Vietnam*

E-learning student satisfaction and e-learning student loyalty

Customer loyalty is a long-term commitment to rebuying or re-patronizing one or more products or services preferred by customers, which is formed and accumulated

when a customer feels that consuming a product or service can bring value to him or her (Jiang et al., 2013; Oliver, 1999). In order to survive and sustain in higher education in general, particularly in e-learning environment, characterized by increasingly fierce competition, universities are building student-caring strategies (Stodnick & Rogers, 2008). The highlight of these strategies is to treat students as customers and universities as educational service providing organizations. Universities must do their best to provide the highest educational service quality for students – "their customers" (Martinez-Arguelles et al., 2013). Providing the highest educational service quality brings about student satisfaction, which in turn leads to student loyalty (Martinez-Arguelles & Batalla-Busquets, 2016).

Student loyalty plays a very important role in universities' sustainable development (Kilburn, Kilburn, & Davis, 2016). It should be noted that retaining existing students costs much less than gaining new students (Hennig-Thurau, Gwinner, & Gremler, 2002). Loyal students have a very high commitment to contributing to the development of universities in general and their educational programs in particular, which is reflected by students' comments/suggestions aimed at improving the quality of educational programs (Pham, Williamson, & Berry, 2018). Loyal students say positive things about the university to their relatives and friends, and motivate them to enroll in the university at different levels (Helgesen & Nesset, 2007). Last but not least, loyal students serve as an indispensable factor for maintaining financial resources through tuition that can be utilized for the university's sustainable development activities, including teaching, research, and services (Hoyt & Howell, 2011).

In the e-learning environment, universities are required to continually improve the quality of e-learning services to bring satisfaction to students (Lee, 2010). There are many studies in the field of traditional services and online services supporting the notion that customer satisfaction positively influences customer loyalty (Dehghan, Dugger, Dobrzykowski, & Balazs, 2014). Studies on e-learning also confirms that student satisfaction is very likely to lead to improved student loyalty (Kilburn et al., 2016). Therefore, we hypothesize the following:

H3: *E-learning student satisfaction is positively related to e-learning student loyalty in Vietnam*

Method

Sample, data collection procedure, and instrument development

Prior e-learning service quality scales are limited and inconsistent as the e-learning environment in universities is constituted by different stakeholders (Donlagic & Fazlic, 2015). With an increasing number of ICT applications in universities, and the fact that universities are building student-focused development strategies that consider students as customers (Stodnick & Rogers, 2008), the authors of this study relied on previous studies on information technology systems, end-user satisfaction, online customer service, and results of some studies on e-learning service quality to develop a measurement scale of e-learning service quality in Vietnam's e-learning environment.

In particular, based on the review of related studies, such as DeLone and McLean (2003), Han and Baek (2004), Jun and Cai (2001), Parasuraman et al. (2005), and Yang

et al. (2004), the authors developed a questionnaire consisting of 60 items measuring e-learning service quality. Specifically, items related to tangibles, reliability, responsiveness, and empathy were adapted from Han and Baek (2004); items related to ease of use, accuracy, and security/privacy from Jun and Cai (2001), and Yang et al. (2004); items related to contents and timeliness from DeLone and McLean (2003), Jun and Cai (2001) and Parasuraman et al. (2005).

The questionnaire was evaluated by two independent groups on the content validity. The first group consisted of six instructors who had experience of teaching online courses such as management information systems, e-commerce, and service quality management. The second group consisted of six students who had completed at least one online course. Based on suggestions from members of these two groups, 12 items were removed because of semantic duplication or unsuitable for the e-learning environment. The revised questionnaire was sent back to the members of the two groups to ensure that the e-learning service quality scale had the content validity. This questionnaire consisted of 48 items that measured e-learning service quality perceived by students based on their most recent e-learning experience. The questionnaire also included some information on demographics.

The translation of the questionnaire into Vietnamese was conducted by two bilingual instructors who were fluent in English and Vietnamese languages. In addition, these two faculty had 4 years of online teaching experience at the university level in Vietnam. Each instructor translated the questionnaire from English to Vietnamese independently and then discussed with each other their output to ensure that the Vietnamese version of questionnaire was consistent and content-validated. A preliminary Vietnamese questionnaire was sent to ten Vietnamese students who completed at least one online course to check if the questionnaire was understandable. Feedback from these students helped to edit the Vietnamese version of the questionnaire. Finally, the Vietnamese version of the questionnaire was translated back into English by two other bilingual instructors who had 4 years of online teaching experience at university level in Vietnam. After the results were agreed by the two translators, this English version of the questionnaire and the original English version of the questionnaire were sent to three English-speaking students who were studying online at a university in the US for consistency checking. The students indicated that both were consistent and understandable.

Data was collected with the help of a university (called University A) located in the capital of Vietnam, which had implemented e-learning for more than 10 years. Specifically, University A sent an invitation letter and a questionnaire to its students, who had completed at least one online course to participate in the survey. The invitation letter explained the purpose of this study and encouraged the students to participate in the survey in order to improve the university's e-learning service quality. Within 10 days, 351 students returned the completed questionnaires. Participants responded to the questions on a five-point Likert scale (1 = totally disagree, 5 = totally agree). After checking the content of these responses, 51 responses were removed due to incomplete information or missing data. Finally, 300 questionnaires were used for further statistical analysis to determine e-learning service quality attributes. In this sample, 60% of the students were male; 70% of the students were in the age group of 25 and 44 and 94% of the students were working and studying at the same time. About 31% of them were

the first year students; 41% the second year students; 26% the third year students; and 2% the fourth year students.

By using the exploratory factor analysis technique with varimax rotation, the criterion of eigenvalues > 1, and the removal of items which did not load significantly on their designated factors (loading value less than 0.5) or did load significantly on different factors, the results after five iterations showed that three factors with 40 items (accounting for 71.99% of the variance) were extracted. The first factor was "e-learning system quality" (F1); the second factor was "e-learning instructor and course materials quality" (F2); and the third factor was "e-learning administrative and support service quality" (F3). The e-learning system quality seemed to be the most important factor as it explained the highest proportion (29.91%) of the total variance and consisted of 19 items. The e-learning instructor and course materials quality explained 25.763% of the total variance and consisted of 13 items. The e-learning administrative and support service quality accounted for 16.304% of the total variance and included 8 items.

The next step was the confirmatory factor analysis and hypotheses testing. The authors re-established the questionnaire. Specifically, the questionnaire included the e-learning service quality scale with three factors including 40 items extracted above; the satisfaction scale consisted of three items; the loyalty scale consisted of three items; and demographic information. These scales were based on the Likert scale with five levels where 1 was is "totally disagree" and 5 was "totally agree". Answering the questionnaire was based on the student's most recent experience with e-learning. The students were asked to choose the level that best reflected their experience and perception for each item in the questionnaire.

With the help of two universities (University A and University B) which were located in Hanoi - the capital of Vietnam and their prestige and experience of over 10 years of implementing e-learning, the questionnaire was sent to the students who had completed at least one e-learning course. The students at University A who had participated in the previous survey were asked to not participate in this survey. A total of 1010 questionnaires were returned. After checking the content of these responses, 78 responses were removed because of incomplete information or missing data. The rest of 932 responses were used for subsequent statistical analyses. In this phase 2 sample, 62% of the students were male; 82% of the students were in the age group of 25 and 44; 92% of the students were studying and working at the same time. About 5% of them were the first year students; 12% the second year students; 15% the third year students; and 68% the fourth year students.

Results

Confirmatory factor analysis for e-learning service quality dimensions

Because the e-learning service quality attributes extracted above were exploratory, it was necessary to carry out a confirmatory factor analysis for these e-learning service quality attributes before testing hypotheses. The analysis was done using SmartPLS 3.0. The results from running the first-order measurement model for e-learning service quality factors showed that the fit of the model was not good because there were nine items with high variance inflation factor (VIF) values (> 5), or with high loadings on different factors. After removing these items and re-running the first-order measurement

model, the results showed that the fit of the model was good. Specifically, the SRMR value was 0.03 and the NFI value was 0.91. In addition, factor loadings were significant and higher than 0.7 (see Appendix 1). No item had high loadings on different factors at the same time.

Reliability and validity of the whole measurement model

Before testing hypotheses, we first determine reliability and validity of the whole measurement model. Appendix 2 presents composite reliability estimates for constructs. Very high composite reliability estimates (greater than 0.7) represent the fact that the constructs demonstrate a high reliability (Bagozzi & Yi, 1988). Convergent validity is acceptable if all average variance extracted (AVE) estimates are greater than 0.5 (Hair, Black, Babin, & Anderson, 2010). Due to the fact that AVE estimates for overall e-learning service quality, e-learning system quality, e-learning instructor and course materials quality, e-learning administrative and support service quality, e-learning student satisfaction, and e-learning student loyalty were 0.621; 0.696; 0.659; 0.709; 0.807; and 0.762, respectively, so it could be confirmed that convergent validity was met.

Since the correlation coefficients between any pair of constructs are less than 0.85 and the square root of the AVE estimate is larger than the corresponding correlation coefficients, it can be concluded that discriminant validity was met (Kline, 2005). Table 1 shows that most of the correlation coefficients between two constructs are less than 0.85 (a few of them are slightly higher than 0.85) and most of the squared roots of the AVE estimates (located on the diagonal of the matrix) are higher than the corresponding correlation coefficients.

Hypotheses testing

Once reliability, convergent validity, and discriminant validity of the measurement model were confirmed, the hypotheses testing was conducted via the structural equation modeling technique, using SmartPLS 3.0. Figure 2 shows the regression coefficient estimates and adjusted R^2 coefficients of the structural model. Overall e-learning service quality is a second-order factor with regression coefficient on e-learning system quality 0.99; on e-learning instructor and course materials quality 0.97; and on e-learning administrative and support service quality 0.95. All the regression coefficients in the structural model were significant at $p < 0.01$. Overall e-learning service quality explains 98% of the variance of e-learning system quality; 93.4% of the variance of e-learning instructor and course materials quality; 89.5% of the variance of

Table 1 Inter-construct correlations and squared root of AVE estimates

Constructs	1	2	3	4	5	6
1. E-learning system quality	0.83					
2. E-learning instructor and course materials quality	0.88	0.81				
3. E-learning administrative and support service quality	0.89	0.81	0.84			
4. E-learning student satisfaction	0.83	0.75	0.90	0.90		
5. E-learning student loyalty	0.83	0.78	0.87	0.90	0.87	
6. Overall e-learning service quality	0.99	0.97	0.95	0.86	0.86	0.79

Note: Diagonal values show square root of AVE

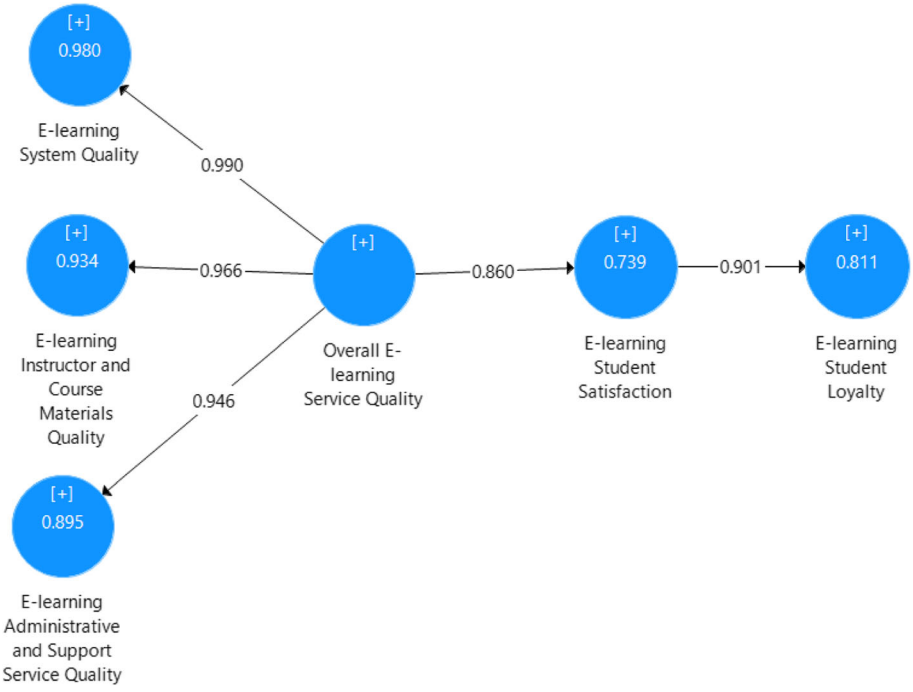

Fig. 2 Regression coefficient estimates and adjusted R^2 values

e-learning administrative and support service quality. Further, Fig. 3 shows t-statistic values of the structural model. The t-statistic value for the relationship between overall e-learning service quality and e-learning system quality is 132.74; t-statistic value for the relationship between overall e-learning service quality and e-learning instructor and course materials quality is 123.29; and t-statistic value for the relationship between overall e-learning service quality and e-learning administrative and support service quality is 91.07. Therefore, hypothesis 1 is supported.

Hypothesis 2 predicted that overall e-learning service quality would be positively related to e-learning student satisfaction. The regression coefficient of overall e-learning service quality on e-learning student satisfaction is 0.86 and overall e-learning service quality explains 73.9% of variance of e-learning student satisfaction. Moreover, t-statistic value for the relationship between overall e-learning service quality and e-learning student satisfaction is 39.420 ($p < 0.01$), providing support for hypothesis 2.

The regression coefficient of e-learning student satisfaction on e-learning student loyalty is 0.90 and e-learning student satisfaction accounts for 81.1% of the variance of the e-learning student loyalty. The t-statistic value between e-learning student satisfaction and e-learning student loyalty is 35.152 ($p < 0.01$). Thus, hypothesis 3 is supported.

We went further to analyze whether there is a direct relationship between overall e-learning service quality and e-learning student loyalty. Figure 4 shows the regression coefficient estimates and adjusted R^2 coefficients of the alternative structural model. The regression coefficients of overall e-learning service quality on e-learning system quality, e-learning instructor and course materials quality, and e-learning administrative and support service quality are unchanged – 099, 0.97, and 0.95, respectively. All the regression coefficients were significant at $p < 0.01$. Overall e-learning service quality explains 98% of the variance of e-learning system quality; 93.4% of the variance of

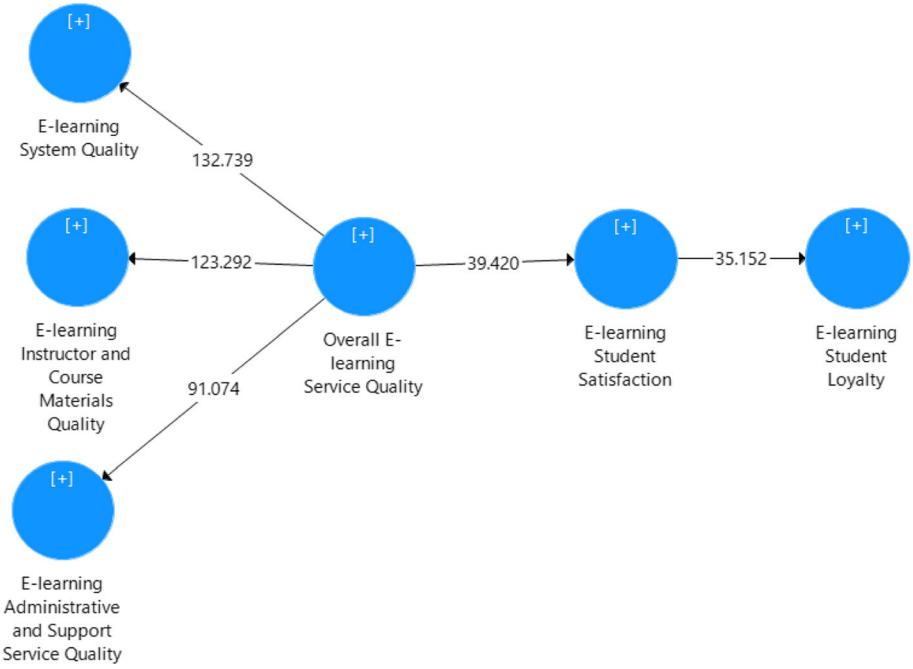

Fig. 3 T-statistic values of the structural model

e-learning instructor and course materials quality; 89.5% of the variance of e-learning administrative and support service quality. In addition, the regression coefficient of overall e-learning service quality on e-learning student satisfaction is unchanged, 0.86 and overall e-learning service quality explain the same 73.9% of the variance of e-learning student satisfaction.

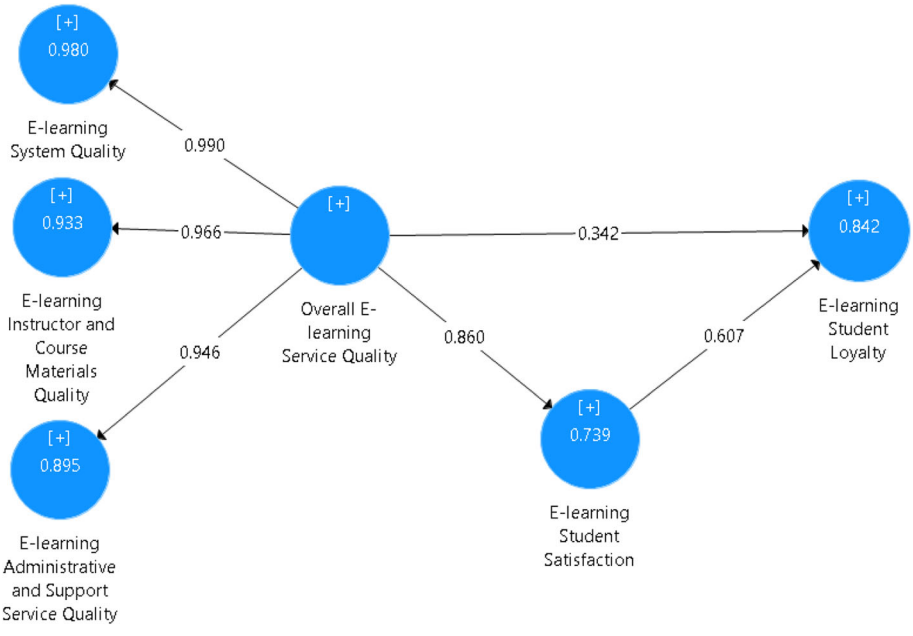

Fig. 4 Regression coefficient estimates and adjusted R^2 values when the direct relationship between overall e-learning service quality and e-learning student loyalty is considered

The new findings are that the regression coefficient of e-learning student satisfaction on e-learning student loyalty is 0.607, the regression coefficient of overall e-learning service quality on e-learning student loyalty is 0.342, and both overall e-learning service quality and e-learning student satisfaction explain 84.2% of the variance of e-learning student loyalty (3.1% higher than the original model).

Figure 5 shows t-statistic values of the alternative structural model. Specifically, t-statistic value for the relationship between overall e-learning service quality and e-learning system quality is 131.44; between overall e-learning service quality and e-learning instructor and course materials quality 126.91; between overall e-learning service quality and e-learning administrative and support service quality 92.09. The relationship between overall e-learning service quality and e-learning student satisfaction has t-statistic value 40.03; between overall e-learning service quality and e-learning student loyalty 3.84. Finally, the relationship between e-learning student satisfaction and e-learning student loyalty has t-statistic value 6.36. All the t-statistic values indicate that all the parameter estimates are significant at $p < 0.01$.

The analyses of the alternative structural model once again strongly support Hypothesis 1, Hypothesis 2, and Hypothesis 3. Moreover, it is interesting to learn that overall e-learning service quality not only has a direct effect but also an indirect effect on e-learning student loyalty via e-learning student satisfaction.

Discussion and implications

In Vietnam, the number of Internet users has been increasing in the past decade, accounting for more than 50% of the total population (CIEM, 2018). Besides, the use of mobile phones (e.g., smart phones) connected to the Internet is increasingly

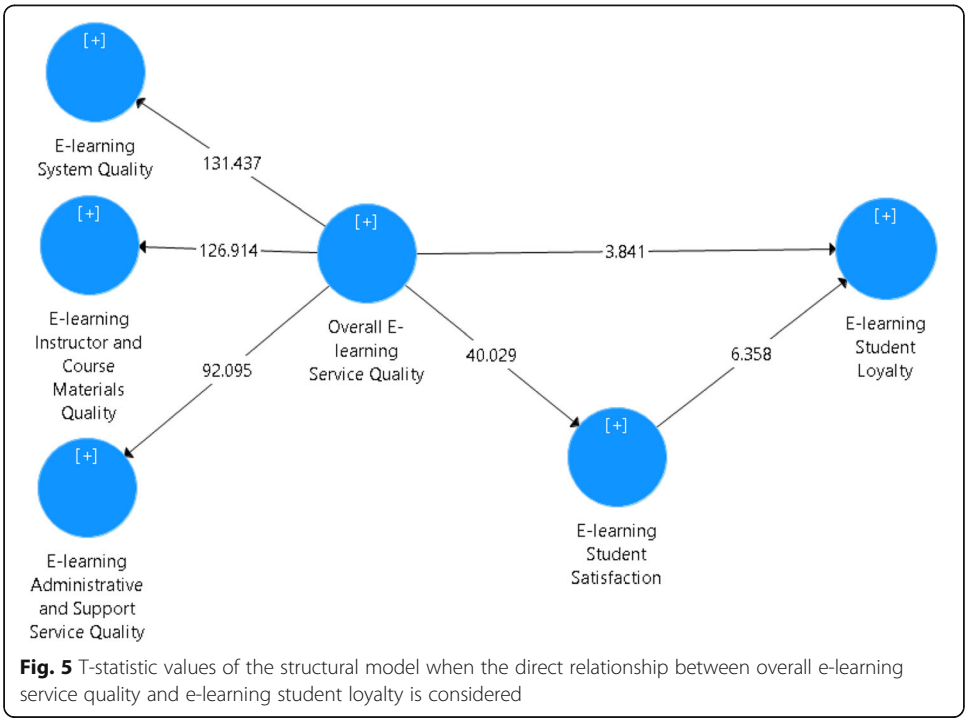

Fig. 5 T-statistic values of the structural model when the direct relationship between overall e-learning service quality and e-learning student loyalty is considered

becoming popular. Vietnam has about 129 million mobile phone subscribers (CIEM, 2018). The ubiquity of the Internet, technology-savvy young people, and a series of economic reforms implemented by the Vietnamese government after joining the World Trade Organization in 2007 create favorable conditions for e-business in general and e-commerce in particular in Vietnam to grow rapidly (Pham & Doan, 2014). The rapid growth of e-business/e-commerce also motivates the Vietnamese government and Ministry of Education and Training to invest in information technology and Internet infrastructures for Vietnam's higher education system to quickly integrate into the global higher education system, including e-learning (VDIC, 2012).

Currently there are about 20 universities out of 278 higher education institutions (with 2,061,641 students) providing online education programs in Vietnam, and this number is expected to increase in the future (Vietnam's Ministry of Education and Training, 2015). This shows that e-learning is still at the beginning stage of its development and has a great potential in Vietnam, requiring universities to constantly improve learning quality in general and e-learning quality in particular to bring about student satisfaction and loyalty. However, there has so far been no systematic and comprehensive research on this topic in Vietnam. The current research aims to fill this research gap.

The purpose of this study was to examine the relationships among e-learning service quality attributes, overall e-learning service quality, e-learning student satisfaction, and e-learning student loyalty in the context of e-learning in Vietnam, an emerging country. The results indicate that e-learning service quality perceived by e-learning students includes three factors: e-learning system quality, e-learning instructor and course materials quality, and e-learning administrative and support service quality. In general, the factors extracted from this study are quite similar to those extracted in previous studies.

Specifically, system quality, information quality, and service quality are the main e-learning service quality attributes in the studies of Alsabawy, Cater-Steel, and Soar (2012), Lin (2007b), Machado-Da-Silva et al. (2014), Ozkan and Koseler (2009), and Wang et al. (2007), although these studies focused on the success of the e-learning system, not e-learning service quality. Martinez-Arguelles et al. (2013) emphasized on core business (teaching), facilitative or administrative services, support services, and user interface; however, the power of their predictive model is limited with adjusted $R^2 = 50.1\%$. Pham et al. (2018) identified e-learning administrative and support service quality, e-learning instructor quality, e-learning accuracy, e-learning course materials quality, and e-learning security and privacy as the main attributes constituting overall e-learning service quality, but their study is of exploratory nature with a limited sample size of 142.

Today, universities are changing their strategy of managing relationships with students by considering students as customers and universities as providers of educational services (Kilburn et al., 2016). From this perspective, the results of this study are also consistent with that of previous studies on online service quality in general, for example, Han and Baek (2004), Jun and Cai (2001), Parasuraman et al. (2005), and Yang et al. (2004), to name a few. These studies have emphasized on online system quality and online service quality.

The difference between this study and previous studies is that overall e-learning service quality in this study is a second-order construct which is composed of three first-order constructs: e-learning system quality, e-learning instructor and course materials quality, and e-learning administrative and support service quality. Moreover, the relative importance of factors constituting overall e-learning service quality in this study is different from that of other studies. Specifically, e-learning system quality plays the most important role, followed by e-learning instructor and course materials quality, and e-learning administrative and support service quality. This suggests that in Vietnam as an emerging country, where online technology infrastructure is still in the investment stage, e-learning system quality is critical to making contribution to overall e-learning service quality.

This study also shows that overall e-learning service quality affects e-learning student satisfaction and, which in turn positively affects e-learning student loyalty. It should be noted that overall e-learning service quality also has a direct effect on e-learning student loyalty. These results are consistent with that of previous studies in both traditional and online educational environments (Al-Rahmi et al., 2018; Eom & Ashill, 2018; Goh et al., 2017; Kilburn et al., 2016; Shahsavar & Sudzina, 2017; Yilmaz, 2017). This may indicate that there is no difference between students in developed countries and emerging countries in the sense if service quality is good, students are satisfied, and if students are satisfied, students are loyal to the university.

This research contributes significantly to the literature by pointing out e-learning service quality attributes that constitute overall e-learning service quality in an emerging country context - Vietnam. In particular, overall e-learning service quality is a second-order construct which is composed of three factors: e-learning system quality, e-learning instructor and course materials quality, and e-learning administrative and support service quality. Moreover, overall e-learning service quality is positively related to e-learning student satisfaction, and e-learning student satisfaction is positively related to e-learning student loyalty. The noteworthy discovery of this study is that e-learning system quality is the most important factor perceived by Vietnamese students, followed by e-learning instructor and course materials quality, and e-learning administrative and support service quality. The implications drawn from this research for universities in Vietnam are presented below.

Of the three components that make up overall e-learning service quality, universities must pay special attention to e-learning system quality. In the e-learning environment, student learning is achieved primarily through interactions between students and the e-learning system. The e-learning system is manifested through the university's e-learning website. Therefore, e-learning system quality can be considered as the quality of the e-learning website and is related to the capability of hardware and software used to meet online teaching and learning's needs. Universities providing e-learning services must ensure that the e-learning system's software and hardware are modern and compatible so that the e-learning system operates smoothly and reliably. Note that items that make up e-learning system quality in this study are primarily related to ease of use, security/ privacy, and accuracy.

Many studies confirm the importance of the e-learning system's "ease of use" attribute. Ease of use here means easy navigation to facilitate students, especially for those

students who do not have much experience in interacting with computers and websites, to search for needed information easily. In order to do this, the organization and structure of pages and information content displayed must be truly logical and easy to understand. A well-organized navigation structure will provide students a better sense of technology readiness and a greater enjoyment in learning. As students have more technology readiness and become more interested in learning, their level of satisfaction with the e-learning system will be higher and that is a measure of the e-learning system's success.

In order to improve e-learning system quality, safety and security of students' personal information must be adequately taken into consideration. Before, during and after e-learning courses, students' financial and personal information is provided in transactions between students and the university via the utilization of credit and debit cards. Therefore, if this information is not secured, then negative consequences can happen for both students and the university. Universities must constantly upgrade their safety and security systems with advanced algorithms to enhance students' trust in the e-learning system.

The e-learning system's accuracy must also be adequately paid attention. Information displayed on the e-learning system's website must be accurate, easily accessible, and reasonably organized, which will enable students to complete e-learning transactions and interactions quickly and accurately. As a result, students will be more satisfied with the e-learning system.

The second factor that constitutes overall e-learning service quality is e-learning instructor and course materials quality. This factor is also confirmed in many studies in developed countries (Martinez-Arguelles et al., 2013). For a newly emerging country like Vietnam, this factor is even more important. According to cultures of many countries, including Vietnam, many people still think that e-learning is often not a kind of learning with good quality. Therefore, universities must recruit highly qualified instructors who are passionate about their profession and are well-trained (much better if they are trained in developed countries). Instructors must have both theoretical and practical knowledge, always care about students' interests, and motivate students to interact continuously: student-student interactions, student-faculty interactions, and student-e-learning materials interactions in order to achieve a better learning outcome.

In addition to the recruitment of excellent faculty, universities in Vietnam must gradually improve their teaching and learning materials systems. Materials for teaching and learning should be well streamlined and logical so that students can easily feel what to do first and what to do next. Teaching and learning materials systems must be both theoretical and practical, ensuring that continuity and relevance are updated to meet students' learning needs and more importantly, to make students enjoyed with learning. In addition, universities in Vietnam must further strengthen their cooperation with prestigious publishers in the world to gain access to modern and new book and teaching materials systems used for e-learning.

Finally, while e-learning system quality and e-learning instructors and course materials quality can be considered as core, e-learning administrative and support quality also makes significant contribution to overall e-learning service quality. This factor is also confirmed in studies in developed countries (Martinez-Arguelles &

Batalla-Busquets, 2016). Many universities in emerging countrirs like Vietnam still do not consider students as customers to serve. This point of view can be very detrimental to univiersities. Thus, universitities must treat students as customers to serve and provide committed services to students. Meeting students' needs such as information inquiries, course selection, enrollment, tuition, and other administrative procedures before, during and after e-learning courses must be fast, accurate, and convenient. Universities must maintain both physical and online offices to meet students' information inquiry needs 24/7. Students will be more satisfied if their interests are always appreciated by university staff.

Universities in Vietnam must continually enhance the performance of three e-learning service quality attributes identified in this study. Improved e-learning service quality attributes will enhance overall e-learning service quality. The higher the overall e-learning service quality, the more satisfied the e-learning students. The more satisfied the e-learning students, the more loyal to the university the e-learning students. As e-learning students become more loyal to the university, they will register for more e-learning courses; after their graduation, they are very likely to return to study graduate programs online or on campus; they can be messengers to freely advertise about the university in general and e-learning programs in particular to their friends and relatives.

Limitations and future research

This research has made a significant contribution to the literature by pinpointing three e-learning service quality attributes constituting overall e-learning service quality in Vietnam – an emerging country. In addition, the results indicate a positive relationship between overall e-learning service quality and e-learning student satisfaction, a positive relationship between overall e-learning service quality and e-learning student loyalty, and a positive relationship between e-learning student satisfaction and e-learning student loyalty. However, this study also has some limitations.

Firstly, data was collected from only two universities in Vietnam. Although these two universities have experienced over 10 years of e-learning implementation and are two prestigious universities in Vietnam, the generalization of this study's findings to other universities in Vietnam or universities in an emerging country should be made with caution.

This study focuses only on factors that constitute overall e-learning service quality, the relationship between overall e-learning service quality and e-learning student satisfaction, and the relationship between e-learning student satisfaction and e-learning student loyalty. There might be other factors influencing e-learning student satisfaction and loyalty. For example, furture studies can examine the moderating roles of university's reputation and perceived value from e-learning on the relationship between e-learning service quality and students' satisfaction and loyalty. Another factor that might affect e-learning student satisfaction and e-learning student loyalty is cultural difference among countries that should be added to the research model in order to provide more meaningful insights. Comparing relative importance of the attributes constituting overall e-learning service quality between a developing or emerging country and a developed country is also an interesting topic for future research.

Appendix 1

Table 2 Measurement items, factor loadings, average variance extracted (AVE), and composite reliabilities

E-learning service quality attributes	Factor loading	Composite reliability	AVE
Factor 1 (F1): E-learning system quality		0.97	0.70
f11: The layout of the information at my university's e-learning website is easy to follow	0.80		
f111: I feel the risk associated with e-transactions is low through my university's e-learning website	0.86		
f112: I feel secure in providing sensitive information for e-transactions through my university's e-learning website	0.86		
f114: The information on my university's e-learning website is up-to-date	0.83		
f116: My university's e-learning course website provides me with valuable information	0.81		
f117: My university's e-learning course website allows me to find information easily	0.80		
f118: My university's e-learning course website is visually appealing	0.83		
f119: With my e-learning, when my university promises to do something by a certain time, it does so.	0.86		
f13: It is easy for me to complete a transaction through my university's e-learning website	0.85		
f14: I do not encounter long delays when searching for information on my university's e-learning website	0.87		
f17: The information on my university's e-learning website is accurate	0.81		
f18: The e-transactions are accurately dealt with	0.85		
Factor 2 (F2): E-learning instructor and course materials quality		0.96	0.66
f21: My university's e-learning instructors are knowledgeable in their fields	0.81		
f210: My university's e-learning course materials are practical	0.80		
f211: My university's e-learning course materials challenge me to think	0.86		
f212: My university's e-learning course exams are reasonable in length and difficulty	0.81		
f22: My university's e-learning instructors quickly and efficiently respond to student needs	0.80		
f23: My university's e-learning instructors consistently provide good lectures	0.80		
f24: My university's e-learning instructors are well prepared and organized	0.77		
f25: My university's e-learning instructors provide an environment which encourages interactive participation	0.84		
f26: My university's e-learning instructors have the students' best long-term interests in mind	0.82		
f28: My university's e-learning course materials are useful	0.84		
f29: My university's e-learning course materials are up-to-date	0.84		
f213: My university's e-learning course assignments are reason able in length and difficulty	0.75		
Factor 3 (F3): E-learning administrative and support service quality		0.94	0.71
f31: My university gets its e-learning support service right the first time	0.84		
f33: With my e-learning, my university's staff tells me exactly when the service I require will be performed	0.84		

Table 2 Measurement items, factor loadings, average variance extracted (AVE), and composite reliabilities *(Continued)*

E-learning service quality attributes	Factor loading	Composite reliability	AVE
f34: For my e-learning, my university's staff gives me prompt service	0.86		
f35: For my e-learning, my university's staff has my best interests at heart	0.84		
f36: For my e-learning, my university's staff understands my specific needs	0.80		
f37: For my e-learning, my university's staff gives me personal attention	0.84		
f38: For my e-learning, the help desk of my university has convenient operating hours	0.88		

Note: $p < .01$

Appendix 2

Table 3 Reliability and validity of the whole measurement model

Constructs	Indicators	Factor loadings	AVE	Composite reliability
Overall e-learning service quality			0.621	0.981
E-learning system quality (0.990)	f11/f111/f112/f114/ f116/f117/f118/ f119/f13/f14/f17/f18	0.809/0.857/0.863/0.834/ 0.806/0.798/0.829/0.854/ 0.840/0.859/0.812/0.846	0.696	0.965
E-learning instructor and course materials quality (0.966)	f21/f210/f211/f212/ f22/f23/f24/f25/f26/ f28/f29/f213	0.824/0.805/0.842/0.805/ 0.799/0.811/0.780/0.827/ 0.815/0.839/0.835/0.756	0.659	0.959
E-learning administrative and support service quality (0.946)	f31/f33/f34/f35/f36/ f37/f38	0.850/0.841/0.861/0.841/ 0.806/0.835/0.859	0.709	0.945
E-learning student satisfaction	STSA1/STSA2/STSA3	0.897/0.911/0.887	0.807	0.926
E-learning student loyalty	STLO1/STLO2/STLO3	0.874/0.886/0.857	0.762	0.905

Note: Values in the parentheses are factor loadings of latent constructs on the second order construct – overall e-learning service quality

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Availability of data and materials
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Authors' contributions
LP and YBL formulated the study idea and developed the conceptual framework. HTN, TKB and HTP designed the materials and collected the data. LP, YBL, and TKB analyzed and interpreted the student data. All authors wrote, read, and approved the final manuscript.

Competing interests
The authors declare that they have no competing interests.

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Author details
[1]School of Management, College of Business and Social Sciences, University of Louisiana at Monroe, 700 University Ave, Monroe, LA 71209, USA. [2]Department of Economics and Management, Thuyloi University, Hanoi, Vietnam. [3]Department of Marketing, Feliciano School of Business, Montclair State University, 1 Normal Ave, Montclair, NJ 07043, USA. [4]Department of Economic Mathematics, National Economics University, 207 Giai Phong Str, Hanoi, Vietnam. [5]Distance Education Center, National Economics University, 207 Giai Phong Str, Hanoi, Vietnam. [6]Department of Academic Affairs, Vietnam Japan Institute for Human Resources Development, Foreign Trade University, 91 Chua Lang Str, Hanoi, Vietnam. [7]Vietnam Japan Institute for Human Resources Development, Foreign Trade University, 91 Chua Lang Str, Hanoi, Vietnam. [8]Department of Academic Affairs, Vietnam Japan Institute for Human Resources Development, Foreign Trade University, 91 Chua Lang Str, Hanoi, Vietnam. [9]Training Management Department, Foreign Trade University, 91 Chua Lang Str, Hanoi, Vietnam.

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