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Investigating the e-learning choice under the learners' perspective using demand driven learning model: insights from Vietnam

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Over the past four decades, e-learning has experienced rapid global growth, revolutionizing higher education. In Vietnam, universities have increasingly turned their attention and resources toward e-learning development, adapting to specific contexts and needs. This study investigates the drivers of e-learning choice within the framework of the demand-driven learning model (DDLM), with a primary focus on three core factors: quality content, delivery, and service. Employing a quantitative approach and the PLS-SEM technique, this research uncovers significant findings. The results of the study highlight the pivotal role of quality content, which exerts the most potent influence on e-learning choice, evidenced by a robust path coefficient of 0.400. Service and delivery, with direct path coefficients of 0.183 and 0.173, respectively, also play substantial roles in shaping e-learning decisions. Moreover, mediate role of delivery in the the e-learning choice model has been confirmed. Quality content leads to delivery, and delivery, in turn, leads to e-learning choice. Similar pathway has been found with service. A higher level of service increases delivery, which positively impacts on e-learning choice. These findings hold critical implications for the formulation of e-learning development policies in Vietnam's higher education institutions. Universities should prioritize the continuous development of high-quality, engaging, and up-to-date educational content that aligns with industry needs and student interests. Additionally, emphasis should be placed on providing a supportive e-learning experience, characterized by responsive customer service, accessible technical support, and efficient issue resolution mechanisms. Moreover, universities should consider the implementation of user-friendly and interactive content delivery platforms and methods that actively engage learners. In essence, this research serves as a guide for universities in Vietnam, enabling them to enhance their e-learning offerings by ensuring the content quality, support services, and delivery methods, ultimately fostering a dynamic and accessible learning environment that meets the evolving needs of their students and the demands of the modern educational landscape.

Keywords Demand-driven learning model, E-learning choice, Learners' perspectives, Higher education institutions, Vietnam

The educational sector plays a pivotal role in fostering human capital, a crucial resource for the growth and sustainable development of the nations, in addition to the other four capital resources including natural capital, physical capital, financial capital and social capital, as outlined in the economic theories[1]. Aligned with the United Nations Sustainable Development Goals (SDGs) and their 2030 action plan, the emphasis on education underscores the importance of lifelong learning, in the knowledge economy era, especially within the transformative landscape of the Fourth Industrial Revolution[2]. In this context, e-learning emerges as a significant innovation, offering flexible and accessible educational opportunities globally, irrespective of age, gender, race, or geographic location[3,4]. E-learning is rapidly becoming an integral and indispensable component of mainstream educational systems in both developed and developing nations, including Vietnam, where it provides an alternative to traditional classroom-based instruction[5–8].

The adoption of e-learning in Vietnam has experienced a notable expansion in recent years, driven by technological advancements, increased internet accessibility, and a growing demand for skill development in an increasingly competitive global job market especially during the COVID-19 pandemic[9]. However, despite

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the surging popularity of e-learning, a significant gap persists in the understanding of the factors motivating Vietnamese learners to opt for this mode of education over conventional classroom-based approaches. Presently, research on e-learning in Vietnam is still in its early stages with limitations[10–12]. Furthermore, while e-learning offers advantages, its drawbacks are not exceptional. Therefore, conducting thorough research on this subject is essential in order to formulate an appropriate application model and effective policy mechanisms in the Vietnamese context because this approach to education fundamentally differs from traditional learning methods.

E-learning choice has a multifaceted nature, encompassing both the initial decision to opt for e-learning over traditional methods and advocacy for this mode of learning. We incorporate the specific measures outlined by Dash and Chakraborty[13] into our conceptual framework. The constructs for e-learning choice are operationalized by three items: (a) Volunteer to select e-learning instead of traditional learning, (b) Happy with e-learning choice, and (c) Recommend e-learning to others. By integrating these measures into our conceptual model, we explored the factors influencing e-learning choice comprehensively, considering both individual motivations and external influences. This approach allows for a holistic understanding of the determinants of e-learning adoption and usage, shedding light on the drivers of voluntary engagement, satisfaction levels, and the propensity to recommend e-learning to others.

This research aims to fill the existing knowledge gap by exploring e-learning choices through the lens of the Demand-Driven Learning Model (DDLM), which emphasizes the significance of harmonizing educational offerings with learners' preferences and requirements, thereby shaping their choices and experiences in the e-learning domain. This model recognizes that learners' demands and expectations play a central role in driving educational decisions and outcomes. By integrating the DDLM into our study, we explored the factors influencing e-learning choices in Vietnam through the prism of learner-driven demand, elucidating how quality content, delivery mechanism and service provision interact to shape learners' decisions. Though this lens, we seek to provide a nuanced understanding of e-learning adoption and usage patterns in the Vietnamese context, contributing to both theoretical and practical implications for educational policy and practice.

The application of the DDLM in comprehending the factors influencing e-learning choices in Vietnam can be effectively examined through three distinct pillars: quality content, delivery, and service. The first pillar of quality content plays a pivotal role in influencing e-learning choices in Vietnam. As learners increasingly seek educational experiences that are engaging and pertinent, the demand for high-quality course content is of paramount importance. Within the DDLM, the emphasis on quality content translates into a necessity for updated, culturally relevant, and interactive materials. In Vietnam, learners are attracted to e-learning platforms that provide content aligned with their educational and career objectives[14]. They value courses offering a diverse array of multimedia resources, assessments, and real-world applications, thereby enhancing their learning experience. Recognizing and catering to the content demands of learners is essential for e-learning providers to customize their offerings to suit the Vietnamese context. The second pillar, delivery, pertains to how e-learning content is presented and accessed. The DDLM emphasizes the importance of adaptable and user-friendly delivery methods that cater to individual learning preferences. In Vietnam, where connectivity and digital access can vary, the demand for adaptive and accessible delivery mechanisms is substantial. E-learners prefer platforms that offer mobile-friendly interfaces, offline learning options, and various content delivery methods, such as video lectures, webinars, and downloadable resources[15,16]. The freedom to choose when and how to access course materials plays a pivotal role in the e-learning decisions of Vietnamese students, realizing the significance of this aspect of the model. The third pillar, service, encompasses the entirety of the e-learning experience, including support, interactivity, and the overall user interface[17]. In Vietnam, where cultural values of respect and community are paramount, learners place high value on responsive and personalized support services. E-learners seek assistance in the form of timely responses to queries, peer interaction, and guidance from instructors. Furthermore, the demand for a user-friendly interface, intuitive navigation, and well-structured courses significantly contributes to the e-learning choices made in Vietnam. The DDML focuses on the importance of responsive services that cater to the unique needs of learners, ensuring a positive and supportive e-learning environment.

This paper is structured into five sections, each serving a specific purpose in the comprehensive exploration of e-learning choices in Vietnam through the DDLM lens. Following the introduction, Section "Literature review" provides a theoretical foundation through a literature review of e-learning concept, the DDLM theory and its application on e-learning choices. Section "Methods" outlines the research methodology detailing the research instrument, data collection methods, and analytical techniques. Section "Results, the core of the paper, presents findings and discussions, unveiling and analyzing the empirical results. It assesses how the DDLM's three pillars (quality content, delivery, and service) directly and indirectly influence e-learning choices in Vietnam. Section "Discussions", the conclusion, synthesizes key findings and implications while highlighting the importance of aligning e-learning with learners' needs, as guided by the DDLM, to enhance the quality and accessibility of online education in Vietnam. This structured approach ensures a well-rounded exploration of e-learning choices, combining theory and empirical evidence.

Literature review

E-learning concept

Defining e-learning has long been a challenge for the research community. E-learning, an abbreviation for electronic learning, is a systematic and comprehensive approach to education and training, leveraging digital technologies and the internet[18–20]. It involves the utilization of electronic devices like computers, tablets, and smartphones, as well as online platforms and resources to deliver educational content, instructions, assessments, and interactions between learners and instructors, often with flexibility and asynchrony[21]. Cheng[22] similarly posited that e-learning employs the internet, intranet, and extranet in order to guide learners. However, Tavangarian[23] contended that defining cognitive learning solely in technological terms is insufficient. They asserted that technology's role is not merely procedural but transformative.

This view is complemented by Oblinger and Hawkins[24], who argued that cognitive learning encompasses a substantial portion of a learner's exposure to courses conducted online, often involving interactive online discussions among participants. Interactive learning is seen as a constructive method where learners derive value from network connections and interactive dialogues. E-learning encompasses a wide range of formats, including online courses, virtual classrooms, webinars, multimedia content, and interactive simulations. It is designed to facilitate learning at various levels, from formal education in traditional institutions to informal, self-directed learning for personal and professional development. E-learning can incorporate diverse multimedia elements, discussion forums, and assessment tools, making it a versatile and accessible mode of learning that transcends geographical constraints and time limitations.

In essence, e-learning is an innovative approach that aspires to create a well-designed, learner-centered, interactive, and enabling learning environment, accessible to anyone, anywhere, at any time. This is achieved through the use of various digital technologies, suitable materials, and an open, flexible, and distributed learning environment[25]. Drucker[26] compared e-learning with traditional learning processes and highlighted key distinctions. Traditional learning often involves centralized authority in which educators select the content, a strong push delivery of knowledge from teachers to students, limited personalization as content must cater to many, and a linear and static learning process with unchanging content. However, in today's rapidly changing business environments, the learning process must be efficient, just-in-time, and task-relevant, leading to a shift towards e-learning. E-learning fosters a distributed, student-oriented, personalized, and dynamic learning process, aligning with the demands of modern, dynamic learning environments.

Demand-driven learning model

The DDLM represents a holistic framework comprising five primary elements: the superior structure, along with the three consumer demands encompassing quality content, delivery, and service, in addition to learner outcomes[27–29]. This model serves as a structured guide for comprehending and skillfully executing e-learning, offering precise definitions that render it pragmatic for both educators and researchers. Within the DDLM, quality assurance assumes a pivotal role, underscoring the continual assessment of programs and the continuous pursuit of enhancement and refinement. To fully actualize the concepts within the DDLM, it is essential to engage in pilot testing within authentic educational settings, affording the opportunity to validate its usefulness and efficacy.

While e-learning offers numerous benefits, it is important to acknowledge that there exist certain drawbacks related to the quality content, delivery, and service components within the DDLM[28]. These shortcomings can impede the overall efficiency and attractiveness of online education. Regarding quality content, a notable disadvantage is the occasional excessive theoretical nature of online course materials, which may lack practical application. Consequently, this can pose challenges for learners in terms of effectively applying and internalizing the knowledge they acquire. Furthermore, there is a concern that some course content may not align with industry standards, thereby raising issues about its pertinence and quality[30]. Regarding delivery, technical issues such as download failures, installation complexities, login and audio/visual problems can pose substantial obstacles for learners. These technical challenges cause frustration and impede the learning experience. Additionally, there are moments when online teaching may be perceived as monotonous and uninspiring, impacting student engagement[9,31].

In terms of service, a prominent drawback is the absence of personalized attention. E-learning frequently falls short of providing the same level of interactive two-way communication that students anticipate. This limitation can foster feelings of isolation and hinder the creation of a supportive learning community. Furthermore, students may encounter difficulties in grasping educational objectives and may feel ill-prepared to juggle their work, family, social, and study commitments within the online learning environment. This lack of readiness extends to their general e-learning and academic-related skills, including their proficiency in utilizing learning management systems[32]. Lastly, the stability of the internet connection can significantly affect students' listening experiences, underscoring the delivery aspect's susceptibility to technical issues[33]. These disadvantages emphasize the importance of addressing issues related to quality content, delivery, and service in e-learning to enhance the overall educational experience for students and to make online education a more effective and accessible mode of learning.

When applying the DDLM to investigate e-learning options from the perspective of learners, the emphasis on the three consumer demands of quality content, delivery, and service is entirely justified due to its paramount importance in establishing an education environment that is truly learner-centric and effective[34]. Quality content represents the foundational knowledge and skills that learners aim to acquire, and by understanding their specific content-related requirements, educational offerings can be personalized to comprehensively address these needs[35]. On the other hand, delivery pertains to how learners access, interact with, and engage in learning materials. Prioritizing the delivery aspect can make the e-learning experience more accessible, engaging, and adaptable to individual learning styles and preferences[36]. Service, as the third crucial component, encompasses the support, resources, and guidance that learners need throughout their educational journey. Placing a premium on service quality ensures that learners receive the assistance and resources necessary to overcome challenges and maximize their e-learning experience[37]. This tripartite approach not only provides a comprehensive grasp of learners' viewpoints but also empowers e-learning providers to customize their programs to meet the distinct requirements and expectations of a diverse learner base. The amalgamation of high-quality content, effective delivery methods, and responsive service fosters learner satisfaction, engagement, and ultimately, success. Furthermore, it closely aligns with the core principles of the DDLM, as the model inherently underscores these three consumer demands as pivotal components.

A central element of the DDLM is the thorough consideration of consumer demands in the e-learning landscape, with a specific emphasis on three vital components: quality content, delivery, and service[38]. In the

realm of content, high-quality content is defined by its comprehensiveness, alignment with authentic industry standards, and its grounding in research. Learners derive significant benefits from content that is impartial, devoid of bias, tailored to their comprehension level, and distinguished by its extensive scope and profound insights. Emphasizing authenticity ensures that e-learning materials faithfully mirror the challenges encountered in real-world workplaces. This authenticity is achieved through the input and insights of industry professionals, guaranteeing that the content effectively addresses both current and future educational requirements. Furthermore, the foundation of research-backed content is crucial, drawing upon validated empirical research and the expertise of both academic and industry content specialists[5,39,40].

Within the delivery component, the DDLM suggests that e-learning programs should be web-based and interactive. Ensuring high-quality delivery involves focusing on usability, interactivity, and the careful selection of suitable tools. Usability entails crafting a user-friendly interface, adhering to established web conventions, and ensuring smooth navigation[41,42]. The content is organized into structured segments that enable learners to establish a sense of progression and achievement, with tracking mechanisms in place for necessary adjustments. Interactivity is another crucial aspect of top-tier delivery, fostering learner engagement through a variety of activities. The chosen tools are viewed as an intellectual toolkit that assists learners in constructing meaningful interpretations and representations of the world. This approach aligns with the principle of technological minimalism, where tools are selected with precise consideration of their strengths and limitations to effectively address well-defined instructional goals. The inclusion of multimodal content, encompassing text, graphics, video, and audio, caters to diverse learning preferences, enhancing the overall learning experience[43]. Within the service aspect of the DDLM, superior service is characterized by a holistic support system that includes resources, administrative and technical assistance, proficient personnel, accessibility, and responsiveness. The resources are specifically tailored to assist learners in identifying their educational requirements, while also promoting self-reflection and an understanding of their cognitive and learning processes[27]. Support is readily available to assist learners in navigating the learning environment, and experienced staff ensure the effectiveness of the learning experience. Accessibility to services and staff is straightforward, promoting unconstrained access to a wealth of learning resources[38,44]. Responsiveness is a key element, ensuring that all service requests are met with minimal waiting times, including prompt feedback, fast responses to inquiries, and timely assistance. In short, the DDLM's multifaceted components provide a comprehensive and practical framework for the design and implementation of e-learning, aligning content, delivery, and service with learner needs and promoting continuous improvement.

DDLM plays a transformative role in e-learning choices, as evidenced by its multifaceted impacts on the education and training[27,35]. It introduces a paradigm shift, breaking down traditional barriers and offering learners a new world of opportunities.The DDLM-driven e-learning approach strives to provide comprehensive, authentic, and research-grounded content. This transformative approach transcends traditional barriers, offering learners engaging, relevant, and up-to-date materials. The liberation from time and location constraints allows learners to access content that matches their level of understanding and covers topics in appropriate breadth and depth, ultimately promoting a learner-centric and engaging educational experience. Therefore, it is hypothesized that high-quality content, as facilitated by DDLM, positively influences learners' e-learning choices.

Hypothesis 1 Quality content positively impacts e-learning choice.

Quality content is aligned with learners' preferences and goals in creating more meaningful learning experience. This, in turn, influences how quality content is delivered, as platform may prioritize interactive, multimedia-rich formats to maintain engagement. Furthermore, quality content that is adapatable and accessible facilitates flexible delivery modes[45,46]. Platforms may offer various delivery options, such as mobile-friendly interfaces or downloadable resources, to accommodate learners' diverse preferences and technological capabilities.

Hypothesis 2 Delivery mediates the impact of quality content on e-learning choice.

The inclusive approach of DDLM extends e-learning to a global audience, including disabled, part-time, and non-traditional learners, making education accessible to a diverse range of individuals[45]. Additionally, DDLM-driven e-learning leads to substantial cost and time savings as learners do not need to travel to specific locations. The flexibility in delivery methods, such as mobile-friendly interfaces, offline learning options, and various content delivery options, caters to individual learning preferences and enhances the accessibility of e-learning[47].

Hypothesis 3 Delivery positively impacts e-learning choice.

DDLM fosters a collaborative learning environment that connects learners and experts worldwide, encouraging open dialogue and the sharing of diverse perspectives. Furthermore, it offers learners unprecedented access to instructors, facilitating continuous communication and guidance. The emphasis on responsive services that cater to learners' needs ensures a positive and supportive e-learning environment[48]. Therefore, it is hypothesized that the responsive service quality, as guided by DDLM, has a positive impact on learners' e-learning choices.

Hypothesis 4 Service quality positively impacts e-learning choice.

Responsive and personalized service enhances the delivery of content by providing learners with support and guidance throughout their learning journey[49]. Service features such as timely response to queries, peer interaction opportunities and instructor feedback contribute to a positive learning environment (Megahed et al.[5], MacDonald and Thompson[27], Meyen et al.[44]). Service provision inludes maintaining the technical infrastructure

of the e-learning platform, which directly impacts delivery[50]. Technical support services play a crucial role in resolving issues promptly and maintaining the smooth delivery of quality content.

Hypothesis 5 Delivery mediate the impact of service on e-learning choice.

These five hypotheses highlight the direct impacts of DDLM's quality content, adaptable delivery methods, and responsive service on e-learning choices as well as the mediating role of delivery to e-learning choice (see Fig. 1). DDLM's transformative role in e-learning, as evidenced by its impacts on democratizing education, promoting self-directed learning, fostering collaboration, and expanding access, redefines the choices available to learners in the digital age, making these hypotheses a crucial foundation for exploring the factors directly and indirectly influencing e-learning choices. This paper introduces a novel perspective within the framework of the DDLM by delving into the mediating role of delivery in the influence of quality content and service on e-learning choice. While the traditional model acknowledges the importance of these three pillars individually, this study extends the understanding by examining how delivery acts as a mediator between quality content, service, and e-learning choice. By elucidating the intricate relationship between these factors, the paper contributes to a deeper comprehension of the mechanisms driving learners' decisions in the digital learning landscape. Through this exploration, the paper offers valuable insights which can inform the design and implementation of e-learning platforms, ultimately enhancing their effectiveness and appeal to a diverse range of learners.

Methods

Data were collected from learners in higher education institutions in Vietnam to test the study hypotheses. The survey participants consisted of individuals who were enrolled in educational programs, either undergraduate or post graduate, offered by the higher education institutes in Vietnam that utilized various forms of online education. Learners were defined as individuals who had experience with online learning for at least one course or program. The term potential learners referred to individuals who had not yet experienced online learning for any course. The study focused on students enrolled in regular and distance education programs using traditional delivery methods. They were considered potential learners when applying the e-learning method in Vietnamese higher education, including fully online and blended learning models. The survey encompassed a total of 1,000 learners, with a response rate of 40%, conducted through Google Forms. The survey scope primarily targeted three regions in Vietnam: North, Central, and South, specifically major cities where higher education institutions offering online education were concentrated, including Hanoi, Da Nang, Ho Chi Minh and Can Tho cities. The selection of these educational institutions was carried out randomly, and the participants willingly agreed to take part in the survey. The summary of the respondents' information is presented in Table 1.

In this study, all the variables under examination were originally presented in English and were subsequently translated into Vietnamese by a bilingual translator. To assure the translation's quality and prevent potential cultural biases, the Vietnamese version was then reverse-translated into English by another bilingual translator.

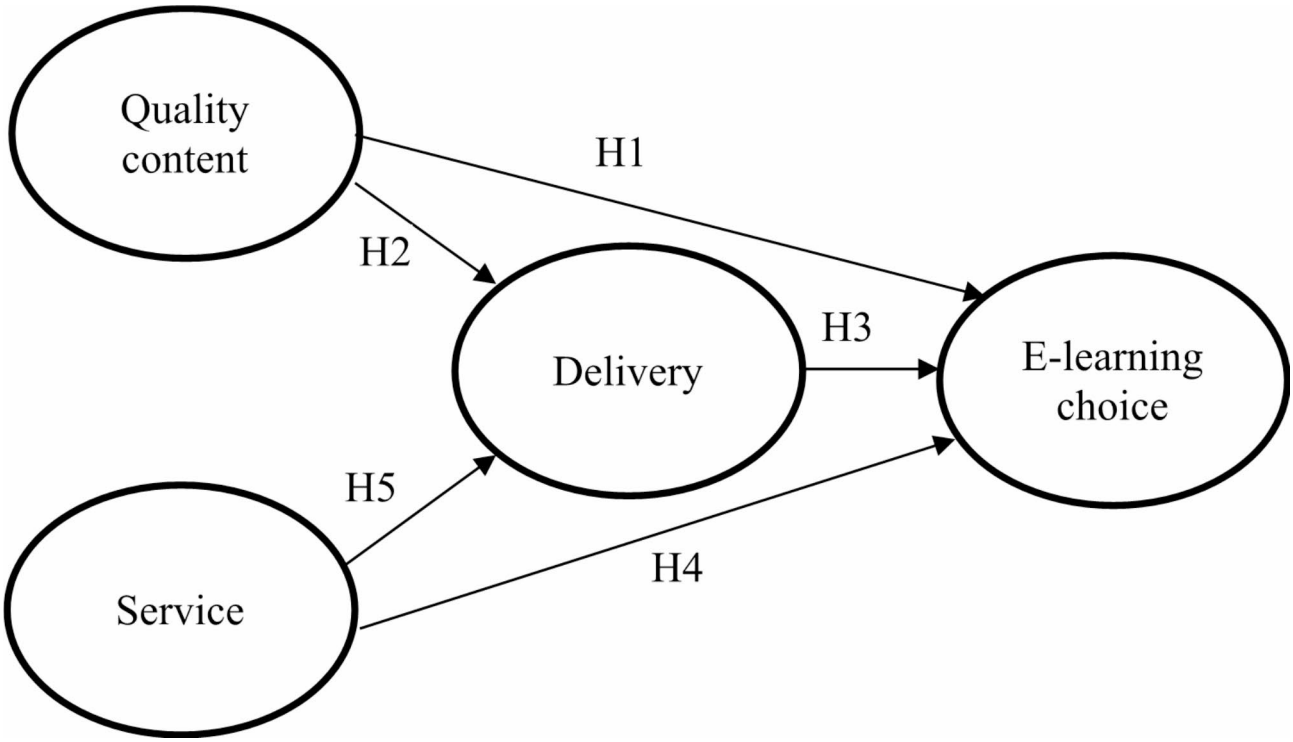

Fig. 1. E-learning choice model.

Description	Frequency	Percentage
Gender		
Male	207	51.8
Female	193	48.2
Age groups		
< 25	120	30.0
25–34	192	48.0
> 35	88	22.0
E-learning experience		
0 subject	60	15.0
1–3 subjects	40	10.0
4–5 subjects	72	18.0
> 5 subjects	228	57.0
Education		
Undergraduate	164	41
Postgraduate	236	59

Table 1. Summary of the respondents' information.

Construct	Indicators	Source
Content	C1: The course content encompasses all the information essential for consumers to understand.	MacDonald and Thompson [27], Megahed et al.[5]
	C2: The course content accurately mirrors the challenges and concerns that typically occur in work environments.	Megahed et al.[5], Savery and Duffy[39], Barab et al.[40]
	C3: The course content is based on readily available and validated empirical research.	MacDonald and Thompson[27], Megahed et al.[5]
Delivery	D1: The user interface of programs based on the DDLM is meticulously designed and rigorously tested for usability.	MacDonald and Thompson[27], Megahed et al.[5]
	D2: Programs based on DDLM are designed to guarantee the inclusion of activities that promote interaction.	Berge[41]
	D3: The tools selected for programs based on DDLM are aligned with instructional goals, with a thorough assessment of the pros and cons of each tool.	Calvert[51], Jonassen, et al.[52]
Service	S1: Educational materials are provided in various formats to enable learners to explore concepts from different viewpoints.	MacDonald and Thompson[27], Megahed et al.[5]
	S2: Administrative and technical support is readily accessible.	MacDonald and Thompson[27], Megahed et al.[5]
	S3: The instructors and technical support staff are highly qualified and experienced professionals.	Megahed et al.[5], MacDonald and Thompson [27], Meyen et al.[44]
	S4: Any requests for assistance and support are addressed promptly with minimal wait times.	MacDonald and Thompson [27], Megahed et al.[5]
E-learning choice	E1: Volunteer to select e-learning instead of traditional learning	Dash and Chakraborty[13]
	E2: Happy with e-learning choice	
	E3: Recommend e-learning to the others	

Table 2. Three pillars of consumers demand in DDLM and e-learning choice.

Any minor adjustments resulting from this process were incorporated into the ultimate version of the survey. In our model, each latent variable was conceived with multiple items. To ensure high reliability, the items used to gauge the latent variables were drawn from previous studies. These items were assessed using a seven-point Likert scale, ranging from 1 (completely disagree) to 7 (completely agree). The final questionnaire for the current study consisted of a total of 13 items.

Latent variables in this study were assessed using indicators outlined in Table 2. The focus of the research encompassed the three fundamental components of the DDLM: quality content, delivery, and service. For the measurement of content, a scale consisting of three indicators was employed. The indicators for comprehensive content and research-based content were adopted from the studies conducted by Megahed et al.[5], MacDonald and Thompson[27]. The industry-driven content indicator was designed based on the references of Megahed et al.[5], MacDonald and Thompson[27], Savery and Duffy[39], Barab et al.[40].

The measurement of delivery employed a scale comprising three indicators that assessed the following aspects: (i) usability; (ii) interactivity; and (iii) tools. The service measurement consisted of four indicators: (i) resources, (ii) staff qualification, (iii) accessibility, and (iv) responsiveness. The indicators were based on research conducted by Megahed et al.[5], MacDonald and Thompson[27], Meyen et al.[44]. The measurement of e-learning choice utilized a scale comprising three indicators, drawing from the research conducted by Dash and Chakraborty[13].

Partial least squares structural equation modeling (PLS-SEM) was employed instead of using covariance-based structural equation modeling (CB-SEM) in this study for several reasons. This study falls under the exploratory category rather than the confirmatory one, and PLS-SEM is deemed more advantageous for this

purpose[53,54]. Furthermore, PLS-SEM is less affected by the assumption of normality in the data. The modeling process was conducted using Smart PLS 4 software v. 4.0.9.6, as detailed in Hair et al.[55], Avkiran and Ringle[56].

The steps for assessing the measurement model are conducted following the guidelines provided by Hair et al.[55], Ringle, et al.[57]:

Step 1: Factor loadings should have values of 0.708 or higher.

Step 2: Reliability. Cronbach's Alpha and Composite Reliability should be above 0.7. If the reliability is 0.95 or higher, it indicates that the observed variables are measuring a concept redundantly.

Step 3: Convergent Validity. Convergent validity is assessed using the Average Variance Extracted (AVE), with a criterion of AVE values being 0.5 or higher.

Step 4: Discriminant Validity: Discriminant validity is confirmed when the Average Variance Extracted (AVE) of a construct exceeds the squared inter-construct correlations, as proposed by Fornell and Larcker[58]. Nonetheless, recent studies are doubtful on the reliability of the Fornell-Larcker criterion. As an alternative, Henseler, et al.[59] advocated for the use of the heterotrait-monotrait ratio (HTMT) of correlations to accurately evaluate discriminant validity, setting a threshold value of 0.9. An HTMT value surpassing 0.9 indicates a deficiency in discriminant validity.

The evaluation of the structural model is also conducted in line with the suggestions of Hair Jr et al.[60,61]:

Step 1: Multicollinearity. The Variance Inflation Factor (VIF) should be less than 3.0 to indicate no multicollinearity.

Step 2: Path Coefficients. Path coefficients are standardized values ranging from -1 to $+1$. A path coefficient closer to 0 suggests weaker predictive power of the dependent variables, while a coefficient closer to 1 indicates a stronger prediction.

Step 3: Model Explanation. R-squared (R^2) is used to measure the extent to which the structural model explains the variance in the dependent variables. An R^2 of 0 indicates no explanatory power, and a higher R^2 suggests a stronger relationship between the independent and dependent variables, with a maximum value of 1.

Step 4: Effect Size. Effect size is measured using f^2, where values from 0.02 to 0.15 are considered small effects, values from 0.15 to 0.35 are moderate effects, and values exceeding 0.35 indicate large effects.

PLS-SEM estimates the parameters with the aim of maximizing the explained variance of the endogenous latent variables in stead of minimizing the differences between covariance matrices like CB-SEM.Therefore, model fit provides little value for applied research. However, model fit can be assessed through various criteria, each shedding light on different aspects of model performance. The Standardized Root Mean Square Residual (SRMR) measures the discrepancy between the observed and model-implied covariance matrices, with lower values indicating better fit. The d_ULS and d_G indices evaluate the degree of model redundancy and goodness of model fit, respectively, with smaller values indicating better fit. Lastly, the Normed Fit Index (NFI) assesses the proportion of improvement in model fit relative to the null model, with values closer to 1 indicating better fit. Evaluating a model's fit using these criteria collectively offers a comprehensive understanding of its adequacy in explaining the observed data[62].

Results

The majority of online learners were male (51.8%), postgraduate (59%), aged 25–34, accounting for 48.0% (Table 1). This is a comparatively young age with convenient access to information technology. At the same time, this is also the period when employees seek to foster and improve their skills as well as supplement knowledge after leaving school. The majority of learners were enrolled in more than 5 subjects online (57.0%).

Table 3 displays the factor loadings of 13 observed variables measuring four constructs: content, delivery, service, and e-learning choice. The variables exhibit factor loadings ranging from 0.843 to 0.920, with the exception of variable S2, which had a factor loading of 0.642 (< 0.7). However, it is worth noting that that prior research has already established the significance and validity of including the administrative and technical

Description	Code	Factor loadings
The course content encompasses all the information essential for consumers to understand.	C1	0.899
The course content accurately mirrors the challenges and concerns that typically occur in work environments.	C2	0.886
The course content is based on readily available and validated empirical research.	C3	0.907
The user interface of programs based on the DDLM is meticulously designed and rigorously tested for usability.	D1	0.843
Programs based on DDLM are designed to guarantee the inclusion of activities that promote interaction.	D2	0.852
The tools selected for programs based on DDLM are aligned with instructional goals, with a thorough assessment of the pros and cons of each tool.	D3	0.878
Educational materials are provided in various formats to enable learners to explore concepts from different viewpoints.	S1	0.896
Administrative and technical support is readily accessible.	S2	0.642
The instructors and technical support staff are highly qualified and experienced professionals.	S3	0.878
Any requests for assistance and support are addressed promptly with minimal wait times.	S4	0.897
Volunteer to select e-learning instead of traditional learning.	E1	0.920
Happy with e-learning choice.	E2	0.902
Recommend e-learning to the others.	E3	0.906

Table 3. Factor loadings.

Construct	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Content (C)	0.879	0.882	0.926	0.806
Delivery (D)	0.822	0.841	0.893	0.736
Service (S)	0.855	0.918	0.901	0.698
E-learning choice (E)	0.895	0.896	0.935	0.827

Table 4. Construct reliability and validity.

	C	D	E	S
C (Content)	0.898			
D (Deliviery)	0.417	0.858		
E (E-learning choice)	0.576	0.429	0.909	
S (Service)	0.567	0.445	0.493	0.835

Table 5. Discriminant validity (Fornell-Larcker).

	C	D	E	S
C (Content)				
D (Deliviery)	0.490			
E (E-learning choice)	0.648	0.491		
S (Service)	0.628	0.531	0.533	

Table 6. Discriminant validity (HTMT).

	E (E-learning choice)
C (Content)	1.551
D (Delivery)	1.312
S (Service)	1.598

Table 7. VIF.

support item when measuring the service construct Megahed et al.[5]. As a result, there is a rationale for retaining this specific item within the measurement model for the service factor in this study.

The constructs have achieved both reliability and validity. Table 4 illustrates that they exhibit values ranging from 0.822 to 0.895, surpassing the threshold of 0.7 for reliability. The composite reliability, ranging from 0.841 to 0.935, falls below the value of 0.95. Additionally, all AVE values are substantial, ranging from 0.698 to 0.827, meeting the requirement of being greater than or equal to 0.7.

Tables 5 and 6 reveals the discriminant validity of the constructs as per the Fornell-Larcker criterion and HTMT respectively. According to this criterion, the square root of the AVE for each construct should exceed the highest correlation that construct has with any other construct in the model. In terms of HTMT ratios, the value is lower than the corresponding threshold values (0.9).

The results of the analysis in Table 7 indicate that the highest VIF value is 1.598, which is below the threshold of 3. Thus, there is multicollinearity in the model.

The model fit indices indicate a moderately satisfactory fit for the PLS-SEM. The Standardized SRMR stands at 0.070, suggesting a relatively acceptable level of discrepancy between the observed and model-implied covariance matrices. Both the d_ULS and d_G indices, measuring redundancy and goodness of fit, respectively, demonstrate values of 0.445 and 0.248, indicating a moderate degree of redundancy and a reasonably good model fit. The NFI values at 0.819, reflecting a substantial proportion of improvement compared to the null model. These results suggest a generally adequate fit. Further investigation into specific model relationships for more nuanced interpretation has been conducted.

The hypotheses regarding the influence of quality content, delivery, and service on e-learning choice are presented in Table 8; Fig. 2. Following the execution of the PLS-SEM algorithm, we obtained estimates for the relationships within the structural model, specifically the path coefficients. These path coefficients are standardized values that typically range between −1 and +1, although they can occasionally fall outside these bounds. Path coefficients approaching +1 indicate robust positive relationships conversely for negative values that are often statistically significant, meaning they differ significantly from zero in the population. On the other hand, the closer the estimated coefficients are to 0, the weaker the relationships and a construct's

	Path coefficients	Standard deviation	t-value	*p*-value
C -> D	0.236	0.114	2.064	0.039
C -> E	0.400	0.104	3.845	0.000
D -> E	0.173	0.080	2.145	0.032
S-> D	0.320	0.109	2.941	0.003
S-> E	0.183	0.098	1.864	0.062
R^2_E	0.392			
R^2_D	0.244			
f^2	$f^2_{C->D}$= 0.05; $f^2_{C->E}$= 0.171; $f^2_{D->E}$= 0.03742; $f^2_{S->D}$= 0.092; $f^2_{S->E}$= 0.034			

Table 8. Significance testing results of the structural model significance testing results of the structural model.

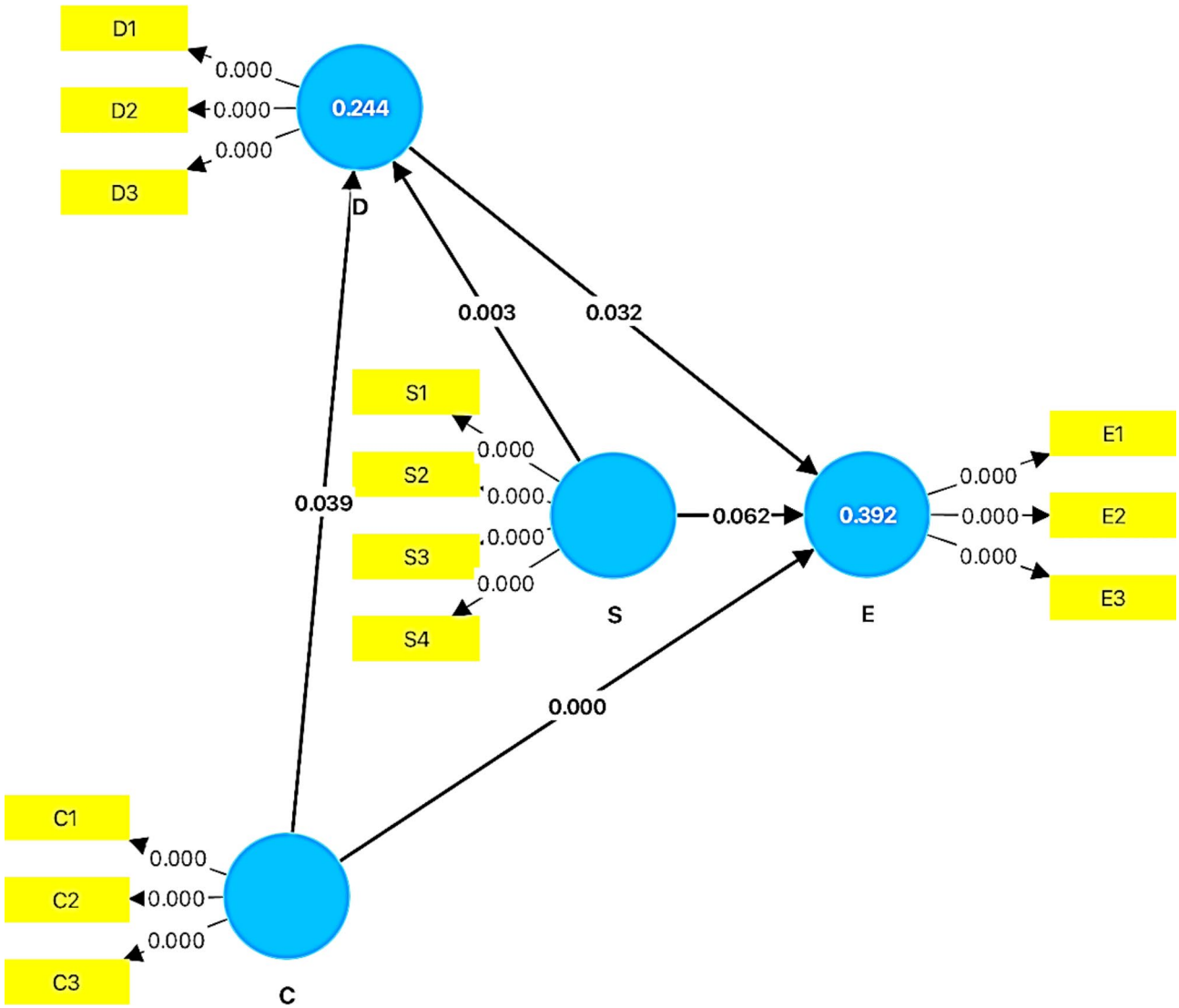

Fig. 2. Result of PLS-SEM model.

relative explanatory power in the structural model. Very low values approaching 0 are typically not statistically significant, meaning that they are not significantly different from zero in the population. Content exerts the strongest influence on e-learning choice, with a direct path coefficient of 0.400 in Table 8. Following this, service and delivery have path coefficients of 0.183 and 0.173, respectively. Delivery plays a dual mediating role in the structural model, acting as a mediator between both quality content and e-learning choice, as well as service and e-learning choice. These findings underscore the pivotal role of delivery in mediating the relationships

between quality content and e-learning choice, as well as between service and e-learning choice, highlighting its importance in shaping students' e-learning decisions within the study's framework.

Discussions

The impact of various factors, including quality content, delivery, and service, on the e-learning choice within the framework of the DDLM in Vietnamese universities, was a central focus of this research. Mediating role of delivery in the e-learning choice model has also been confirmed. The high path coefficient of quality content, as indicated by the research, underscores its significance in e-learning choice. Quality content represents the heart of any educational program, and it should be designed to be engaging, relevant, and of high quality. A well-structured and informative content can captivate learners and motivate them to choose e-learning as a preferred mode of education. In the Vietnamese context, focusing on curriculum development and ensuring that course materials are up-to-date and appealing to students' needs and interests is crucial. Based on the research findings emphasizing the significance of quality content in e-learning, Vietnamese universities can undertake several strategic actions to enhance their educational programs and attract more students to e-learning platforms. Firstly, they can prioritize curriculum development efforts, ensuring that course content is meticulously designed to meet the standards of engagement, relevance, and quality highlighted in the research. This involves regular reviews and updates of course materials to reflect the latest advancements and trends in respective fields. Moreover, universities can integrate multimedia elements, interactive activities, and real-world applications into their e-learning content to enhance its appeal and effectiveness. Collaborating with industry partners can also provide valuable insights into emerging trends and skill requirements, thus enabling universities to tailor their content accordingly. Additionally, fostering a culture of innovation and continuous improvement among faculty members can further enhance the quality and appeal of e-learning content. Finally, conducting regular surveys and feedback sessions with students can provide valuable insights into their preferences and needs, guiding universities in refining their content development strategies to better serve the diverse learning styles and interests of students in the Vietnamese context.

The research results emphasize the relevance of service, which encompasses administrative and technical support, in influencing e-learning choices. Vietnamese universities should recognize the importance of providing students with a seamless and supportive e-learning experience. This includes responsive customer service, accessible technical assistance, and efficient problem-solving mechanisms. Enhancing the service aspect can instill confidence in learners and reduce barriers to e-learning adoption. Drawing from the research highlighting the critical role of service in influencing e-learning choices, Vietnamese universities should enhance their support infrastructure to provide students with a seamless and supportive e-learning experience. This entails establishing responsive customer service channels, accessible technical assistance, and efficient problem-solving mechanisms. By offering robust support mechanisms, such as dedicated hotlines, live chat functionalities, comprehensive online tutorials, and IT help desks, universities can address students' inquiries and technical issues promptly. Streamlining administrative processes and proactively addressing potential technical glitches further contribute to fostering confidence in learners and reducing barriers to e-learning adoption. Additionally, actively soliciting feedback from students and using this feedback to continuously refine and improve service offerings ensures that universities remain responsive to students' needs and preferences, ultimately enhancing the overall e-learning experience.

The role of delivery should not be underestimated as it also contributes significantly to e-learning choices directly and indirectly via quality content and service. The mode and method of delivering content can greatly impact the learning experience. In Vietnam, universities should consider investing in effective delivery platforms and methods that are user-friendly and conducive to active engagement. Accessibility and user-friendliness are key factors that can make e-learning a more attractive choice for students. Vietnamese universities can implement various strategic measures to optimize the delivery of quality content and enhance the overall e-learning experience. Investing in modern and user-friendly delivery platforms that facilitate seamless access to course materials and interactive learning resources should be made. This may involve adopting Learning Management Systems (LMS) equipped with features such as multimedia integration, discussion forums, and personalized learning paths to cater to diverse learning preferences and styles. Additionally, universities can explore innovative delivery methods such as flipped classrooms, blended learning models, and gamified learning experiences to promote active engagement and knowledge retention among students. Ensuring the accessibility of e-learning platforms to students with disabilities through features like screen reader compatibility and captioning services is also imperative. Furthermore, universities can provide comprehensive training and support for faculty members to effectively utilize delivery platforms and incorporate technology-enhanced pedagogical strategies into their teaching practices. Regular assessment and evaluation of the effectiveness of delivery methods and platforms through student feedback and performance metrics can further inform continuous improvement efforts. By prioritizing the optimization of quality content and service delivery mechanisms, Vietnamese universities can create an enriched e-learning environment that is both appealing and conducive to student success.

In summary, the findings indicate that content has the most significant influence on e-learning choice, reflecting a robust path coefficient of 0.400. Following closely are service and delivery, each with path coefficients of 0.183 and 0.173, respectively. Mediating roles of delivery on the mehanisim impact of quality content and service on e-learning choice have been confirmed. These results hold particular importance in the context of prior research. Notably, they align with previous studies conducted by MacDonald and Thompson[27], Megahed et al.[5]. The substantial impact of content on e-learning choice corroborates the assertion made by Megahed et al.[5], Savery and Duffy[39], Barab et al.[40] regarding the significance of course materials and content quality.

In comparison to the earlier research, this study highlights the consistent importance of these factors in the e-learning decision-making process. Furthermore, the quantified path coefficients provide a nuanced understanding of the relative strengths of these influences, offering valuable insights for universities in Vietnam

seeking to optimize their e-learning offerings. In light of these results, there are important policy implications for higher education providers with e-learning method in Vietnam. The development of content, service and delivery should be prioritized. These findings contribute to a deeper understanding of the factors driving e-learning choices, offering a basis for refining educational strategies and services in the digital learning landscape.

Conclusions

The research findings confirm that content has an important influence on the choice of e-learning, followed by service and delivery through the perspectives of both learners and potential learners of e-learning at the higher education institutes (HEI) in Vietnam. The novel results on mediating the role of delivery in e-learning choice model under DDLM have been determined. Based on the findings, there are a few issues to consider when formulating policies. Firstly, universities should prioritize the development of high-quality, engaging, and relevant educational content. This involves continuously updating course materials to ensure that they remain current and aligned with both the needs of industry and interests of students. Secondly, the importance of administrative and technical support services, as indicated by the research, cannot be overstated. Educational institutions in Vietnam should invest in and enhance these support services to ensure a supportive e-learning experience. This encompasses responsive customer service, accessible technical assistance, and efficient problem-solving mechanisms. Furthermore, the delivery of e-learning content is a critical factor. Universities should focus on user-friendly and interactive delivery platforms and methods that encourage active engagement. Ensuring that e-learning is accessible to all students, regardless of their technological proficiency, is paramount. In conclusion, the research highlights the significance of content, service, and delivery in shaping e-learning choices in Vietnamese higher education institutions. To capitalize on these findings, universities should concentrate on content quality, improve support services, and enhance content delivery methods. By doing so, they can make e-learning a more attractive and effective mode of education, thereby meeting the evolving needs of their students and fostering a dynamic and accessible learning environment.

Data availability

All data generated or analysed during this study are included in this published article.

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Author contributions

P.T.N.: Writing- Original draft preparation, Funding acquisition, Supervision, Project administration, Resources & Review & Editing. Q.L.H.T.T.N.: Methodology, Data curation, Writing - Review & Editing, Investigation. L.T.N.: Software, Writing - Review & Editing. V.D.B.H.: Resources & Review & Editing.

Declarations

Competing interests
The authors declare no competing interests.

Ethics approval
All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by the Committee of the Vietnam National Foundation for Science and Technology Development (NAFOSTED) on 15 April 2020 (Ref. No. 503.99-2020.04).

Informed consent
We informed each participant of the participant information statement, their rights to withdraw from the study, their voluntary participation and their personal information treated with confidentiality during the recruitment. We had obtained their full informed consent before we conducted the interviews for data collection.

Additional information
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