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Quality Assessment of the Blended Learning in Higher Education Using the Modified HEdPERF Instrument

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Abstract

The objective of this study is to introduce the HEdPERF instrument as a means to objectively assess the impact of various factors on the quality of blended learning, particularly focusing on student satisfaction. In the study, both quantitative and qualitative methods were utilized to analyze the results of the survey conducted online with 662 students and face-to-face interviews with 180 students from different faculties at Hanoi University of Science and Technology, covering students from their first to fifth years. The results show that factors including Academic and Non-Academic aspects, IT Facilities and Infrastructure, Access and Learning Organization, as well as the characteristics of the training major of the students and their academic year, impact the quality of blended learning, which requires a need to balance traditional in-person classroom instruction and online learning. The novelty of this study lies in the selection and modification of dimensions and items from Abdullah's HEdPERF instrument to evaluate factors affecting the quality of higher education services. This approach can be applied to assess various learning models or the quality of educational services offered by higher education institutions while considering the characteristics of different academic disciplines and the students' year of study.

Keywords:

Blended Learning;
Online Learning;
Traditional Learning;
Higher Education;
Hedperf Instrument.

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1- Introduction

The rapid advancement of information and communications technology (ICT) has brought numerous benefits to socioeconomic fields, including significant changes in teaching and learning methods due to the integration of digital technology. This development bridges the gap between traditional face-to-face and distance learning. In higher education institutions (HEIs), the adoption of the blended learning (BL) model has become widespread over the past two decades, and is now viewed as an inevitable trend [1, 2]. BL combines the best elements of online education (e-learning) and in-person classroom instruction and is emerging as a mainstream teaching model for the future. Once considered an experimental concept in distance education courses, BL is now recognized as an integral part of formal education [3, 4]. This model allows lecturers to efficiently provide learning materials tailored to diverse student categories, accommodating various learning styles through online interaction. Furthermore, students can personalize their studies through online access to learning resources and the ability to connect with each other and lecturers online.

Although the BL model has become increasingly relevant in recent years in Vietnam, online learning has been implemented at all educational levels. According to the Center for Educational Communications (CEC), during the first

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year of the COVID-19 pandemic in 2020, 46% of HEIs offered online learning [5]. By the beginning of the 2021-2022 school year, the percentage of schools providing distance learning (both online and via local television) in the lower secondary and upper secondary levels reached 56.55% and 66.26%, respectively [5]. After the pandemic, many universities continue to utilize online learning, viewing it as a necessary complement to traditional in-person instruction.

Although many universities have successfully implemented the BL model, the balance of the time ratios between traditional in-person classes and online learning varies. For instance, at Ho Chi Minh City University of Economics, BL has been in place since 2016, with 30% of course content delivered online and 70% delivered through traditional face-to-face learning. In contrast, the Hanoi University of Industry adopted a 50% online and 50% in-person approach in 2016 [6]. These differences can be attributed to the specific characteristics of each institution, whether multidisciplinary or specialized.

The positive benefits of BL are clear, as it reduces face-to-face class time, increases access to materials, and enhances learning amid digital transformation. BL has gained popularity among Vietnamese universities. A survey conducted by Mai (2023) [7] across five universities (National Economics University, Hanoi Pedagogical University, Hanoi University of Industry, Economic School of Vietnam National University, Hanoi, and FPT University) found that 77% of the surveyed students supported the blended learning model, which is eight times higher than the 9.4% who disagreed. Additionally, 82.3% of the respondents stated that BL provides flexibility and convenience, effectively meeting the needs of personalized learning.

The context emphasizes the need for suitable methods to assess the factors influencing the quality of educational services when implementing BL forms based on student satisfaction. This process should lead to recommendations offered by individual universities, considering the specific characteristics of the training specialties and training programs.

1-1- Previous Studies on Blended Learning, Quality of Higher Education and Measuring Instruments

The term “Blended Learning” first appeared in Cooney et al. (2000) [8] regarding preschool activities that combine play and work. Between 2003 and 2006, the concept of BL became clearer, with Osguthorpe & Graham (2003) [9] emphasizing that it integrates direct teaching with distance learning systems. This approach goes beyond simply providing digital devices to maximize the benefits of both face-to-face and online methods. Singh (2021) [10] highlighted that this combination is effective, allowing learners to engage directly with teachers and peers while accessing various learning materials both online and offline.

Blended learning can be defined in various ways, but it is generally understood as a combination of traditional face-to-face classroom instruction and online learning. This approach utilizes digital technologies to deliver comprehensive learning content [11]. The concept of BL can be described as “the convergence of online and face-to-face education” Specifically, it represents a seamless integration of traditional in-person teaching with fully online courses. As more distance learning programs become available, online elements are increasingly being incorporated into instructional design within face-to-face instruction [4]. Depending on the proportion of course content delivered online, different types of learning can be categorized, as summarized in Table 1 [12].

Table 1. Classification of BL

Proportion of Content Delivered Online	Type of Course	Typical Description
0%	Traditional	Course with no online technology used - content is delivered in writing or orally
1-29%	Web Facilitated	A course which uses web-based technology to facilitate what is essentially a face-to-face course. Uses a course management system (CMS) or web pages to post the syllabus and assignments, for example.
30 to 79%	Blended/ Hybrid	A course that blends online and face-to-face delivery. A substantial proportion of the content is delivered online, typically uses online discussions, and typically has some face-to- face meetings.
80+%	Online	A course where most or all of the content is delivered online. Typically have no face-to-face meetings.

Higher education institutions are facing significant changes and increasing competition in the digital era. Consequently, BL has emerged as the predominant teaching model that combines the benefits of both online and in-person education. Cheng et al. (2023) [13] used descriptive statistical analysis, one-way ANOVA, Pearson correlation, and multiple linear regressions to analyze student satisfaction with blended learning, and found that 61.7% of students agreed or strongly agreed with this learning style. At a specific HEI, students’ interest in BL varies significantly based on the training program and the students’ year of study [14, 15].

The issues related to BL presented above raise the following questions: if BL is implemented as an educational model, is it necessary to measure its quality and effectiveness? Which tools are suitable for assessing educational services? As BL combines traditional in-person classroom instruction with online learning, what factors determine the balance between these two components?

1-2- Instruments for Measuring Service Quality of Higher Education Servies

Measuring the quality of higher education services begins with understanding that students are customers. According to Jones (2006) [16], as students pay for their education, they have become more expectant about the services that universities should provide. This shift has transformed the relationship between higher education institutions and students from a traditional academic perspective to a contractual one, viewed through a consumer lens. Given this perspective, student satisfaction and benefits should be the primary objectives of universities' educational services [17, 18]. Increasingly, students are regarded as customers, making student satisfaction a crucial focus of university policies and academic activities. In this context, the new perception of students signifies a significant change in how they are traditionally viewed, with student satisfaction serving as a key measure of service quality in higher education [19].

Service quality and customer satisfaction are essential concepts for understanding consumer behavior. Parasuraman et al. (1985, 1988) [20, 21] proposed that service quality be defined as the gap between customers' expectations and their perceptions of the service they receive. They introduced the SERVQUAL model as a measurement tool to assess service quality. This concept was further supported by a study conducted by Cronin & Taylor (1992) [22], which indicated that service quality can be determined by measuring customer perceptions, which are closely related to customer satisfaction. Quality in education is defined as the conformity of educational output with a country's training goals and requirements [23, 24]. In a study on the quality of educational services among students at secondary vocational institutions in the Samara region of the Russian Federation, Mitrofanova et al. (2021) [25] suggested a strong link between educational service quality and student satisfaction. Similarly, Pérez-Sullcaray et al. (2024) [26] found a positive causal relationship between the quality of educational services and student satisfaction; that is, higher levels of student satisfaction are associated with better service quality and vice versa. Therefore, the reviewed studies reached a consensus that the quality of educational services could be effectively measured by student satisfaction.

SERVQUAL, SERVPERF, and HEdPERF are commonly used to assess the quality of higher education services. The SERVQUAL instrument developed by Parasuraman et al. (1985, 1988) [20, 21] has garnered the most attention for measuring perceived quality in the higher education sector [27-29]. This model is based on the difference between customer expectations and perceptions of service quality and incorporates a set of five gaps: Assurance, Reliability, Responsiveness, Empathy, and Tangibles. These gaps relate to management's perceptions of service quality and the tasks involved in delivering the service. However, SERVQUAL has faced criticism for being theoretically inadequate to measure service quality across different facilities [30] and appears to lack conceptual and empirical support compared to SERVPERF, which provides a reliable and valid scale for measuring service quality levels [31]. Additionally, the Five Gaps Model indicates that users' expectations regarding services can easily change based on their experiences. Therefore, measuring quality based on frequently fluctuating variables may lack significant relevance [22, 31, 32].

The SERVPERF model, developed and tested by Cronin & Taylor (1992) [22], is a powerful tool for assessing service quality. It is widely regarded as more predictive and effective than the other available measurement instruments. This model encompasses five critical dimensions: Reliability, Assurance, Tangibility, Empathy, and Responsiveness. SERVPERF can serve as a valuable framework for evaluating service quality in higher education settings [33-35]. However, Karavasilis et al. (2016) [36] stated that both SERVQUAL and SERVPERF are generic models for measuring service quality, and there is still a need for a more appropriate service quality measurement instrument that can capture the authentic determinants of service quality within the higher education sector. This observation aligns with Yorke's (1992) [37] perspective, which argues that to effectively measure service quality in higher education, strong emphasis must be placed on academic aspects, teaching quality, and course organization.

Abdullah (2005) [38] introduced a new tool called HEdPERF, which has better measurement capabilities than SERVPERF in terms of unidimensionality, reliability, validity, and explained variance. After surveying six higher education institutions in Malaysia, Abdullah (2006) [33] proposed a 41-item instrument tested for unidimensionality, reliability, and validity. The HEdPERF model includes six dimensions: (1) Non-academic Aspects relate to the tasks performed by university administrative staff to assist students in meeting their academic obligations; (2) Academic Aspects consist solely of elements that fall under the responsibility of academic staff; (3) Reputation pertains to the facilities that contribute to creating a professional image for the university; (4) Access includes components related to issues such as accessibility, ease of communication, availability, and convenience; (5) Program issues emphasize the importance of offering diverse and reputable academic programs with flexible structures and curricula; and (6) Understanding pertains to additional services that cater to students' needs. However, Abdullah later removed this dimension.

Subsequently, this argument was reinforced by Obeidi (2021) [39] and Kalim et al. (2022) [40], who further highlighted that non-academic aspects such as administrative services are closely linked to the quality of education. In HEIs, various forms of learning are increasingly diversified to meet students' needs, as they are the primary drivers advocating for change. Therefore, measuring the quality of teaching and learning methods is crucial for HEIs and stakeholders invested in the educational process to measure the quality of educational services and implement necessary improvements. Thus, the HEdPERF scale, which includes five evaluation criteria (dimensions), has been extensively used to measure perceived service quality from the perspective of students in HEIs worldwide [41]. Its specialized construction, along with its distinctive features and advantages over other evaluation tools, makes it a preferred choice [42-44].

1-3- Research Gap, Objective and Hypotheses Development

A notable aspect of the HEdPERF model is its focus on assessing the quality of university training services, making it more accurate than other models. Researchers have utilized this model to assess various forms of learning, including online learning [45, 46] and the effectiveness of the BL model in higher education [47]. Banahene et al. [46] used the HEdPERF model to assess educational service quality, concentrating on the relationship between student satisfaction, academic performance, and attitudes towards learning. In a study conducted by Panigrahi et al. [47], the BL quality assessment included only four dimensions: technology integration, pedagogy and curriculum, physical infrastructure, and educator proficiency. These studies did not fully cover all five dimensions of the HEdPERF instrument and did not consider nonacademic aspects. In Vietnam, this model is also widely applied to HEIs' training quality assessment [48-50] and to evaluate the quality of learning models [51, 52]. A study conducted by Mai (2023) [7] on BL highlighted the necessity of implementing this model during digital transformation. It also lists various ratios of course content delivered online at several universities, although it does not explain the reasons for these differences. Tu & Phuong (2023) [51] argued that in the context of online learning, factors such as teacher quality, system quality, content quality, and support quality impact student satisfaction, indicating that student satisfaction is primarily related to academic aspects and the quality of the ICT infrastructure.

An overview of studies on service quality, particularly regarding BL as a learning style in higher education, reveals a significant research gap. Very few studies have utilized the HEdPERF tool to assess the quality of BL applications. Furthermore, the approaches taken in these studies have not been thorough, as they do not incorporate all the criteria and dimensions of the HEdPERF instrument.

The HEdPERF model, which is recognized for its exceptional features and advantages, is widely used to evaluate the quality of higher education. Consequently, the research team at the Hanoi University of Science and Technology (HUST) selected this model as the framework for their empirical study on BL currently practiced at HUST. Unlike Abdullah's original model, which includes "Reputation' and "Program Issues", we have substituted these factors with "Material Facilities and ICT Infrastructure" and "Organization of Learning" to better align with the characteristics of BL, which encompasses various aspects related to information and communication technology (ICT). As a result, we propose five hypotheses to analyze the impact of Non-Academic Aspects, Academic Aspects, Material Facilities and ICT Infrastructure, Access, and Organization of Learning on student satisfaction at HUST, specifically concerning the quality of educational services provided through BL:

- *H1: Non-academic aspects have a positive effect on student satisfaction (S).*
- *H2: Academic aspects have a positive effect on student satisfaction.*
- *H3: Material facilities and ICT infrastructure have a positive effect on Student satisfaction.*
- *H4: Access has a positive effect on student satisfaction.*
- *H5: Organization of learning has a positive effect on student satisfaction.*

The conceptual research model is illustrated in Figure 1.

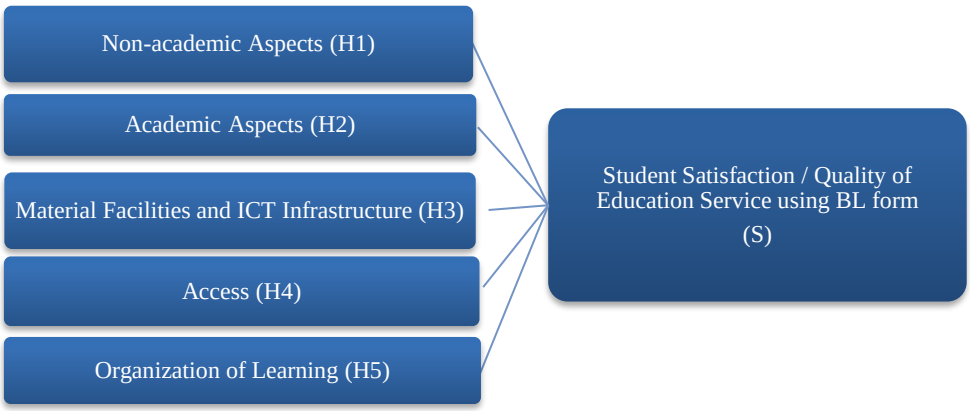

Figure 1. Proposed conceptual research model

It is essential to evaluate the balance between in-person classroom instruction and online learning, considering the specific characteristics of training majors, courses, and students' academic years. Based on a review of students' preferences for face-to-face learning versus online learning, we propose the following hypothesis:

- *H6: The characteristics of training majors, academic courses, and students' academic years influence the blended learning (BL) format.*

We intentionally separated hypothesis H6 due to the complexity of student responses and plan to validate it using qualitative research methods.

To address the abovementioned research gap and confirm the hypotheses, it is essential to explore the following: (i) to adjust and modify the dimensions and components of the HEdPERF tool to fit the specific conditions of the given university; (ii) to identify and objectively evaluate the factors that influence the quality of educational services using the BL model; and (iii) to analyze student feedback on the advantages and disadvantages of the BL format, with the aim of optimizing its implementation based on the characteristics of different learning subjects and training specialties.

The structure of the study is organized as follows: Section 1 provides the research background, reviews previous studies on blended learning (BL), assesses the quality of higher education, identifies the HEdPERF instrument as a suitable model for evaluating BL, and formulates the research hypotheses and objectives. Section 2 outlines the research methodology. Section 3 presents the quantitative data analysis, which includes an overview of the collected sample's characteristics, testing the research model for scale reliability using Cronbach's alpha coefficient, and conducting an in-depth qualitative analysis. Section 4 discusses the findings and offers recommendations for future research. Finally, Section 5 concludes the study. Section 6 presents the references, and the final section contains the appendices.

2- Research Methodology

In this study, considering the unique features of the HEdPERF instrument specifically used to assess the quality of higher education and the direct relationship between BL and modern ICT, the authors chose it to assess the quality of learning in the BL format. This approach involves modifying the original five dimensions (scales) of Abdullah's HEdPERF instrument and renaming them (as shown in Figure 1) to better highlight the factors influencing the learning process when applying the BL model in the context of digital transformation in Vietnamese HEIs.

A qualitative research method was employed in the initial part of the study. This involved systematizing theories, classifying data, utilizing descriptive statistics, and comparing the findings of previous studies for analysis. Through this process, comments were made on the identified research gaps. To align with the research objectives, hypotheses, and models, the Research Team at HUST conducted a survey from March to April 2024. 25 observed variables across five selected dimensions relevant to the HEdPERF tool were identified and coded as detailed in Table 2.

Table 2. Observed variables in the research model

No.	Dimensions and variables	Code
	Non-Academic Aspects (administrative)	
1	Positive attitude of lecturers and assistants in supporting you during the process of studying BL modules	PHT1
2	The attention and understanding of your learning situation from lecturers and assistants during the BL application process	PHT2
3	Timeliness and reasonableness of lecturers and teaching assistants in handling complaints about your learning assessment results during the BL process	PHT3
4	The readiness and timeliness of administrative staff and Information Network Center staff in supporting technical problems you encounter during the BL process	PHT4
	Academic Aspects	
5	Good quality of lecture video and sound	HT1
6	The reasonableness of video lecture duration for learning by student	HT2
7	Completeness and detail, ease of understanding and querying of learning materials (lecture videos, textbooks, slides, quizzes, reference materials, question bank system, etc.)	HT3
8	The standardity of the information of the learning materials you are provided with	HT4
9	Consistency and standardization of knowledge between face-to-face (offline) learning and online learning	HT5
10	The effectiveness of the question system, situations, exercises, and practices in supporting the review of learned knowledge	HT6
	Material Facilities and ICT Infrastructure	
11	The learning management system (LMS) interface is easy to access and use	CSVC1
12	Good physical facilities (lecture halls, teaching equipment, etc.) to serve your learning needs	CSVC2
13	Class size of BL modules is suitable for your learning needs	CSVC3
14	The level of ICT updates and innovations supporting lecturers and students in the learning/teaching	CSVC4
	Access	
15	The ability to flexibly manage your study time helps you save time, balance family work and study.	TC1
16	Your device easily accesses the BL classroom	TC2
17	The design and interface on the LMS are easy to manipulate	TC3
18	You are regularly reminded of your homework schedule on the LMS	TC4
19	Connecting your classroom to your personal account makes it easy to access learning materials	TC5
	Organization of Learning	
20	The compatibility of general and theoretical modules with the BL form	TCHT1
21	The compatibility of practical modules - exercises with the BL form	TCHT2
22	The suitability of the study schedule (arranged according to each semester's study plan) of the courses applying the BL method.	TCHT3
23	The reasonableness of the online/ offline ratio in the arrangement of the BL.	TCHT4
24	Reasonable level of arranging BL modules in A or B semester	TCHT5
25	Learning in AB semesters	TCHT6

The research team developed a questionnaire consisting of 25 questions, which were structured according to five dimensions of the research model based on the HEdPERF instrument. Additionally, we added two groups of eight questions to the questionnaire that focused on assessing student satisfaction using the BL format. The areas covered in the two groups of the questionnaire were as follows:

- Student satisfaction with the current BL format applied at HUST and its effect on learning progress;
- Quality of digital learning resources, including lectures, audio materials, and images;
- The impact of Bl on learning design and planning, as well as its convenience and personalization for students;
- Reliability and quality of supporting technology, such as computer systems, servers, and transmissions. This includes interactive tools, such as chat boxes and comment sections for discussions with lecturers and peers;
- Students' interactions with lecturers, classmates, and other individuals are involved in the learning process.

These questions were designed to explore student satisfaction while aligning with the five dimensions outlined in the research model. All questions utilized a 5-point Likert scale, ranging from "strongly disagree" (1) to "strongly agree" (5) (see Appendix I, Table A1). To gain a quick overview of students' preferences for this learning model, the brief question "Do you like blended learning, and why?" was posed to 180 students during the face-to-face interviews.

Our survey involved a diverse population of students, ranging from their first to fifth year of study, across various HUST training majors. Both the Microsoft Forms online survey tool and direct interviews were used to capture a rich set of data. Of 1,058 students who participated, 662 valid responses were obtained. In addition, 180 students engaged in face-to-face interviews with specialized questions that allowed them to explore their insights more deeply. This thorough approach ensures that our findings are both credible and impactful.

To quantify the impact of the factors, we also utilized quantitative research methods, including descriptive statistics, correlation analysis, regression, post-regression testing, and research model testing, which confirmed hypotheses H1 to H5, as well as hypothesis H6, along with qualitative methods, based on survey results.

The research stages were conducted sequentially, following the flowchart (Figure 2).

The first stage (Introduction) provides a background and overview of the literature related to BL, focusing on assessment tools commonly used in assessing quality in HEIs. It analyzes various research models and identifies existing gaps in the literature as well as outlines the objectives of the study and the development of hypotheses. The second stage describes the research design and methods used, presenting the initial steps of sample collection. The third stage assessed the reliability of the factors (dimensions) using Cronbach's alpha coefficient, explored correlation coefficients, and conducted exploratory factor analysis and multiple regression analysis. Additionally, an in-depth qualitative analysis was performed to investigate other factors that influence BL quality. The goal of this analysis was to clarify the advantages and disadvantages of the BL approach used at HUST. This evaluation serves as a foundation for the discussion and formulation of recommendations in the fourth stage. Finally, the fifth stage (Conclusion) summarizes the objectives, methods, results, and limitations of the research and highlights the novelty of the study, particularly in showcasing the HEdPERF tool as an effective framework for evaluating the quality of higher education services in general, and applied learning models in HEIs, particularly due to its specialized characteristics.

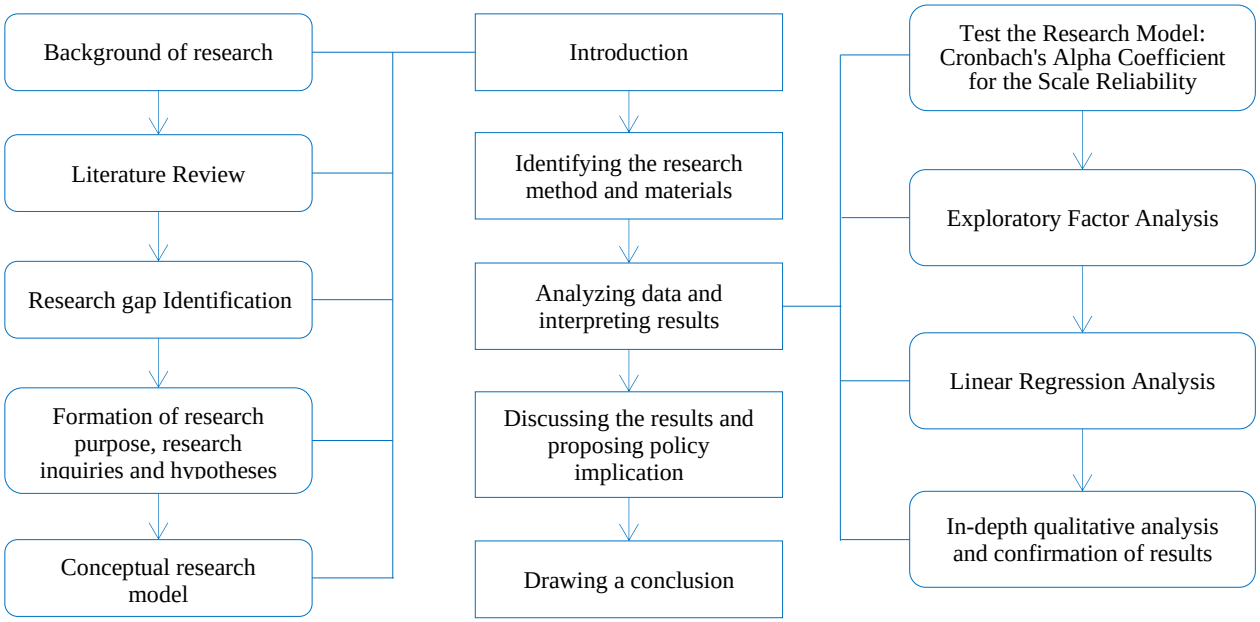

Figure 2. Flowchart of the research methodology illustrated by the authors

3- Results

3-1- Characteristics of the Samples

Survey sample analyses by study year and training fields are presented in Figures 3 and 4, respectively.

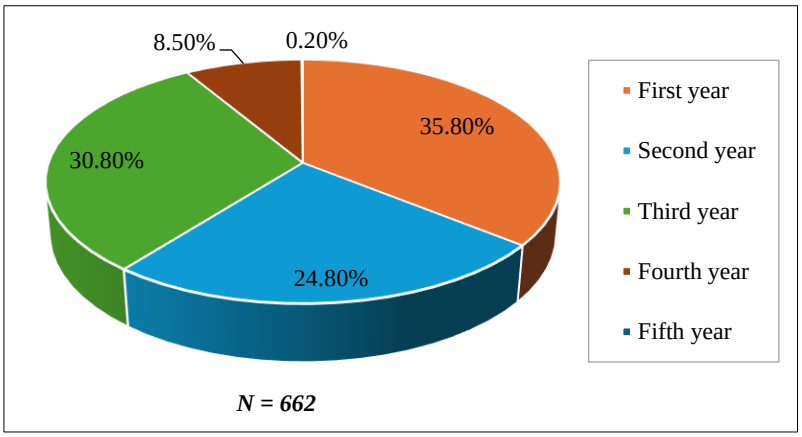

Figure 3. Proportion of respondents by years of study within the survey samples

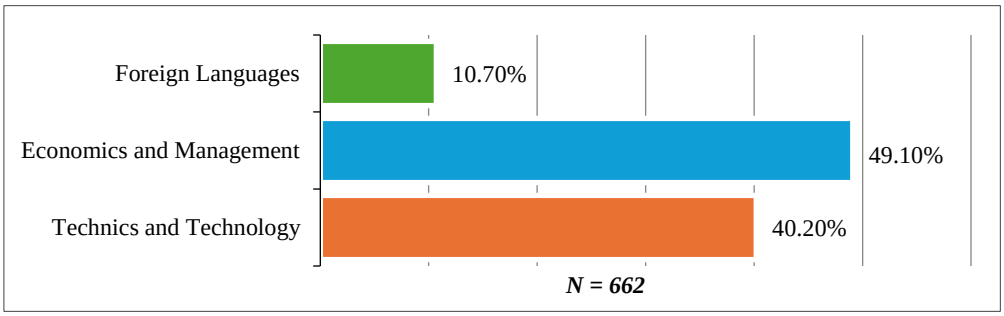

Figure 4. Proportion of the survey sample by training majors

The students' interest in BL varied significantly, as reflected in their participation in the survey. Most respondents were in their first year (238 students), second year (163 students), or third year (204 students), representing 35.8%, 24.8%, and 30.8% of the total, respectively. Regarding their fields of study, the majority of respondents were enrolled in faculties of foreign languages and economics, accounting for 50.8%, while those studying technology and engineering accounted for 40.2%. The survey results on student satisfaction with BL training quality are summarized in Tables 3 and 4.

Table 3. Summary of survey sample results (number/%) by variables and items

Non-Academic Aspects (administrative)						
Variables	**Strongly disagree**	**Disagree**	**Neither agree or disagree**	**Agree**	**Strongly agree**	**Total**
Non-Academic Aspects (administrative)						
PHT1	23/3.47%	28/4.23%	150/22.66%	254/38.37%	207/31.27%	662/100%
PHT2	11/ 1.66%	55/8.31%	169/25.53%	272/41.09%	155/23.41%	662/100%
PHT3	16/ 2.42%	42/6.34%	170/25.52%	275/41.54%	159/24.02%	662/100%
PHT4	22/ 3.32%	40/6.04%	175/26.44%	275/41.54%	150/22.66%	662/100%
Average (%)	2.72%	6.23%	25.04%	40.64%	25.34%	662/100%
Academic Aspects						
HT1	27/ 4.08%	50/7.55%	181/ 27.34%	273/ 41.24%	131/19.79%	662/100%
HT2	14/ 2.11&	53/8.00%	161/ 24.32%	289/ 43.66%	145/21.90%	662/100%
HT3	19/ 2.87%	49/ 7.40%	169/ 25.53%	261/ 39.43%	164/24.77%	662/100%
HT4	9/ 1.36%	22/3.32%	122/ 18.43%	297/ 44.86%	212/32.02%	662/100%
HT5	14/ 2.11%	41/ 6.19%	155/ 23.41%	268/ 40.48%	184/27.81%	662/100%
HT6	17/ 2.11%	49/ 7.70%	175/ 26.43%	273/ 41.24%	148/22.36%	662/100%
Average (%)	2.44%	6.69%	24.33%	41.82%	24.78%	662/100%

Material Facility – ICT infrastructure						
CSVC1	28/4.23%	32/4.84%	153/23.11%	269/40.63%	180/27.19%	662/100%
CSVC2	10/1.51%	39/5.89%	167/24.32%	278/42.00%	168/25.38%	662/100%
CSVC3	19/2.87%	34/5.13%	171/25.83%	272/41.09%	166/25.07%	662100%
CSVC4	15/2.27%	45/6.80%	192/29.00%	268/40.48%	142/21.45%	662100%
Average (%)	2.72%	5.67%	25.57%	41.05%	24.77%	662/100%
Access						
TC1	32/4.83%	59/8.91%	195/29.46%	210/31.72%	166/25.08%	662/100%
TC2	14/2.11%	29/4.38%	160/24.17%	253/38.22%	206/31.11%	662/100%
TC3	15/2.27%	34/5.14%	171/25.83%	262/39.58%	180/27.19%	662/100%
TC4	15/2.27%	30/4.53%	159/24.02%	25137.92%	207/31.23%	662/100%
TC5	15/2.27%	29/4.38%	173/26.13%	271/40.94%	174/26.28%	662/100%
Average (%)	2.75%	5.56%	25.91%	37.67%	28.17%	662/100%
Organization of Learning						
TCHT1	37/5.59%	52/7.85%	185/27.95	254/38.37	134/20.24%	662/100%
TCHT2	36/5.44%	66/9.97%	202/30.51	240/36.25	118/17.82%	662/100%
TCHT3	18/2.72%	45/6.70%	179/27.04	276/41.69	144/27.75%	662/100%
TCHT4	21/3.17%	41/6.19%	178/26.89	269/40.63	153/23.11%	662/100%
TCHT5	25/7.76%	44/6.65%	197/29.76%	256/38.67%	140/21.15%	662/100%
TCHT6	16/2.42%	38/5.74%	184/27.79%	267/40.33%	157/20.10%	662/100%
Average (%)	4.52%	7.18%	28.32%	39.41%	21.16%	662/100%

Table 4. Students' satisfaction with the quality of training in the BL format

Dimensions	Code	Items observed	5-point Likert scale	Average score	Max. of item average score	Min. of item average score	Item with Min average score
None – academic aspects	PHT	4	5	3.79	3.9	3.74	PHT4
Academic aspects	HT	6	5	3.8	4.03	3.65	HT1
Material facility	CSVC	4	5	3.83	3.91	3.63	CSVC4
Access	KNTC	5	5	3.83	3.91	3.63	TC1
Organization of learning	TCHT	6	5	3.67	3.77	3.51	TC1
$\sum = 5$		$\sum = 25$					

The preliminary analysis of the survey results served as a basis for further in-depth assessment.

3-1-1- Test the Research Model through Cronbach's Alpha Coefficient for the Scale Reliability

All items listed in Table 5 had Cronbach's alpha coefficients exceeding 0.8. This indicates that the items and scales were considered valid. A dimension is deemed valid if it has a Cronbach's alpha reliability of 0.7 or higher.

Table 5. Summary of Cronbach's Alpha coefficient

	Cronbach's alpha	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item – Total Correlation	Cronbach's Alpha if Item Deleted
	Non-Academic Aspects		**0.896**		
1	PHT1	11.29	6.702	0.751	0.872
2	PHT2	11.42	6.744	0.790	0.875
3	PHT3	11.40	6.622	0.826	0.844
4	PHT4	11.44	6.976	0.710	0.887

	Academic Aspects			**0.897**	
5	HT1	19.13	15.808	0.651	0.890
6	HT2	19.03	15.447	0.758	0.873
7	HT3	19.02	15.099	0.766	0.872
8	HT4	18.75	16.347	0.702	0.882
9	HT5	18.92	15.510	0.738	0.876
10	HT6	19.05	15.573	0.721	0.879
	Material Facilities and ICT Infrastructure			**0.885**	
11	CSVC1	11.36	6.407	0.707	0.870
12	CSVC2	11.34	6.622	0.766	0.847
13	CSVC3	11.38	6.383	0.776	0.842
14	CSVC4	11.46	6.551	0.752	0.851
	Access			**0.904**	
15	TC1	15.52	11.406	0.662	0.908
16	TC2	15.24	11.267	0.832	0.868
17	TC3	15.31	11.588	0.769	0.881
18	TC4	15.24	11.100	0.853	0.863
19	TC5	15.31	12.044	0.705	0.894
	Organization of Learning			**0.932**	
20	TCHT1	18.42	18.774	0.798	0.920
21	TCHT2	18.51	18.895	0.785	0.922
22	TCHT3	18.29	19.272	0.836	0.915
23	TCHT4	18.28	19.172	0.830	0.916
24	TCHT5	18.35	19.370	0.784	0.922
25	TCHT6	18.25	19.800	0.775	0.923

Accordingly, a dimension is considered valid when the observed variables yield a Corrected Item-Total Correlation coefficient of 0.3 or higher [53]. In this instance, all 25 observed variables had a Corrected Item-Total Correlation coefficient ranging from 0.65 0.83. This indicates that each observed variable has a strong positive correlation with the other variables within the dimensions.

3-1-2- Exploratory Factor Analysis

The Kaiser-Meyer Olkin Measure (KMO) coefficient = 0.950, which satisfies the condition $0.5 < 0.950 < 1$, indicating that factor analysis is acceptable.

Table 6. KMO coefficient

Kaiser-Meyer Olkin Measure of Sampling Adequacy		0.950
Bartlett's Test of Sphericity	**Approx. Chi-Square**	13765,466
	df	300
	Sig.	0.000

Bartlett's test showed statistical significance with a Sig. value of 0.00 (Table 6), which is less than 0.05. This confirms that the observed variables are correlated with one another overall.

The results of the rotation matrix presented in Table 7 indicate that the 25 observed variables can be grouped into four categories. All observed variables had factor-loading coefficients greater than 0.5, and no problematic variables were identified. Therefore, all eligible variables will continue to be analyzed for correlation.

Table 7. Results of rotated component matrix

	Component			
	1	2	3	4
PHT1				0.739
PHT2				0.788
PHT3				0.821
PHT4				0.771
HT1			0.646	
HT2			0.741	
HT3			0.751	
HT4			0.720	
HT5			0.712	
HT6			0.660	
CSVC1	0.709			
CSVC2	0.660			
CSVC3	0.568			
CSVC4	0.569			
TC1	0.540			
TC2	0.834			
TC3	0.774			
TC4	0.842			
TC5	0.637			
TCHT1		0.770		
TCHT2		0.771		
TCHT3		0.784		
TCHT4		0.788		
TCHT5		0.763		
TCHT6		0.725		

As a result, only four dimensions or factors remained, which included the original categories: Non-academic (H1), Academic Aspects (H2), and Learning Organization (H5).

The two original groups of factors, Material Facilities and ICT Infrastructure (H3) and Access (H4), were combined and analyzed together using a calculation program automatically for optimal results. There are several reasons for using this approach. First, the use of a 5-point Likert scale, which is convenient for respondents, has limitations in distinguishing the levels on the scale. This can lead to situations in which some responses are evaluated similarly, which may explain the correlation between the two factors. Secondly, in terms of BL, the dimensions of Facility and Infrastructure (H3) and Access (H4) are related to the online learning management system (LMS). This connection, combined with the limitations of the 5-point Likert scale, may result in similar assessments of these two factors by some students, further contributing to their correlation. Third, the analysis of eigenvalues showed that four items or scales were appropriate (with an eigenvalue of 1.276). The total variance explained by these four factors was 70.122%, which exceeded the 50% threshold, thus meeting the requirements outlined in Table 8. Therefore, these four factors accounted for 70.122% of the data variation among the 25 observed variables in the exploratory factor analysis (EFA).

Continuously, the analysis of eigenvalues shows that there are four items/scales appropriate (eigenvalue is 1.276). The total variance explained by these four factors was 70.122% > 50%, meeting the requirements (Table 8). Thus, these four factors explain 70.122% of the data variation in the 25 observed variables participating in exploratory factor analysis (EFA).

Table 8. Eigenvalue and total variance explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	**Total**	**% of Variance**	**Cumulative, %**	**Total**	**% of Variance**	**Cumulative, %**	**Total**	**% of Variance**	**Cumulative, %**
1	12.713	50.850	50.850	12.713	50.850	50.850	5.262	21.049	21.049
2	1.886	7.544	58.394	1.886	7.544	58.394	4.864	19.456	40.505
3	1.656	6.624	65.018	1.656	6.624	65.018	4.026	16.106	56.611
4	**1.276**	**5.103**	**70.122**	**1.276**	**5.103**	**70.122**	**3.378**	**13.511**	**70.122**
5	0.892	3.569	73.691						
6	0.697	2.788	76.479						
7	0.859	2.355	78.834						
8	0.485	1.940	80.774						
9	0.474	1.895	82.669						
10	0.436	1.744	84.413						
11	0.405	1.618	86.031						
12	0.358	1.432	87.463						
13	0.356	1.422	88.886						
14	0.321	1.282	90.168						
15	0.313	1.251	91.420						
16	0.287	1.146	92.566						
17	0.281	1.125	93.691						
18	0.262	1.047	94.738						
19	0.251	1.005	95.743						
20	0.234	0.934	96.677						
21	0.219	0.876	97.554						
22	0.204	0.815	98.369						
23	0.194	0.774	99.143						
24	0.177	0.709	99.852						
25	0.037	0.148	100.000						

After re-running the data to calculate Cronbach's alpha coefficient for the dataset with four dimensions, which were combined from H3 and H4 as mentioned earlier, the results are presented in Table 9.

Table 9. Summary of Cronbach's Alpha coefficient after combining the two scales of ICT Infrastructure and Access

Observed variables	Cronbach's Alpha
None – Academic Aspects	**0.896**
PHT1	0.872
PHT2	0.875
PHT3	0.844
PHT4	0.887
Academic Aspects	**0.897**
HT1	0.890
HT2	0.873
HT3	0.872
HT4	0.882
HT5	0.876
HT6	0.879

Material Facilities, ICT Infrastructure and Access	**0.931**
CSVC1	0.925
CSVC2	0.925
CSVC3	0.924
CSVC4	0.923
TC1	0.928
TC2	0.920
TC3	0.921
TC4	0.920
TC5	0.923
Organization of learning	**0.932**
TCHT1	0.920
TCHT2	0.922
TCHT3	0.915
TCHT4	0.916
TCHT5	0.922
TCHT6	0.923

The data presented in Table 9 indicate that all items retained the same Cronbach's alpha coefficient as the original, with all values exceeding 0.8. Additionally, the new factor, which combines two original dimensions (Material Facilities, ICT Infrastructure and Access), had a higher Cronbach's alpha coefficient. This suggests that the combination is reasonable and enhances the reliability of factors. Consequently, this correlation creates a complex factor that integrates Material Facilities and ICT Infrastructure with Access.

3-1-3- Linear Regression Analysis

To test the appropriateness of the regression model, the research team hypothesized that H0: R Square (R^2) = 0. An F-test was used to test this hypothesis, and the results are presented in Table 10.

Table 10. ANOVA[a] test results

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	345,610	4	86,402	241,560	0.000 [b]
	Residual	234,999	657	0.358		
	Total	580,609	661			

[a] Dependent Variable: HL.

[b] Predictors (constant): PHT, HT, TCHT, CSVC + TC.

The value of Sig < 0.05 allows H0 to be rejected, meaning that $R^2 \neq 0$ is statistically significant, and at the same time, the F-test with sig. value of 0.000 < 0.05. Therefore, the regression model was appropriate.

In a regression model, the R Square (R^2) and adjusted R-square values reflect the extent to which the independent variables explain the dependent variable. According to the currently accepted standard, the Durbin-Watson value (Table 11) is 0.595, which is in the range of 1.5-2.5, there will be no autocorrelation and first-order serial autocorrelation. The result of the adjusted R Square coefficient is 0.595, meaning that 59.5% of the variation in the dependent variable of service quality is explained by the four independent variables. This shows that this linear regression model fits the sample dataset at the level of 59.5%, or the independent variables explain 59.5% of the variation in the dependent variables.

Table 11. Rotation matrix results

Model	R	R square	Adjusted R Square	Std. Error of the Estimate	Durbin Watson
1	0.772 [a]	0.595	0.593	0.59807	1.883

The Sig. values of all independent variables presented in Table 12 are less than 0.05, so all independent variables have a meaningful explanation for the dependent variables, and no variable is eliminated from the model. Furthermore, when the standardized regression coefficient beta of a variable is the largest, it has the greatest impact on the change in the dependent variable. The regression coefficients had absolute values greater than 0.

Table 12. Regression results and confirmation of hypotheses H1-H5

Model 1	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	Confirmation
	B	Std. Error	Beta			Tolerance	
(Constant)	3.680	0.023		158,306	0.000		
HT	0.266	0.023	0.283	11.421	0.000	1.000	H1 has a positive impact on student satisfaction
PHT	0.391	0.023	0.417	16.806	0.000	1.000	H2 has a positive impact on student satisfaction
CSVC + TC	0.414	0.023	0.441	17.778	0.000	1.000	H3 + H4 have a positive impact on student satisfaction
TCHT	0.358	0.023	0.382	15.405	0.000	1.000	H5 has a positive impact on student satisfaction

The results of the quantitative analysis presented in Table 12 show that no multicollinearity was detected, and the dependent variables related to HUST students' satisfaction with the quality of training using the BL model were influenced by several factors: Non-Academic Aspects, Academic Aspects, Facilities and Technology, and Access and Organization of Learning. The significance value (Sig.) of less than 0.05, and the coefficient for the Academic Aspect scale (HT) is 0.266, meaning that a 1-point increase in evaluation results in a 0.266-point increase in satisfaction with the quality of training services provided by HUST. This indicates that academic factors positively influence student satisfaction, supporting Hypothesis H1. Similarly, the Sig. value of less than 0.05, and the coefficient for the Non-Academic Aspect scale (PHT) was 0.391, confirming that non-academic factors positively impact student satisfaction, thus confirming Hypothesis 2. Furthermore, Hypotheses H3+ H4 (CSVT+TC), and H5 (TCHT) are also confirmed, demonstrating a similar positive effect on student satisfaction regarding the quality of training at HUST when utilizing the BL model (see Table 12).

Thus, all the independent variables included in the regression analysis have an impact on the dependent variable. Consequently, we obtained the standardized regression equation for student satisfaction (S) or training quality when adopting the BL model as follows:

$$S = 0.441*(CSVC+TC) + 0.382*TCHT + 0.283*HT + 0.417*PHT \quad (1)$$

Based on the aforementioned results, the factors affecting the satisfaction of HUST students are shown in Figure 5.

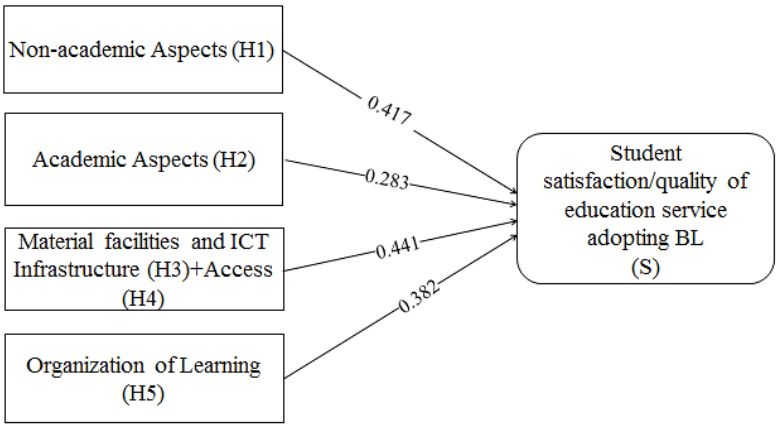

Figure 5. Groups of factors affecting student satisfaction after quantitative analysis

3-2- In-depth qualitative analysis

To evaluate student satisfaction with learning in the BL model, the authors used qualitative methods to analyze various hypotheses (H1-H5 and H6) that impact the quality of learning in this format. This analysis is based on the results presented in Table 3. The findings were as follows:

1) Further evidence for the confirmation of hypotheses H1-H5

- Non-academic factors, such as the attitudes and activities of the teaching staff, ICT specialists, and administrative personnel, are highly valued by respondents. The satisfaction rate for these factors, combined responses of "strongly agree" and "agree" was 65.98%. This is nearly 7.4 times higher than the dissatisfaction rate of 8.95%, which includes "disagree" and "strongly disagree." Most respondents expressed a positive view of lecturers' support of student learning. However, some students reported dissatisfaction with the technical assistance they provided. They noted that they did not receive timely support to address technical issues with the Learning Management System (LMS) during their studies.

- Regarding academic factors, 66.60% of the respondents expressed satisfaction with video lectures and learning materials, which was significantly higher than the 9.13% who were dissatisfied. Dissatisfied respondents primarily complained about the audio and visual quality of the videos, finding them boring and less engaging, which led some students to prefer studying the slides over the video content.
- In terms of Material Facilities, ICT Infrastructure, and Access, the survey results indicated that an average of 65.82% of respondents were satisfied with the lecture hall equipment and ICT infrastructure. This satisfaction rate is significantly higher than the 8.39% who expressed dissatisfaction, citing issues such as poor quality of the transmission line, slow responses from the technical support team, and a lack of regular updates on the LMS (Learning Management System) platform. Regarding accessibility, 65.84% of respondents reported being satisfied with their ability to access the Internet and the digital learning materials available in the digital library. However, 7.41% remained dissatisfied with the LMS platform interface, noting that it lacked several useful features, such as dialog boxes and keyword search options for finding learning materials.
- The average satisfaction rate among respondents regarding the learning organization factor was 60.57%, which was significantly higher than the 11.70% dissatisfaction rate. Dissatisfaction mainly centers on the compatibility of theoretical models, practical exercises, and the organization of BL modules across semesters, with rates of 13.44%, 15.41%, and 14.41%, respectively. Respondents emphasized that for core specialities at HUST, in-person learning should constitute at least 50% of the course duration, as these subjects are crucial for developing specialized careers.

The above findings indicate that most students favor using the BL model in their educational experiences. However, they have expressed concerns about the quality of the digital lecture content, the university's ICT support, and the software interface, which they feel does not adequately meet the requirements for effective online learning. Thus, the above results further confirm hypotheses H1-H5, which were confirmed in Subsection 3.1.

2) The effect of student attitudes on the blended learning format varies by training sector, course, and year of study

It is important to note that, on average, 25.83% of respondents expressed hesitation by neither agreeing nor disagreeing with the statements. At HUST, a university focused on science and engineering, students from economics and foreign language faculties often shared negative opinions. Notably, 252 respondents (63.6%) from these faculties reported disliking online learning, believing that they could better resolve issues with instructors in a face-to-face setting. By contrast, 196 respondents (73.7%) from the faculties of engineering and technology supported online learning. By year of study, a high percentage of satisfied and strongly satisfied students in the BL model was primarily observed among first-to third-year students.

The percentages shown in Table 13 indicate that students' satisfaction with the BL model decreases with the academic year: the percentage of strongly satisfied and somewhat satisfied students in the first and second academic years is 58% and 62.33%, respectively, while this preference drops to only 41% and 37.1% among their third- and fourth-year counterparts. The percentage of fifth-year students was negligible. This may be because students studying in the 5-year training program (engineering) accounted for a small proportion, and they were less interested in participating in the survey, as they were on practical courses and completing their graduation thesis. These findings provide a foundation for proposing measures to enhance the factors influencing the adoption and balance of BL in HEIs, taking into consideration the specific characteristics of each training field.

Table 13. Satisfaction rate with BL model

Satisfied					Strongly satisfied					+
1-year of study	2-year of study	3-year of study	4-year of study	5-year of study	1-year of study	2-year of study	3-year of study	4-year of study	1-year of study	
94	72	72	27	1	45	41	46	14	-	
35.33%	27.0%	27.0%	10.1%	0,003%	30.8%	28%	31.5%	9.5%	-	
266 (100%)					146 (100%)					412/662 (100%)

Furthermore, when addressing the question regarding "The appropriate Level of balancing BL Modules in Semester A or Semester B" (TCHT5), 59.82% of respondents believe it is suitable, while 14.41% feel it is not appropriate. Correspondingly, for the question "The appropriateness of arranging BL courses in Semesters A and B" (TCHT6), 60.43% considered it suitable, whereas only 8.16% thought it was not suitable (see Table 3). Therefore, it is important to consider these differences in interest in the BL format.

Consequently, Hypothesis H6, "Characteristics of training majors, academic courses, and students' academic years affect the BL format", is confirmed.

4- Discussion

In this study, to, as well as the overall quality of higher education, the authors have considered the following points: (i) identifying specific research objectives that focus on quality assessment through student satisfaction and (ii) selecting and customizing dimensions to align with the unique characteristics of the university type, specialties, and training field. This new approach uses the HEdPERF tool to assess learning quality in the BL format. The authors modified some of the original five dimensions of Abdullah's HEdPERF tool, giving them new names that better reflect the relationship between BL and the advancement of digital devices. This aligns with the trend of applying measurement tools to the digital age [54]. Additionally, it is similar to the studies conducted by Banahene et al. (2018) [46], Panigrahi et al. (2024) [47], Việt (2017) [48], and Quang & Danh (2020) [49], who adapted the HEdPERF model to evaluate educational service quality in higher education by modifying its dimensions to meet their research objectives.

The findings shown in Subsection 3.1 confirmed that the factors, including Non-Academic Aspects, Academic Aspects, Material Facilities, ICT Infrastructure, Access, and the Organization of Learning, significantly influence training quality/student satisfaction with the BL format at HUST, confirming the previously stated hypotheses 1–5. These results align with both theoretical and empirical findings from previous research conducted by Abdullah (2005, 2006) [33, 38], Bartolo & Tinmaz (2024) [43], and Silva et al. (2017) [42].

The results of an in-depth qualitative analysis indicated that BL met the needs of students from various training majors, with an average satisfaction rate of 64.74%. This was significantly higher than 25.83% of students who expressed dissatisfaction. Notably, students from the Faculty of Economics and Foreign Languages reported a dissatisfaction rate of 63.6% with online learning. This preference is likely due to the nature of their training fields, which require more direct interaction in the classroom setting. Conversely, students studying technology, engineering, and mechanics favored online learning, with 83.7% supporting this mode of education. These findings are similar to those of previous studies conducted by Cheng et al. (2023) [13], Thapa et al. (2023) [14], and Hassan et al. (2024) [15], which noted that students from different disciplines have varying preferences for the BL format.

In the case of HUST, respondents expressed concerns about online learning for several reasons.

- As a multidisciplinary university specializing in engineering and science, students require ample time for in-person classroom learning and practical sessions in university laboratories, industrial facilities, and research institutes.
- In the initial years of study, students gained significant benefits from face-to-face classroom learning to address the various challenges that arise in the learning process.
- The quality of online learning resources, such as video lectures and slides, often lacks detail and fails to meet the educational requirements. Additionally, strict regulations limit access to universities'' digital libraries and other databases.
- There is a lack of Learning Management System (LMS) applications for smartphones, which hinders students from receiving instant notifications. Furthermore, the server has not been upgraded over time.

The benefits of the BL model have been proven in practice at universities both in Vietnam and abroad. The application of this model to teaching and learning is an inevitable trend in the digital age. To enhance the factors influencing student satisfaction and effectively meet their needs and expectations, the following solutions should be implemented.

- Enhancing the professionalism of university administrative staff; simplifying processes related to non-academic factors such as administrative procedures.
- Improving digital skills of lecturers and students. IT technical support teams should collaborate with instructors to develop ideas, produce video lectures, and postprocess these videos to ensure that learners can easily understand the content.
- Since the quality of learning resources significantly impacts the effectiveness of the learning process, it is crucial to focus on the production process and quality of digital lecture content and learning resources (e.g., lectures, textbooks, research works). Learning materials should be digitized and designed to include questions, exercises, reference materials, and online games to engage learners and promote interaction.
- Regularly maintain and upgrade computer systems, servers, and networks to provide a stable and advanced ICT infrastructure. This will ensure effective online learning and convenient access to learning materials for the students. Additionally, professional and accessible technical support and ICT services should be provided to help students and lecturers resolve their technical issues. Access to the university's digital library, along with other libraries and databases from higher education institutions and state agencies, should be streamlined, especially the databases with which HUST's digital library collaborates.
- Focusing on developing training courses and programs, designing each subject to suit learners' needs while considering the characteristics of each training field, gathering feedback from learners after completing courses is essential to adjust course design and enhance its alignment with learners' needs to ensure better quality.
- Modifying the balance between traditional in-person classroom learning and online learning for students in various faculties and academic years based on feedback from learners and their individual learning preferences.

5- Conclusion

Blended learning is an innovative educational approach that combines the strengths of traditional classroom instruction and online learning. This method offers initiative, flexibility, and efficiency in the learning process, while fostering personalized learning for students in the digital age.

The unique contribution of this study is the introduction of a new approach that employs the HEdPERF instrument to evaluate the quality of university BL environments. This approach identifies key factors, including non-academic aspects, academic aspects, material facilities and ICT infrastructure, Access and Organization of Learning, and feedback from students across various fields of study and academic years at HUST, that positively influence learning quality by assessing student satisfaction.

The proposed solutions consider the unique characteristics of different training areas at universities, aiming to enhance the HEdPERF tool for measuring the quality of services provided by universities, and (ii) while highlighting its benefits by balancing traditional classroom instruction with online learning to improve educational services and student satisfaction. The findings of this study can also be applied to evaluate other learning models and higher education services.

The limitation of this study is that the survey was only conducted at HUST, Vietnam, and the small sample size and unevenness of sample size by academic year and training sector may affect representativeness. In the future, the research team plans to conduct similar studies, expanding to student groups from other universities in Vietnam and abroad. This will contribute to continuously improving the quality of training in the BL format and changing students' attitudes towards BL in the context of digital transformation and the establishment of digital universities.

6- Declarations

6-1- Author Contributions

Conceptualization, D.T.B. and N.T.T.B.; methodology, G.B. and N.T.T.B.; software, L.T.S.; validation, T.T.T. and N.T.T.B.; formal analysis, N.H.L.; investigation, N.H.L. and D.T.B.; resources, N.T.T.B.; data curation, T.T.T.; writing—original draft preparation, L.T.S., N.H.L., and G.B.; writing—review and editing, D.T.B., N.T.T.B., and L.T.S.; visualization, L.M.S.; supervision, N.T.T.B.; project administration, D.T.B. All authors have read and agreed to the published version of the manuscript.

6-2- Data Availability Statement

The data presented in this study are available in the article.

6-3- Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

6-4- Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki. Under the guidelines of Helsinki, human rights have been preserved and participants' safety was considered as a priority for sharing information. During the research, the study made sure to maintain the confidentiality of the respondents, and the results were generated and presented based on demographic and psychographic factors rather than the identity revelation of the respondents. The respondents were not forced to share any personal information.

6-5- Informed Consent Statement

Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin. No potentially identifiable human images or data is presented in this study.

6-6- Conflicts of Interest

The authors declare that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

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Appendix I

Table A1. Survey Questionnaire

Survey on factors affecting the quality of training in the form of Blended - Learning at Hanoi University of Science and Technology							
Hello everyone! The Blended Learning training form has been implemented at Hanoi University of Science and Technology. It brings many benefits to both lecturers and students. With the aim of in-depth research and recommendations to improve the quality of training with the application of this learning form, our research group from the Institute of Economics and Management conducted a "Survey on factors affecting the quality of training in the form of Blended - Learning at Hanoi University of Science and Technology". The results of this survey are only for our research topic and are not used for any other purpose. We are committed to the confidentiality of the information you provide. Your honest and objective opinions are valuable information to help us complete this research. We sincerely thank you for taking the time to help us complete the survey.							
1	**Full Name:**						
2	**Student ID**						
3	**Which major are you a student of (Faculty, training major)?**						
	Engineering and Technology						
	Economics and Management						
	Foreign Languages						
4	**How many credits have you taken in Blended – Learning format?**						
	The following questions were designed by the research team according to the 5-point Likert scale consisting of: (1) Strongly Disagree; (2) Disagree; (3) Neither Agree nor Disagree; (4) Agree; (5) Strongly Agree.						
HEdPERF	***1. Non-Academic - Administrative aspect (you will rate that statement on a scale of 1 to 5 with: Level 1: Strongly disagree; Level 2: Disagree; Level 3: Neutral; Level 4: Agree; Level 5: Strongly agree)***						
	1.1	The instructors' attitude is positive in supporting you during the courses using Blended Learning format.	1	2	3	4	5
	1.2	Lecturers and assistants are interested in your learning situation during teaching process using the Blended Learning.	1	2	3	4	5
	1.3	Lecturers and teaching assistants promptly resolve complaints about learning assessment results during the Blended - Learning process	1	2	3	4	5
	1.4	Administrative staff and the Information Network Center are ready to answer students' requests for technical support during the Blended Learning process.	1	2	3	4	5
	2. Academic aspect (you will rate that statement on a scale of 1 to 5 with: Level 1: Strongly disagree; Level 2: Disagree; Level 3: Neutral; Level 4: Agree; Level 5: Strongly agree)						
	2.1	Good quality audio, video and lecture images.	1	2	3	4	5
	2.2	Video lecture duration is appropriate for students' learning.	1	2	3	4	5
	2.3	Learning materials (lecture videos, textbooks, slides, quizzes, reference materials, question bank system, etc.) are complete and detailed, easy to understand and easy to query	1	2	3	4	5
	2.4	The information in the course materials you are provided with is of standard nature	1	2	3	4	5
	2.5	The consistency of knowledge between offline and online learning is standardized	1	2	3	4	5
	2.6	The training and practice system supports effective review of learned knowledge	1	2	3	4	5
	3. ICT infrastructure and facilities (you will rate that statement on a scale of 1 to 5 with: Level 1: Strongly disagree; Level 2: Disagree; Level 3: Neutral; Level 4: Agree; Level 5: Strongly agree)						
	3.1	The learning management system (LMS) interface is easy to use and access	1	2	3	4	5
	3.2	Physical facilities (lecture halls, teaching equipment, etc.) serve your learning needs well	1	2	3	4	5
	3.3	The size of the courses using Blended Learning is suitable for your learning needs	1	2	3	4	5
	3.4	Hanoi University of Science and Technology regularly applies information technology to support lecturers and students in the learning and teaching process	1	2	3	4	5
	4. Access (you will rate that statement on a scale of 1 to 5 with: Level 1: Strongly disagree; Level 2: Disagree; Level 3: Neutral; Level 4: Agree; Level 5: Strongly agree)						
	4.1	Managing your study time flexibly helps you save time and balance work, family and study	1	2	3	4	5
	4.2	Your digital device easily accesses the Blended Learning classroom	1	2	3	4	5
	4.3	The structure and interface on LMS are easy to manipulate during use.	1	2	3	4	5
	4.4	You are regularly reminded of your assignment schedule on the LMS	1	2	3	4	5
	4.5	Connecting your classroom to your personal account makes it easy to access learning materials	1	2	3	4	5

5. Organisation of Learning (you will rate that statement on a scale of 1 to 5 with: Level 1: Strongly disagree; Level 2: Disagree; Level 3: Neutral; Level 4: Agree; Level 5: Strongly agree)						
5.1	General and theoretical courses are suitable for Blended - Learning format	1	2	3	4	5
5.2	Course modules Practices- exercises suitable for Blended Learning format	1	2	3	4	5
5.3	The courses applying the Blended-Learning format have been arranged appropriately in the study schedule (arranged according to the study plan for each semester)	1	2	3	4	5
5.4	The online - offline ratio in the arrangement of courses in the Blended Learning form is reasonable	1	2	3	4	5
5.5	The appropriate level of balancing Blended Learning modules into either Semester A or Semester B	1	2	3	4	5
5.6	The appropriateness of arranging Blended Learning courses in AB semester	1	2	3	4	5
6. Student Satisfaction (These questions are some of the comments and opinions that the research team has collected. You will rate that comment on a scale from 1 to 5: Level 1: Completely dissatisfied Level 2: Dissatisfied; Level 3: Neutral; Level 4: Satisfied; Level 5: Completely satisfied)						
6.1	You are satisfied with the Blended Learning format currently applying in HUST	1	2	3	4	5
6.2	You are satisfied with your progress in learning using the Blended Learning format	1	2	3	4	5
7. The level of influence of factors on the quality of training in the form of Blended Learning. How do you rate the level of influence of the following factors on the quality of learning in the form of Blended - Learning? (You rate these factors on the level of influence from 1 to 5 with: Level 1: No influence; Level 2: Little influence; Level 3: Average influence; Level 4: Relatively influence; Level 5: Very influence)						
7.1	Content of learning resources (quality of lectures, audio, images transmitted, etc.)	1	2	3	4	5
7.2	Design and Planning	1	2	3	4	5
7.3	Convenience and personalization for learners	1	2	3	4	5
7.4	Computer systems, servers, transmission quality	1	2	3	4	5
7.5	Reliability of supporting technology (interactive tools: chat boxes, comment boxes with lecturers, other students; etc.)	1	2	3	4	5
7.6	Interaction	1	2	3	4	5