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# Key Determinants of Student Satisfaction in Online Learning During COVID-19: Evidence From Vietnamese Students

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The adoption of online learning modalities has increasingly become prevalent, particularly with the advent of COVID-19, aiming to ensure student access to learning materials. This significant shift towards offering online educational formats compels educational institutions to alter their approach and develop curricula to guarantee an optimal student experience and satisfaction within the online environment. The aim of this research is to comprehensively examine the key factors that significantly impact the satisfaction of undergraduate students with online learning in Vietnamese universities. The quantitative research methodology was implemented through the collection of surveys from a total of 437 Vietnamese students. Utilizing the PLS-SEM statistical approach, the findings reveal that technology, communication, course, outcome, and motivation for learning have significant positive influences on students' satisfaction with online education during the COVID-19 pandemic, while the effect of instructors' attitude and the sudden change from traditional to online classes have been found with as nonsignificant. Valuable implications and practical recommendations are suggested for educational organizations and institutions in Vietnam to enhance specific activities that promote students' satisfaction with online learning and improve teaching methods provided by instructors.

## 1. Introduction

The COVID-19 pandemic profoundly impacted the global education system. Escalating cases led to school closures and the urgent need to shift to online education [1, 2]. As a result, higher education worldwide had to adapt to unconventional online teaching and learning environments to address the pandemic emergency. However, there is limited educational research on specific online factors that significantly affect learning enjoyment, such as usability, appeal, practicality, and proficiency.

The accessibility of learning materials plays a pivotal role in ensuring the quality of students' learning experiences and performance [3, 4]. Directly related to student engagement, ease of access to learning resources allows students to be more proactive in seeking out materials, thereby enhancing their ability to learn independently, boosting confidence, and consequently reducing stress or burnout in the learning process by facilitating straightforward access to reference materials and support [5]. Additionally, it is instrumental in promoting lifelong learning and supporting the development of a more diverse and personalized learning experience, wherein students can find resources aligned with their preferred learning methodologies.

Educational institutions used to predominantly rely on traditional approaches to access learning materials and organize learning formats physically, including in-person classes and other tangible resources [6]. However, this mode encountered significant challenges during the COVID-19 pandemic when physical attendance was severely limited by social distancing policies over an extended period globally [4]. This situation led to substantial disruptions in the

learning experience and students' access to learning materials as physical classes could not be organized, and students faced difficulties in reaching support from lecturers or accessing other educational support resources [7]. COVID-19 has precipitated profound changes and directly impacted how learning materials are accessed, challenging the traditional face-to-face approach while simultaneously facilitating the rise of online learning modalities [8].

The transition to online learning has emerged as a critical solution for addressing key issues in education stemming from the disruptions caused by COVID-19 [7]. Digital learning is regarded as a solution that enables the provision and access to education to overcome barriers associated with the reduction of social interactions in the context of distancing, which could adversely affect student learning experiences and performance [9]. This shift not only ensures continuous access to learning materials but also highlights the flexibility and resilience of digital platforms in maintaining educational processes in the face of unexpected disruptions [7]. Simultaneously, it underscores the necessity of developing and ensuring that educational systems are adaptable and capable of adjusting to changing circumstances.

Previous research during the pandemic primarily examined online education strategies, teaching facilitation, resources, policies, and the impact of lockdowns on student learning [10–12]. However, few studies compared factors affecting online learning experiences and satisfaction [6, 13]. The aspects that enhanced students' satisfaction with online learning before the COVID-19 era were also understudied, making it challenging to determine satisfaction during the pandemic.

Gopal, Singh, and Aggarwal [14] noted insufficient research attention to students' satisfaction and performance in online learning during COVID-19. Andersson and Grönlund [15] identified challenges in e-learning implementation in developed and developing countries, including learner, technology, course, and context dimensions. Developed countries faced fewer technology challenges due to advanced platforms. However, the attributes of e-learning that contribute to satisfaction during challenging times like COVID-19 remain unclear. Thus, our research question is as follows: What factors of online education determine students' satisfaction across all universities in Vietnam during COVID-19? Our study objectives are (1) to identify factors influencing students' satisfaction with online learning and (2) to examine their relationship with satisfaction among all university students during the pandemic.

To achieve our research goals, the technology acceptance model (TAM) is utilized as the theoretical model in this study. The TAM was proposed by Fred Davis in 1986, with the aim of explaining user behavior towards new technology based on user attitudes. The TAM shows its dominance in most research to examine the online learning satisfaction of undergraduates who experienced the COVID-19 pandemic period [16, 17]. This study focuses on Vietnamese undergraduate students' online learning experiences across all universities. Data is collected from various faculties through Zoom and Google Meet during the COVID-19 pandemic using the user experience questionnaire (UEQ) and a quantitative methodology (forms). Results will highlight primary factors significantly influencing undergraduates' satisfaction with online learning, different from previous studies (e.g., [6, 13]). The paper offers potential solutions for online learning challenges and extensive discussion on factors related to online education and satisfaction. The study approach and data collection methods are described, followed by the presentation and discussion of results, incorporating both theoretical implications and practical insights.

## 2. Research Concepts and Hypothesis Development

Prior research during the pandemic predominantly focused on strategies for online education, facilitation of teaching, resources, policies, and the impact of lockdowns on student learning [10–12]. Nonetheless, there has been limited comparative analysis of factors influencing online learning experiences and satisfaction [6, 13]. The exploration of the effects of study workloads, enhancing student engagement, and technical issues in online learning on student experiences constitutes three principal themes that previous research frequently concentrated on [6].

Among the notable factors explored in studies that could impact students' satisfaction with online learning include lecturers' competence and commitment, students' technical abilities, technical self-efficacy, and adaptability, along with system and information quality. Lecturer competence refers to the instructors' ability to deliver online content effectively, engage with students, and provide timely feedback via online platforms [8, 18], while students' technical abilities pertain to the capacity, confidence, and belief of students in their ability to succeed in an online learning environment [4, 19]. Besides these intrinsic factors, an external factor that can affect students' online learning experience is the technical support and system design, such as user-friendly interfaces, ease of navigation, and the availability of necessary resources [8]. Furthermore, constructing a support system that facilitates better communication among students or between students and instructors plays a crucial role in enhancing student engagement and satisfaction in online learning [6]. However, despite receiving significant attention, the aspects that enhanced students' satisfaction with online learning before the COVID-19 era were also understudied, complicating the assessment of satisfaction during the pandemic. Moreover, previous studies focusing on this aspect were often conducted in developed countries such as China [8] and the United States [19, 20], while there has been a scarcity of research in developing countries like Vietnam, where students may exhibit different cultural traits, adaptability, and technological infrastructure compared to those in developed nations.

The strong shift towards online learning and education under the influence of COVID-19 makes comprehending the multifaceted factors influencing student satisfaction with online learning modalities has become paramount for educational institutions globally. This section focuses on exploring several pivotal determinants hypothesized to shape students' online learning experiences, including satisfaction

with online learning, instructors' attitudes, students' perceptions of online learning technology, interactions among students, online communication, the structure and content of online courses, outcomes, motivation for learning, and the impact of the abrupt transition from traditional to face-to-face classes to online formats. While most of these factors are expected to positively influence students' satisfaction, the sudden shift from conventional classroom settings to online platforms is hypothesized to negatively affect their overall sense of learning contentment. Additionally, this section introduces a proposed research model, aimed at providing a detailed understanding of the interrelationships among these factors and their collective impact on students' satisfaction with online learning during this global health crisis.

*2.1. Online Learning Satisfaction.* The COVID-19 outbreak has changed the world, and universities must switch from traditional learning methods to online learning methods to prevent the transmission of infectious diseases through social interaction [21, 22] and adverse impacts on student life, grades, and academic achievement [23]. Online learning means that both teachers and students converge in a virtual classroom environment to participate in educational activities from different places and at different times through an Internet connection [24]. Online learning allows instructors to update learning materials in different file formats and easily track learning progress and students' learning results without having to go to class like lecture-format traditional teaching [25].

In this study, we posit that online learning satisfaction requires advanced teaching methods and technological know-how to capture students' attention and deliver learning instruction [26, 27]. The level of effectiveness when learning online and the psychological state of students will affect student satisfaction in learning. Meanwhile, students' expectations about the online learning system are very complicated due to the novel nature of this form of online learning [27]. Satisfaction with the teaching methods of lecturers also has a positive impact on student learning outcomes [28]. As such, fulfilling the student's expectations and gaining positive views of the online learning system will then create online student satisfaction.

*2.2. Technology.* The efficiency of online learning depends on how users perceive the technology [29, 30]. Technical issues and lack of support can lead to frustration in online learning [31]. Users' perception of the utility and usability of online learning technology plays a crucial role in its adoption [32]. Factors like visual design, navigation, and functionality also influence user engagement [33]. Users' past knowledge and proficiency with the technology, as well as their perception of its quality, impact the success of online learning [34]. Computer self-efficacy is positively related to users' intention to use technology for learning [32]. Past research supports the hypothesis that technology affects students' online learning experiences [35–38].

**H1.** *Students' perception of online learning technology positively affects their online learning satisfaction.*

*2.3. Motivation in Learning.* Motivation plays a crucial role in today's student learning, representing a person's internal drive to achieve goals [39]. It encompasses a student's willingness, creativity, and engagement in classroom activities [40]. Studies have emphasized that maintaining student satisfaction in online classrooms is contingent on motivation [40]. Students with higher motivation tend to succeed more in online learning compared to those with lower motivation [27, 41]. Therefore, our hypothesis is based on the influence of "motivation for learning" as an essential factor in students' online learning satisfaction.

**H2.** *Motivation in learning positively affects students' online learning satisfaction.*

*2.4. Communication.* The success of remote learning relies on effective communication between teachers and students [29]. To combat potential feelings of isolation in online learning, instructors are advised to use interactive teaching techniques, encourage discussions, and provide multiple communication channels [30]. The interaction between learners and teachers within the context of online education is typically facilitated through mechanisms such as real-time feedback systems, learning-management systems, class discussions, emails, and phone calls [42–44]. Research indicates a favorable impact on students' motivation to learn through the provision of support, known as scaffolding [45]. Notably, Borup, Graham, and Davies [46] observed that, among the three interaction types delineated by Moore [47], virtual high school students perceived learner–teacher interaction as the most advantageous for enhancing their motivation to learn. Additionally, Liu and Cavanaugh [48] identified a statistically significant positive correlation between the frequency of learner–teacher interactions and final scores in an online high school algebra course.

**H3.** *Online communication positively affects students' online learning satisfaction.*

*2.5. Instructor.* Teachers and students in online learning significantly influence each other's experiences [29]. Hartman, Dziuban, and Moskal [49] show a strong connection between instructor satisfaction and student learning. When teachers perform well, students are more content. Thus, factors such as a teacher's methods and demeanor impact student motivation and involvement [34]. Effective use of online learning technology by instructors also affects students' learning outcomes [33].

**H4.** *Instructor's attitude and performance positively affect students' online learning satisfaction.*

*2.6. Course.* Students' satisfaction with online learning may depend on their confidence in learning the course material [50]. Subject-specific variations should be considered when evaluating the efficiency of online learning [51]. Courses that require practical information and skills might not be as effective online, impacting student learning and happiness. However, if the course material is well-suited for the

online environment, students may prefer online enrollment. Cultural differences can also influence students' perceptions of the benefits of online courses, with Asian students, for example, having different learning styles and preferences [52, 53].

**H5.** *Online courses positively affect their online learning satisfaction.*

*2.7. Outcome.* Research indicates that student satisfaction is closely connected to academic performance and participation [54]. Perceived learning outcomes also play a significant role in influencing student satisfaction with online learning [55]. By considering both student satisfaction and reported learning outcomes, we can better assess the effectiveness of online education [56]. Previous studies have emphasized a strong link between students' satisfaction with online learning and their overall learning experience [57]. A satisfied student is considered a positive indication of effective learning, and actual student learning outcomes are a reliable indicator of satisfaction in online learning [58]. Hypothesis H6 proposes the following:

**H6.** *Outcome positively affects their online learning satisfaction.*

*2.8. Sudden Change.* The impact of external factors on teachers' and students' online teaching and learning experiences is being investigated, along with the virtual learning environment. The sudden shift to complete online learning due to the pandemic has caused significant disruptions in the global education sector [59]. Although educators and learners were unprepared for this upheaval, they had little choice but to adapt. Therefore, it is crucial to identify potential external elements that may affect teacher and student satisfaction in the virtual educational environment [29]. The hypothesis is that the rapid transition from traditional to online learning during the pandemic could adversely affect students' teaching and learning experiences.

**H7.** *The sudden change from traditional to online classes negatively affects students' online learning satisfaction.*

Based on various studies by authors such as Lei and So [60]; Al-Mawee, Kwayu, and Gharaibeh [61]; Rajeh et al. [62]; and Saravanan et al. [63], several factors are identified that influence students' satisfaction with online learning during the COVID-19 pandemic. Figure 1 illustrates this study's proposed research model which maps the influences of various factors, including the instructor, technology, communication, course, learning outcomes, motivation for learning, and sudden changes, on online learning satisfaction.

## 3. Methodology

This study is aimed at investigating the factors influencing students' satisfaction with online learning during the COVID-19 pandemic and propose solutions for enhancing their learning experience. In this study, the UEQs are uti-
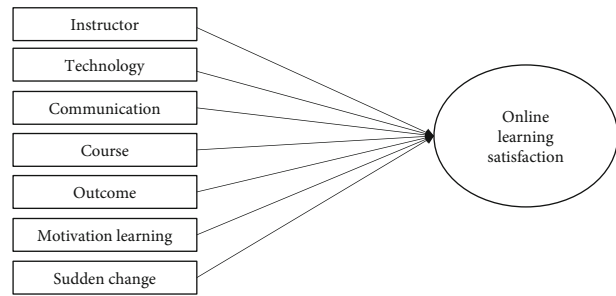


FIGURE 1: Proposal research model.

lized to allow a quick assessment done by end users covering a preferably comprehensive impression of user experience [64]. In fact, we believe that this approach should allow the users to express feelings, impressions, and attitudes that arise when experiencing the service under investigation in a very simple and immediate way.

Measurement scales were adapted from existing scales found in previous research. First, an English version of the measures was developed by adapting items from previous studies. An independent translator helped translate the measures into Vietnamese, which was back-translated into English by another independent translator. The authors worked with these translators to resolve several back-translation ambiguities and ensure the translation accuracy. Second, the adapted items were subjected to a focus group discussion with several experts working in the higher education of Vietnam to enhance the face validity. The items were then revised according to the focus group feedback. Third, a pilot study was conducted with 35 students in Vietnam to validate and further refine the measures.

Sampling was based on convenience and accessibility, with 448 students from various Vietnamese universities selected. After screening, 437 satisfactory samples were obtained from April 25 to April 28, 2022, using an online survey created on Google Forms for accuracy and safety amid the pandemic.

Following the definition of research objectives, subjects, and time, the study developed a scale, outlined in Table 1, utilizing a Likert 5-point scale (ranging from 1: *completely disagree* to 5: *completely agree*) to collect data.

## 4. Results

*4.1. Assessment of Measurement Model*

*4.1.1. Descriptive Statistics for Demographic Variables.* All the participants in the survey are undergraduate students in Vietnam who have participated in online learning during the time of social distancing because of the COVID-19 pandemic. Participants will have characteristics such as gender, year of a course of study, and city/province in which the university is situated. The results obtained after the survey are as follows.

According to Table 2, the survey respondents mainly consist of female students, representing 78.95% of the total, which is 3.75 times higher than male students, who make

TABLE 1: Variables in the research model.

| Constructs | Indicator | Observed variables | Sources |
|---|---|---|---|
| Instructor | GV1 | Instructors often respond promptly to students' questions. | Lei & So [60]; Al-Mawee, Kwayu, and Gharaibeh [61]; Rajeh et al. [62] |
| | GV2 | Instructors provide clear instructions on how to access online learning materials for your class. | |
| | GV3 | Instructors provide complete information about learning materials. | |
| | GV4 | Instructors often facilitate online discussions about lesson content. | |
| | GV5 | Instructors organize the examination and assessment according to the prescribed time. | |
| | GV6 | Instructors respond quickly to test results. | |
| Technology | CN1 | Using the Internet makes it easy to communicate with instructors and other students. | Saravanan et al. [63]; Lei & So [60]; Al-Mawee, Kwayu, and Gharaibeh [61]; Rajeh et al. [62] |
| | CN2 | You can easily download the files to your computer. | |
| | CN3 | Online discussion forums are very helpful. | |
| | CN4 | Technology makes it possible to learn from anywhere without going to class. | |
| Communication | GT1 | Online learning helps you feel more confident in communicating with other students and instructors. | Lei & So [60]; Saravanan et al. [63]; Rajeh et al. [62] |
| | GT2 | You enjoy participating in activities to exchange and contribute ideas in online learning sessions. | |
| | GT3 | Exchange information on online discussion forums to help you see how well you know compared to other students. | |
| | GT4 | Online learning gives you the opportunity to interact with other students through online chat rooms or forums. | |
| Course | KH1 | Online courses provide you with valuable information. | Saravanan et al. [63] |
| | KH2 | The online course provides clear instructions for the learning process. | |
| | KH3 | The course's easy-to-use online learning system helps facilitate student learning and interaction. | |
| | KH4 | An online platform to help you learn more about the course content. | |
| Outcome | KQ1 | Online learning enhances your learning efficiency. | Rajeh et al. [62] |
| | KQ2 | You are satisfied with the learning results achieved during the online learning process. | |
| | KQ3 | You can apply what you learn in the online course. | |
| | KQ4 | You are satisfied with your performance in the online course. | |
| Motivation for learning | DL1 | You are capable of completing the exercises that the teacher gives you and this has motivated you to study. | Saravanan et al. [63] |
| | DL2 | Online learning helps you create a close relationship with your teacher/student, and this motivates you to study. | |
| | DL3 | An online course provides the necessary knowledge, has long-term benefits, and motivates you to study. | |
| | DL4 | You are interested in the online course content, and it motivates you to learn from the course. | |
| | DL5 | An online course enhances your competence and knowledge, and it motivates you to learn from the course. | |
| Sudden change | TD1 | You worry about fairness in grading. | Lei & So [60] |
| | TD2 | You worry about the lack of devices to support online learning. | |
| | TD3 | You worry about the lack of materials to support online learning. | |
| | TD4 | You feel uncomfortable when you have to change the method of communication from face-to-face to online. | |

TABLE 1: Continued.

| Constructs | Indicator | Observed variables | Sources |
|---|---|---|---|
| | HL1 | I will continue to choose online learning if the COVID-19 pandemic continues. | |
| | HL2 | I am more satisfied with online learning compared to face-to-face sessions. | |
| Online learning satisfaction | HL3 | My satisfaction level encourages me to register in other available online. | Lei & So [60]; Rajeh et al. [62] |
| | HL4 | Overall, I am satisfied with my online teaching experiences. | |
| | HL5 | Overall, I am satisfied with the attitudes and performances of myself/my students/instructors who attended/taught my online classes. | |

TABLE 2: Participant demographics.

| | Characteristics | Frequencies | Percentage |
|---|---|---|---|
| Gender | Male | 92 | 21.05% |
| | Female | 345 | 78.95% |
| Year of a course of study | Freshman | 182 | 41.65% |
| | Sophomore | 185 | 42.33% |
| | Junior | 26 | 5.95% |
| | Senior | 40 | 9.15% |
| | 5th year | 2 | 0.50% |
| | 6th year | 2 | 0.50% |

up only 21.05%. Among the participants, the majority are freshmen and sophomores. First-year students constitute the highest proportion at 42.33%, followed closely by second-year students at 41.65%. Fourth-year students account for an average of 9.15%, while third-year students have a lower representation of 5.95%. A few students from the fifth and sixth years also participated in the survey, each at a relatively similar rate of 0.5%.

*4.1.2. Measurement Model Analysis (External Model).* Following Hair et al. [65], we first evaluate the validity and reliability results of all items based on the outer loading value (> 0.7) and AVE value (> 0.5). Hock and Ringle [66] suggest that a scale achieves convergent value if the AVE is 0.5 or higher. This level of 0.5 (50%) means that the average parent latent variable will explain at least 50% of the variation of each observed variable. The results of the analysis are presented in Table 3 as follows.

From Table 3, as we can see, all the outer loadings of the items are above 0.7 and the AVE above 0.5. This result indicates that the measurement model meets the convergent validity requirements [65]. Next, we evaluate the reliability of the scale on SMARTPLS through two main indicators, Cronbach's alpha and composite reliability (CR). Hair et al. [65] suggested that Cronbach's alpha should be higher than 0.7 and CR must be higher than 0.7. We find that the Cronbach alpha of all constructs is higher than 0.7. In particular, the lowest Cronbach alpha value is 0.769 for technology components, while the highest value is 0.912 for components

of motivation for learning. We also can find that all the constructs have a value of CR higher than 0.7, suggesting that the reliability of the constructs is suitable for further testing.

*4.1.3. Discriminant Variable.* We utilize the square root of AVE as proposed by Fornell and Larcker [67] and the HTMT index [68] to evaluate the discriminant value. These results are presented in Tables 4 and 5.

The results of Fornell–Larcker in Table 4 revealed that the square root of AVE of the constructs exceeded the value of estimated correlations of a construct with other latent variables of the study [65], thus confirming the discriminate validity of the constructs. Therefore, with all the statistical criteria met, the validity and the reliability of the reflective measurement model were established for our results.

*4.1.4. Structural Model Analysis (Inner Model).* In this part, we provide the results of the path coefficient and $t$-statistics of our research model by using the PLS-SEM algorithms. The Bootstrapping interface (with subsamples = 5000, two-tailed testing, and a significance level of 0.05) was utilized to verify the statistical significance of the path coefficients [65]. The results are presented in Table 6 and Figure 2.

From Table 6, it could be seen that hypotheses H1 (CN → HL), H2 (DL → HL), H3 (GT → HL), H5 (KH → HL), H6 (KQ → HL) were significant because the $t$-value is significant at $p < 0.05$. However, we find that H4 (GV → HL) and H7 (TD → HL) are statistically insignificant with $p > 0.05$. Thus, the hypotheses H4 and H7 are not accepted.

TABLE 3: The results of validity test.

| Item | Outer loading | AVE | Evidence |
|---|---|---|---|
| Teacher components (GV); Cronbach's alpha = 0.866; composite reliability = 0.899 | | | |
| GV1 | 0.777 | | Valid |
| GV2 | 0.806 | | Valid |
| GV3 | 0.763 | 0.597 | Valid |
| GV4 | 0.772 | | Valid |
| GV5 | 0.723 | | Valid |
| GV6 | 0.791 | | Valid |
| Technology components (CN); Cronbach's alpha = 0.769; composite reliability = 0.851 | | | |
| CN1 | 0.788 | | Valid |
| CN2 | 0.787 | 0.589 | Valid |
| CN3 | 0.763 | | Valid |
| CN4 | 0.731 | | Valid |
| Communication components (GT); Cronbach's alpha = 0.829; composite reliability = 0.886 | | | |
| GT1 | 0.818 | | Valid |
| GT2 | 0.825 | 0.661 | Valid |
| GT3 | 0.834 | | Valid |
| GT4 | 0.775 | | Valid |
| Course components (KH); Cronbach's alpha = 0.865 ; composite reliability = 0.908 | | | |
| KH1 | 0.832 | | Valid |
| KH2 | 0.862 | 0.711 | Valid |
| KH3 | 0.825 | | Valid |
| KH4 | 0.851 | | Valid |
| Outcome components (KQ); Cronbach's alpha = 0.871 ; composite reliability = 0.912 | | | |
| KQ1 | 0.855 | | Valid |
| KQ2 | 0.825 | 0.721 | Valid |
| KQ3 | 0.848 | | Valid |
| KQ4 | 0.868 | | Valid |
| Components of motivation for learning (DL); Cronbach's alpha = 0.912 ; composite reliability = 0.934 | | | |
| DL1 | 0.807 | | Valid |
| DL2 | 0.856 | | Valid |
| DL3 | 0.892 | 0.739 | Valid |
| DL4 | 0.879 | | Valid |
| DL5 | 0.863 | | Valid |
| Sudden change components (TD); Cronbach's alpha = 0.814 ; composite reliability = 0.875 | | | |
| TD1 | 0.841 | | Valid |
| TD2 | 0.808 | 0.636 | Valid |
| TD3 | 0.828 | | Valid |
| TD4 | 0.707 | | Valid |

TABLE 3: Continued.

| Item | Outer loading | AVE | Evidence |
|---|---|---|---|
| Components of online learning satisfaction (HL); Cronbach's alpha = 0.893 ; composite reliability = 0.921 | | | |
| HL1 | 0.712 | | Valid |
| HL2 | 0.835 | | Valid |
| HL3 | 0.873 | 0.702 | Valid |
| HL4 | 0.882 | | Valid |
| HL5 | 0.875 | | Valid |

TABLE 4: The results of the Fornell–Larcker recapitulation.

| | CN | DL | GT | GV | HL | KH | KQ | TD |
|---|---|---|---|---|---|---|---|---|
| CN | **0.768** | | | | | | | |
| DL | 0.465 | **0.860** | | | | | | |
| GT | 0.513 | 0.716 | **0.813** | | | | | |
| GV | 0.640 | 0.574 | 0.545 | **0.773** | | | | |
| HL | 0.527 | 0.706 | 0.648 | 0.505 | **0.838** | | | |
| KH | 0.580 | 0.725 | 0.651 | 0.596 | 0.665 | **0.843** | | |
| KQ | 0.462 | 0.819 | 0.654 | 0.503 | 0.702 | 0.678 | **0.849** | |
| TD | 0.135 | 0.340 | 0.372 | 0.224 | 0.296 | 0.277 | 0.263 | **0.798** |

The discriminant validity was assessed using Fornell and Larcker (1981) by comparing the square root of the average variance extracted in the diagonal (in bold) with the correlation coefficients (off-diagonal) for each construct in the relevant rows and columns.

TABLE 5: The results of Heterotrait-Monotrait Ratio (HTMT) recapitulation.

| | CN | DL | GT | GV | HL | KH | KQ | TD |
|---|---|---|---|---|---|---|---|---|
| CN | | | | | | | | |
| DL | 0.549 | | | | | | | |
| GT | 0.637 | 0.824 | | | | | | |
| GV | 0.790 | 0.637 | 0.637 | | | | | |
| HL | 0.635 | 0.771 | 0.742 | 0.563 | | | | |
| KH | 0.713 | 0.811 | 0.766 | 0.685 | 0.747 | | | |
| KQ | 0.558 | 0.816 | 0.767 | 0.572 | 0.783 | 0.773 | | |
| TD | 0.162 | 0.387 | 0.440 | 0.260 | 0.332 | 0.312 | 0.302 | |

Within the $R$ squared adjusted, according to Hair et al. [65], $R^2$ values of 0.75, 0.50, and 0.25 for the endogenous constructs could be interpreted, respectively, as substantial, moderate, and weak. The $R$ squared adjusted value is 0.602. Thus, it can be concluded that $R^2$ value for HL constructs could be considered to be close to substantial.

To measure the predictive power of the model, Stone [69] and Geisser [70] proposed the $Q^2$ index out-of-sample predictive power. Tenenhaus et al. [71] stated that $Q^2$ is considered an index to evaluate the overall quality of the component model. Accordingly, if all component models have $Q^2 > 0$, the overall structural model of the study also has overall quality. According to Hair et al. [65], the levels of $Q^2$ corresponding to the predictive power of the model are as follows: $0 < Q^2 < 0.25$, low forecast accuracy; $0.25 < Q^2 < 0.5$, average

TABLE 6: The results of path coefficient.

| Hypothesis | | Original sample (O) | Sample mean (M) | Standard deviation (STDEV) | t-statistics (\|O/STDEV\|) | p values | Evidence |
|---|---|---|---|---|---|---|---|
| H1 | CN ➜ HL | 0.156 | 0.155 | 0.050 | 3.110 | $p \leq 0.001$ | Significant |
| H2 | DL ➜ HL | 0.190 | 0.192 | 0.074 | 2.570 | $p \leq 0.001$ | Significant |
| H3 | GT ➜ HL | 0.148 | 0.145 | 0.055 | 2.671 | $p \leq 0.001$ | Significant |
| H4 | GV ➜ HL | -0.025 | -0.021 | 0.048 | 0.527 | $p > 0.05$ | Not significant |
| H5 | KH ➜ HL | 0.159 | 0.161 | 0.053 | 2.977 | $p \leq 0.001$ | Significant |
| H6 | KQ ➜ HL | 0.270 | 0.266 | 0.062 | 4.337 | $p \leq 0.001$ | Significant |
| H7 | TD ➜ HL | 0.046 | 0.049 | 0.036 | 1.276 | $p > 0.05$ | Not significant |

forecast accuracy; $Q^2 > 0.5$, high level of forecast accuracy. The results are presented in Table 7.

From Table 7, we find that HL has $Q^2$ of 0.418 (>0), indicating that the predictive power of the model is middle forecast accuracy.

Following Masudin et al. [72], we next evaluate the model fit results based on three statistical criteria, including, standardized root mean square residual (SRMR), the normed fit index (NFI), and the three fit models for bootstrapped-based statistics (d-ULS, d_G, and chi-square). The results are presented in Table 8.

Table 8 reveals that the NFI value is 0.819 (>50%), indicating that the model is fit because the model used in this research has a percentage of 81.9%. In addition, the SRMR value is 0.057 (<0.08), which indicates that the correlation matrix model is appropriate [73]. This result suggests that student online satisfaction has been successfully modeled.

## 5. Discussions

*5.1. Theoretical Discussions and Implications.* This study investigates the specific attributes of online learning and how those attributes affect students' satisfaction with online educational environments during COVID-19. This study contributes valuable insights by knowing how students' opinions of this new learning environment and how it affects their level of satisfaction with their education can help develop techniques that encourage ongoing involvement and make online learning more appealing. Our findings demonstrate that five out of seven attributes including technology, communication, course, outcome, and motivation for learning are statistically significant on online learning satisfaction, while instructor and sudden change are not.

First, technology is confirmed as a critical attribute to enhance online learning satisfaction. This observation further reinforces prior findings by Mahmood [74], which posited that the technology infrastructure plays a pivotal role in facilitating access to learning materials and significantly influences the students' online learning experience. In fact, the result shows that applying technologies positively impacts online learning satisfaction by supporting students in their learning process, such as easy access to learning materials, including online resources, online forums, and lecture slides, tend to perform better in their studies. This result is consistent with Twigg [75] and Adeyinka-ojo and Ikumoro [76]. This result

can be explained in that the students' satisfaction can be ensured by encouraging active learning in a digital teaching environment with a variety of educational materials. Therefore, technological factors can mitigate the disruptions caused by COVID-19, when educational institutions use online platforms to generate useful, comprehensible, and visually appealing virtual content that encourages satisfaction and continued engagement in online learning [77].

Second, the result shows that online communication positively affects online learning satisfaction. A detailed analysis of this paper has revealed that online learning helps students boost their confidence in communicating with other students and instructors in activities to exchange and contribute ideas [78]. This result is in line with the several previous studies. For instance, Rodriguez, Ooms, and Montañez [79] show that for students with online course experience, comfort or confidence had a strong positive connection with satisfaction. Furthermore, this study also reinforces the assertions made by Chakraborty et al. [80], Mahmood [74], and Toquero and Talidong [81], which argue that communication and interaction with instructors and among students themselves play a crucial role in ensuring a positive online learning experience. This is identified as one of the most significant factors that students consider when engaging in online courses. This consistency suggests that the mode of communication may play a crucial role in shaping student satisfaction. Therefore, fostering meaningful interactions and effective communication between students and teachers in online settings is crucial for enhancing satisfaction [78, 82]. Moreover, by emphasizing the role of communication in students' online learning satisfaction, the findings from this study also reinforce the call to action by Chakraborty et al. [80], who argue that while online education is considered a viable alternative during the pandemic, there is room for improvement in terms of interaction. Furthermore, in line with the observations of Skulmowski and Rey [83], who emphasize the role of deploying hybrid communication models, incorporating both online and in-person interactions to promote student satisfaction, the results of this study consistently recognize the value of online interactions in the current educational landscape, suggesting that with proper strategies and tools, online communication can effectively contribute to a satisfying learning experience. Additionally, instructors can easily promptly address student inquiries and encourage student interactions [84].
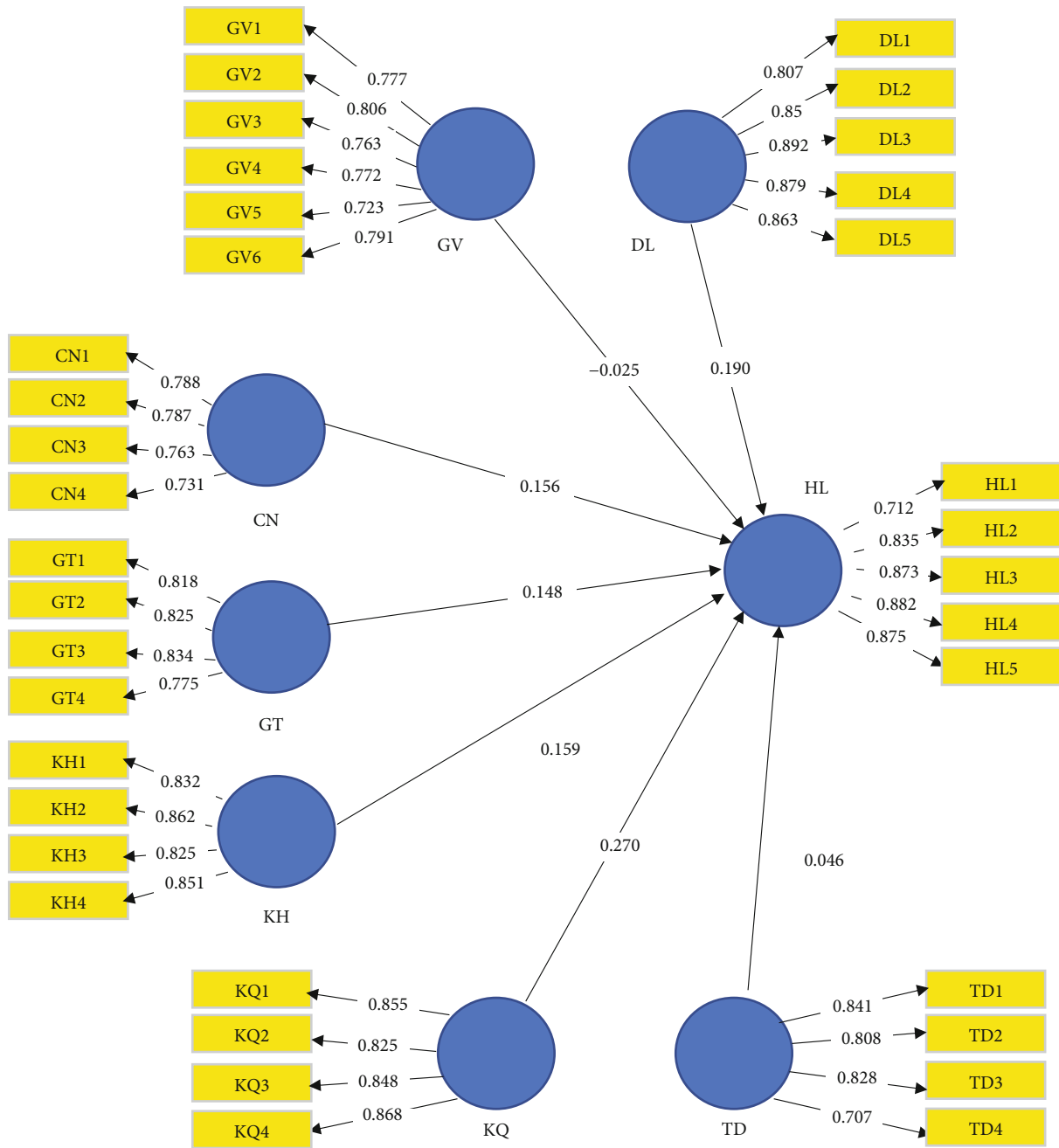
FIGURE 2: The result of path diagram.

TABLE 7: The results of predictive relevant analysis.

|  | SSO | SSE | $Q^2$ (=1-SSE/SSO) |
|---|---|---|---|
| CN | 1748.000 | 1748.000 |  |
| DL | 2185.000 | 2185.000 |  |
| GT | 1748.000 | 1748.000 |  |
| GV | 2622.000 | 2622.000 |  |
| HL | 2185.000 | 1272.468 | 0.418 |
| KH | 1748.000 | 1748.000 |  |
| KQ | 1748.000 | 1748.000 |  |
| TD | 1748.000 | 1748.000 |  |

TABLE 8: The results of model fit analysis.

|  | Saturated model | Estimated model |
|---|---|---|
| SRMR | 0.057 | 0.057 |
| d_ULS | 2.194 | 2.194 |
| d_G | 0.730 | 0.730 |
| Chi-square | 1895.415 | 1895.415 |
| NFI | 0.819 | 0.819 |

Third, the result shows that there is a positive and significant relationship between the course and online learning satisfaction. Particularly, the result reveals that online learning satisfaction comes from the online courses' valuable information, instructions, and easy-to-use. This result is in line with the findings of Kauffman [85]. Kauffman [85] indicates that the integrated course design model (online discussions, guidelines provided by the instructor) can increase the level of online learning satisfaction. This result also provides further support for the findings from Chakraborty et al. [80], which highlighted that the delivery of course content significantly positively affects students' online learning experience. Additionally, this outcome reinforces the observations made by Bao [10], which emphasized the importance of dividing content into smaller units to aid student focus, recognizing the tendency of online learners to have shorter attention spans. Furthermore, learners' preferences for traditional or online classes may vary [86], highlighting the importance of catering to individual learning styles. Thus, a well-balanced interaction that is customized to the preferences of specific learner groups can be incorporated into online course designs to support student learning and satisfaction as well as their social integration [84].

Fourth, the results indicate a positive correlation between learning outcomes and satisfaction in online learning. This correlation affirms the importance of designing online learning environments that prioritize efficiency, align with learner expectations, promote practical application, and foster a sense of accomplishment, ultimately enhancing overall satisfaction and learning success. This result is in line with the findings of Means et al. [87], Boling et al. [78], and Artino [88]. Furthermore, the ability to apply learned concepts to real-world scenarios, a key determinant of successful learning outcomes [78], is emphasized. Means et al. [87] suggested that instructors should incorporate a practical orientation in online learning to facilitate the transfer of skills to real-world contexts, thereby enhancing the relevance of acquired knowledge. Satisfaction with personal performance is often linked to positive learning outcomes, as it signifies a sense of mastery and accomplishment [88]. Additionally, this finding further corroborates the assertion by Chakraborty et al. [80], which identifies the significant impact of online assessment design on student satisfaction. Thus, instructors should support self-directed learning, which is a common feature of online education that contributes to a positive learning experience and a sense of accomplishment [89].

Finally, there is a positive relationship between motivation and online learning satisfaction. It means that maintaining learners' satisfaction with online learning necessitates a deliberate effort to increase their motivation for studying. According to Croxton [84], instructors can foster acquaintance and friendship among students, motivating them to engage actively with peers and instructors. Thus, instructors should be offered many learning options within each course which helps to keep their interest in the online course content [75]. He also mentions that instructors should be flexible and create environments where students are able to choose online courses that provide their necessary knowledge, which has long-term benefits.

*5.2. Practical Discussion and Implications.* Emphasizing the role of students' perceptions of online learning technology in enhancing satisfaction with online learning, this research underscores the necessity for educators to integrate various educational technologies to support the learning process. This includes the utilization of learning management systems, online forums, and multimedia resources to facilitate easy access to learning materials. This suggestion aligns with Toquero and Talidong [81], who highlighted the role of integrating social media into online learning platforms to enhance communication capabilities and serve as supplementary tools for instruction and information dissemination. Additionally, the development or integration of supportive communication platforms within online learning platforms is another aspect that educators need to consider, based on findings confirming the significant impact of communication on students' online learning satisfaction. Furthermore, according to this study's findings, the incorporation of findings regarding the significant effects of online communication and course design suggests that educators should encourage active participation in online discussions and provide diverse platforms for communication, such as video conferences, discussion boards, and social media groups, to enhance students' online learning experiences. This suggestion corresponds with recommendations from Skulmowski and Rey [83] and Chakraborty et al. [80], which underscored the necessity for universities to expand their digital infrastructure. This expansion includes adopting video conferencing tools, significantly increasing the number of classes that offer video-based learning content, and incorporating slideshows, note-taking programs, and specialized online tools for problem-solving, programming, and designing to enrich courses. Implementing communication activities and creating a sense of community also helps maintain student engagement and keep students motivated in an online environment [90], which are significant factors determining students' online learning satisfaction, according to findings from this study.

The findings of this study, which indicate a nonsignificant relationship between instructors' attitudes and the abrupt transition from traditional to online classes on students' satisfaction with online learning, suggest an important implication that students currently possess the capability and confidence in their self-learning abilities to adequately engage in online educational activities. They are not dependent on instructors' guidance to adapt to new learning modalities but are capable of self-exploration and discovery. Therefore, with students' confidence in their ability to self-explore, the development of user-friendly learning systems plays a crucial role in encouraging their desire to explore and thereby enhance the personalized education experience through online learning formats.

## 6. Conclusions

This study investigates factors influencing online learning satisfaction among Vietnamese university students during the COVID-19 pandemic. Thirty-one observed variables representing seven contributing factors, namely, instructor,

technology, communication, course, outcome, motivation for learning, and sudden change, were examined. Notably, technology, communication, course, outcome, and motivation for learning have a significant impact on online learning satisfaction.

To enhance students' online learning satisfaction, instructors should promptly address student inquiries, encourage student interactions, and ensure fairness in grading. Teachers can foster acquaintance and friendship among students, motivating them to engage actively with peers and instructors. Moreover, offering a diverse range of online materials and preferences to meet students' needs can improve their satisfaction with online education. However, students' preferences for traditional or online classes may vary [86], highlighting the importance of catering to individual learning styles. Additionally, fostering meaningful interactions and effective communication between students and teachers in online settings is crucial for satisfaction [78, 82].

The study's limitations include the influence of the COVID-19 pandemic on students' perceptions, potential cultural context restrictions due to the sample being limited to Vietnam, reliance on self-report data with possible biases, exclusion of students with technological challenges, omission of other relevant variables, and the cross-sectional design's inability to capture longitudinal trends.

Each country may have distinct perspectives, cultures, adaptability levels, and technological infrastructures; hence, the factors influencing and their potential impact on students' online learning experiences can vary between countries. Future research could continue to explore the factors affecting students' online learning experiences in other developing countries and compare them with the findings of this study and previous scholars to determine whether the differences that culture, adaptability, and technological infrastructure can introduce to the elements contributing to students' satisfaction. Additionally, student satisfaction can be a subjective concept, and there may be significant variances among individuals. Therefore, to gain a deeper understanding of satisfaction and the factors contributing to students' contentment with online learning courses, implementing qualitative methods might be necessary and promises to provide further significant insights into this research aspect. Moreover, student satisfaction often results from a learning process. Furthermore, the development and adoption of online learning have been underway for an extended period. Consequently, future studies, instead of applying a cross-sectional approach, could adopt a longitudinal approach to explore changes in student satisfaction with online learning and the factors affecting it through different periods, including before, during, and after COVID-19. This promises to offer a more comprehensive view of this research issue and contribute significantly to both theoretical and practical aspects.

## Data Availability Statement

The data used to support the findings of this study are available from the corresponding author upon request.

## Conflicts of Interest

The authors declare no conflicts of interest.

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