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ORIGINAL ARTICLE

Perceived Impacts of Digital Technologies on Post-COVID-19 Teaching and Learning: A Qualitative Study at Nguyen Tat Thanh University

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ABSTRACT
Along with the shutdown of schools, the coronavirus outbreak caused problems for implementing face-to-face classroom instruction. During this period, digital technologies offered a helpful substitute. This study investigated how students at Nguyen Tat Thanh University used digital technology following the coronavirus outbreak. The Technology Acceptance Model (TAM) and Constructivist Learning Theory were used to explain the findings. Thirty students were interviewed as part of the qualitative research design employed in the study. The results showed that, following the outbreak, students primarily used laptops and mobile phones to support their education. Additionally, it was discovered that these devices had the necessary software loaded, enabling communication between course instructors and students via Moodle, Zoom, WhatsApp, and YouTube. This study found that these tools were beneficial in helping students refine their typing, research, and information-seeking skills. However, drawbacks to using these devices included hardware failures, costly data bundles, and a lack of expertise with software operating protocols. When addressing these issues, the students used a variety of coping techniques. The study highlights several practical implications based on these conclusions.

1. INTRODUCTION

The COVID-19 pandemic, which originated in 2019, quickly spread globally, prompting the World Health Organization (WHO) to implement various control and prevention measures. In Vietnam, the government took proactive steps to contain the virus and prevent new cases, including initiating a nationwide lockdown that significantly impacted educational institutions.

As a result, stakeholders sought alternatives to traditional face-to-face teaching and learning methods (Bansah & Darko Agyei, 2022), with digital technologies emerging as the primary solution. Before the pandemic, most educational institutions in Vietnam favored conventional classroom interaction over digital instruction (Dinh & Nguyen, 2020). However, the shift towards digital technologies has facilitated a transition from teacher-centered classrooms to learner-centered engagement, participation, and knowledge sharing (Zhu & Liu, 2020). Mobile phones, in particular, have opened up innovative possibilities for revitalizing teaching and learning (Papadakis & Kalogiannakis, 2017). Digital technologies offer numerous benefits, such as instant feedback, global connectivity, and unlimited access to information, which enable self-directed learning (Papadakis, 2018). To support teaching and learning, Ali (2020) argues that the educational system must adopt digital technologies. While digital technologies have proven helpful, integrating them into teaching and learning remains a challenge.

The theoretical basis of this research is grounded in the Technology Acceptance Model (TAM) and Constructivist Learning Theory. Empirical investigations have revealed the profound influence of digital technologies on student learning outcomes (Jaffar et al., 2022; Engel et al., 2023; Kedia & Mishra, 2023). The spectrum of these technologies is diverse, encompassing mobile devices, personal computers, audio-visual equipment, portable computers, learning management systems (LMS), social networking platforms, radio broadcasts, smart television sets, and Internet connectivity. As these digital tools become increasingly integrated into educational settings, they are reshaping the pedagogical landscape, fundamentally altering instructional methodologies and the student learning experience. Digital technologies have been found to have a significant influence on education (Crawford et al, 2020); Masterson, 2020; Wekerle et al, 2022). Digital technologies in this category include smartphones, computers, laptops, social media, radios, smart TVs, audio-visual equipment, learning management systems (LMS), online meeting apps, and mobile phones. However, the question of digital technology influence lies not in the kinds used, but in the ways that they are employed (Abbas, 2016). Digital technologies offer several well-documented benefits. These benefits include fostering students' digital skills and supporting pedagogies that emphasize collaborative learning.

The Technology Acceptance Model (TAM) suggests that perceived ease of use and perceived usefulness determine the acceptance and use of technology (Enu-Kwesi & Opoku, 2020). Constructivist Learning Theory posits that learners construct knowledge through experiences and interactions, making digital platforms conducive to active learning and engagement (Chuang, 2021). Connectivism, a learning theory for the digital age, emphasizes the role of technology in connecting information sources and fostering learning networks (Hendricks, 2019).

There are many studies worldwide on the adoption of digital learning during and after COVID-19 (Jaffar et al., 2022; Kedia & Mishra, 2023; Engel et al., 2023). However, the majority of studies were conducted in developed countries, and those focusing on Vietnamese students' actual experiences with digital technology remain limited, especially from a qualitative perspective that addresses learners' personal experiences. Studies in Vietnam mainly use quantitative methods or emphasize organizational readiness, ignoring learners' difficulties and their own ways of adapting to technological changes.

This gap highlights the need for research on the organizational context, grounded in experiences of adaptation and overcoming difficulties, as Vietnamese students learn with digital technology after the pandemic. The study adds empirical evidence on digital education in Vietnam. Recommendations will be made to support education stakeholders in policy development. The paper presents new ideas to initiate additional research on COVID-19 and digital technology. Two research questions guide the study: (1) What are the consequences of using digital technology to support education in Vietnam following the COVID-19 pandemic?; (2) What tactics were developed in Vietnam following the COVID-19 pandemic to address the difficulties involved in utilizing digital technologies to advance teaching and learning?

2. LITERATURE REVIEW

2.1. Effects of Digital technologies on teaching and learning

The need for digital technologies fosters the development of an open and collaborative pedagogical model that extends instructional practices beyond the classroom (Goh & Sigala, 2020) as LMSs offer creative ways to collaborate (Giang & Nga, 2024). Digital technologies are necessary because they help students develop good attitudes (Štemberger & Konrad, 2021). To support teaching and learning, Goh and Sigala (2020) emphasize that educators can convert their content into digital formats.

The current study advocates this claim by providing flexible study and practice options that allow students to learn at their own pace, thanks to digital learning resources and effective teaching techniques. According to Lim et al. (2020), digital technologies increase learning results, employ cutting-edge approaches, and facilitate better system management in education.

2.2. The difficulties of utilizing digital technologies

Drawing on the Technology Acceptance Model (TAM), Nurdin et al. (2023) found that a lack of guidance and technical support is increasingly acting as a barrier to the use of digital technology in the classroom. Abbas (2016) found that a teacher's ability to educate and the adoption of new technologies were both highly affected by a classroom's inability to use computers and other technologies. To close educational gaps, the COVID-19 pandemic

compelled Ghana to rapidly overhaul its education system to accommodate remote and at-home learning. Teaching and learning have become increasingly globalized, and digital technologies have a profound impact on education.

2.3. Foundation Theoretical

The Technology Acceptance Model (TAM), developed by Davis in 1989, is a widely used framework for understanding how users come to accept and use a technology. TAM posits that those two beliefs, perceived usefulness (PU) and perceived ease of use (PEOU) are primary determinants of technology acceptance (Abbas, 2016). Perceived usefulness is defined as the degree to which a person believes that using a particular system would enhance their job performance, while perceived ease of use refers to the degree to which a person believes that using a specific system would be free of effort (Scherer & Teo, 2019). TAM provides a valuable lens to analyze how students in Vietnam evaluate the benefits and challenges related to digital learning tools.

Constructivist Learning Theory (Narayan et al., 2013) advocates a student-centered approach, with teachers acting as facilitators who connect existing knowledge with new knowledge. This theory emphasizes that learners actively construct knowledge through interaction, reflection, and collaboration (Chuang, 2021). Digital platforms such as Zoom, Moodle, and YouTube align with this theory by transforming the learning process from passive to active and participatory in new learning environments. Digital platforms support the formation of constructivist classrooms, which increase student-teacher interaction. Students enjoy engaging in clarifying experiences through open-ended tasks, and they are given time to reflect after asking questions. The application of constructivist teaching methods encourages learners to actively seek knowledge from teachers, textbooks, and other information sources, such as the internet. Learning is assessed through products and processes.

Additionally, Connectivism (Hendricks, 2019) extends these ideas to the digital age, arguing that learning occurs through the ability to connect information sources and form knowledge networks. This theory explains how students can connect different sources accurately to find ideas, theories, and knowledge. Interactions and group chats from online communities and other online platforms are used to express different perspectives and positions when solving problems. This theory promotes nurturing and maintaining essential connections to facilitate continuous learning and adapt to ever-changing realities.

In summary, TAM, Constructivism, and Connectivism offer an overview of the learner-centered approach, where learners acquire knowledge through networks of connections that support learning, with teachers acting as facilitators. Together, these frameworks offer a comprehensive perspective for understanding how students in Vietnam adapt to digital learning environments and how their perceptions influence technology adoption in post-pandemic education. On that basis, this study applies a qualitative method to deeply explore university students' perceptions, experiences, and coping strategies in using digital technology for learning after the pandemic. The research results not only expand the application of TAM and Constructivism in the Vietnamese context but also provide practical implications for promoting digital transformation in higher education.

3. MATERIALS AND METHODS

3.1. Theoretical frameworks

Several studies in the educational setting have used TAM, demonstrating its effectiveness and adaptability (Afari-Kumah & Achampong, 2010). According to Rohatgi et al. (2016), TAM provides a suitable framework for examining and assessing technology adoption in education. Teo (2016) agrees that TAM is a straightforward, user-friendly, and effective tool for determining how technology is affecting education. According to Adu Gyamfi (2017), attitudes, perceived utility, and simplicity of use all have an impact on students' desire to embrace digital technology for learning.

Despite its strengths, the application of TAM in educational research also presents certain limitations. One key issue is that TAM primarily focuses on cognitive beliefs (PU and PEOU) and largely ignores social and contextual factors that can influence technology acceptance (Lin & Yu, 2023). Venkatesh and Bala (2008) suggest that this narrow focus can be a hindrance when developing a comprehensive research model for technology acceptance in educational contexts. Furthermore, while TAM has been effective in predicting technology acceptance, it may not fully capture the complexities and dynamics of learning environments where various external factors play a significant role.

Similarly, on applying TAM to online learning in Egyptian universities, Farahat (2012) found that students' perceptions of ease of use, practicality, and attitudes toward online learning were essential determinants of their learning practice Simonaitiene & Kutkaityte (2013) conclude that TAM can be directly implemented in developing countries like Ghana to assess students' intentions to use digital technologies and their impact on teaching and learning. A study on university students' self-reported intentions to use digital technologies in Vietnamese higher education institutions found that perceived usefulness, perceived ease of use, and attitudes significantly impact the use of digital technologies in education.

3.2. Methodology

3.2.1. Research design

This study employs a qualitative research design, specifically utilizing phenomenology to explore students' experiences with digital technology during the COVID-19 pandemic. Qualitative research enables an in-depth exploration of individuals' subjective experiences, offering rich insights into how people interpret and assign meaning to their lived experiences.

Phenomenology, as our chosen approach, focuses on understanding how individuals perceive and make sense of their experiences. This method enables researchers to delve into participants' consciousness and thought processes, offering a unique perspective on how people experience and interpret various phenomena. In our study, this approach enabled us to gain valuable insights into how students experienced and utilized digital technology during their educational journey during the pandemic.

The semi-structured questionnaires were designed to prioritize open-ended questions that could elicit detailed and nuanced responses. This strategy was crucial for gathering rich, comprehensive data on participants' experiences. We avoided simple, superficial questions and instead asked deeper, probing questions that encouraged participants to reflect deeply on their experiences and share specific examples.

For instance, rather than asking a closed-ended question like "Did you find digital technology helpful during the pandemic?", we posed more open-ended questions such as "Can you describe a specific instance when digital technology significantly impacted your learning experience during the pandemic?" This approach allowed participants to express their thoughts and feelings in their own words, yielding detailed narratives and a more comprehensive understanding of their experiences.

By employing this method, we collected in-depth data that provided a nuanced understanding of students' experiences with digital learning technologies during the COVID-19 pandemic. This approach aligned well with our research goals, enabling us to explore the complexities and varied perspectives of students' lived experiences in this unprecedented educational context.

3.2.2. Data collection and analysis

Data for this study were obtained from 30 students at Nguyen Tat Thanh University, selected through convenience sampling (see Table 1). The inclusion criteria ensured that all participants had attended online classes during the COVID-19 pandemic and possessed prior experience with digital learning platforms such as Zoom, Google Meet, or WhatsApp. The sample was intentionally diverse in gender, academic major, and year of study, thereby capturing a range of perspectives. Notably, the proportion of female participants was higher, while the distribution across majors and study years was relatively balanced.

Prior to data collection, all participants provided informed consent, consistent with ethical research standards. Data were gathered through semi-structured interviews, allowing the researchers to pursue additional questions for clarification and depth when appropriate. Each interview lasted approximately twenty minutes and was conducted online in accordance with pandemic-related restrictions.

To ensure analytical rigor, a qualitative content analysis approach was adopted. Interview transcripts were repeatedly reviewed to identify recurring themes and subthemes reflecting students' perceptions of digital technology use in learning during the pandemic. The two researchers independently coded the data and subsequently compared their categorizations to reconcile any discrepancies through discussion and consensus. This process enhanced the credibility and reliability of the findings.

Table 1. Demographic statistics

		Frequency	Percent (%)
Gender	Female	16	53.33
	Male	14	40.00
Year	First year	6	20.00
	Second year	8	26.67
	Third year	8	26.67
	Fourth year	8	26.67
Academic program	Economics Administration	5	16.67
	Engineering – Technology	5	16.67
	Health science	4	13.33
	Social sciences - Humanities	4	13.33
	Arts – Fine Arts	4	13.33
	International Education	4	13.33
	Postgraduate Study	4	13.33

The study employs a thematic analysis approach following the six-phase coding framework proposed by Hagens et al. (2009). All interview transcripts were manually processed using Microsoft Excel, enabling systematic coding, theme identification, and verification through iterative review and discussion among researchers. The analysis ensured both rigor and transparency throughout the data interpretation process.

(1) *Familiarization with the data*: All interview transcripts were read multiple times to gain a holistic understanding of the context and participants' perspectives. Each transcript was entered verbatim into Excel, with every row representing an excerpt. Participant codes were assigned numerically from 1 to 30 for confidentiality and tracking purposes.

(2) *Generating initial codes*: Two researchers independently coded the data by identifying meaningful textual units. Initial codes were recorded in the "original code" column to capture the participants' direct expressions and experiences.

(3) *Searching for themes*: Codes with conceptual or contextual similarities were grouped into clusters. These clusters were then categorized into provisional themes using Excel's *Pivot Table* function to visualize frequency and relationships among codes.

(4) *Reviewing themes*: Themes were validated by ensuring that each was supported by at least two verbatim quotations from the dataset. The two researchers reviewed all themes independently and reached agreement on whether themes should be merged, refined, or separated, thus enhancing the internal consistency of the analysis.

(5) *Defining and naming themes*: Through iterative discussion, the research team finalized five overarching themes, each aligned with specific research questions.

Table 2. Summary Matrix

Main theme	Brief description	Link to research question
Tools & Software	Commonly used devices (phones, laptops) and learning platforms (Zoom, Moodle, YouTube)	RQ1
Impact on learning	Technology helps with flexible learning, quick access to materials	RQ1

Skill development	Improve typing, searching, and researching skills	RQ1
Challenges	Weak network, high cost, lack of technical support	RQ1
Coping strategies	Sharing resources, using public Wi-Fi, and group study	RQ2

(6) *Writing the report*: To verify the inter-coder reliability, two researchers independently coded 20% of the total data and compared their results. The Cohen's Kappa coefficient ($\kappa = 0.82$) indicated strong agreement (85%), consistent with McHugh's (2012) interpretation of substantial reliability. A codebook, complete Excel database, and audit trail were maintained to ensure transparency and traceability of the analytical process. Furthermore, the summary of themes was returned to five participants for member checking, confirming the credibility of interpretations and alignment with participants' intended meanings.

4. RESULTS AND DISCUSSIONS

4.1. The repercussions of using digital technologies

The participants reported that they mainly relied on laptops and mobile phones as their primary digital learning devices during the COVID-19 pandemic (Table 3). The interview extracts below illustrate the diversity of device usage and students' adaptive practices:

Extract 1: "*Alright, during this time, I used both the laptop and my mobile phone.*" (Participant 10)

Extract 2: "*I believe I utilized a variety of technologies during the COVID-19 pandemic. I worked on the laptop. I owned both a computer and a mobile phone, but I spent most of my time on the latter. I was reading practically everything, including Word and PDF documents. Thus, during the COVID period, my mobile phone served as my primary technological tool.*" (Participant 6)

Extract 3: "*My device of choice was a smartphone, or mobile phone.*" (Participant 7)

Table 3. Primary Digital Devices Used by Students

Device	Number of Responses
Laptop	10
Mobile Phone	20
Both	5

The data reveal that most students used **mobile phones** as their principal device for learning activities. As demonstrated in *Extracts 2* and *3*, smartphones became a dominant medium for accessing course materials, reading documents, and engaging in online communication. The preference for mobile phones can be attributed to their **portability**, **affordability**, and **ease of connectivity**, which aligned with the constraints of remote learning during the pandemic period.

From a pedagogical standpoint, these findings suggest that students' engagement with digital technology was shaped by both **functional accessibility** and **technological adaptability**. The simultaneous use of laptops and mobile phones (as shown in *Extract 1*) indicates a **multi-device learning environment**, where the learners flexibly switched between platforms to meet specific learning needs. This dual-device usage reflects the growing trend of **blended digital engagement**, a phenomenon also identified in global studies of online learning during the pandemic, emphasizing the centrality of mobile technology in sustaining learning continuity.

4.2. Software for Teaching and Learning

Software for teaching and learning constitutes an integral component of digital technology in higher education. The respondents reported using a variety of software applications to support online learning during the COVID-19 pandemic, as illustrated in the following extracts:

Extract 4: "*I was using Zoom on both the laptop and the phone.*" (Participant 9)

Extract 5: "*I utilized Moodle, Zoom, Google Meet, and WhatsApp.*" (Participant 3)

Extract 6: "*I utilized YouTube, Zoom, and Google Meet.*" (Participant 13)

Extract 7: "*We utilized our phones the most, in my opinion. Mostly because of the Zalo App*." (Participant 3)

Table 4. Software Used for Teaching and Learning

Software	Number of Responses
Zoom	15
Moodle	10
Google Meet	8
WhatsApp	6
YouTube	7
Zalo App	4

The findings demonstrate that the students employed a diverse range of software tools to facilitate communication, instruction, and self-directed learning. The most commonly used platforms - Zoom and Google Meet - functioned as primary video-conferencing tools that enabled real-time interaction between teachers and learners. Meanwhile, Moodle served as a learning management system (LMS) for organizing course content, submitting assignments, and accessing instructional materials.

In addition to these formal educational platforms, students also made frequent use of messaging applications such as Zalo and WhatsApp, and multimedia platforms such as YouTube, for both academic exchange and supplementary learning. These tools contributed to sustaining engagement and fostering a sense of learning community in an otherwise physically disconnected environment.

During the pandemic, the integration of such digital tools significantly enhanced accessibility, interactivity, and continuity in education. The respondents emphasized that these technologies allowed them to communicate effectively with instructors, collaborate with peers, and maintain learning routines despite restrictions on in-person classes. This broad adoption reflects the pedagogical adaptability of both teachers and students in response to emergency remote teaching conditions.

From an educational management perspective, these findings underscore the strategic importance of software infrastructure in ensuring instructional resilience. The convergence of synchronous platforms (Zoom, Google Meet) and asynchronous tools (Moodle, YouTube) demonstrates how blended technological ecosystems can sustain learning continuity amid crisis contexts. This evidence also highlights the necessity for institutions to invest in digital literacy training and technical support systems to optimize the educational value of such technologies in the post-pandemic period.

4.3. Impact on Learning

Extract 8: "*Well, it makes sense. The smartphone proved to be a significant assistance, especially when the internet connection was strong. I managed to access the internet using my smartphone. Additionally, I believe the laptop is excellent because it allows you to examine documents and adhere to online learning guidelines.*" (Participant 30)

Extract 9: "*Yes, they had a significant effect on my education. Learning was somewhat simplified because most of the resources and sample questions were available on Moodle. This eliminated the need for me to print hard copies, allowing me to read and study in the comfort of my own home using the course materials we would use in class*." (Participant 26)

The respondents' reflections highlight the positive educational impact of digital technologies during the pandemic. As shown in Extract 8, smartphones played an essential role in facilitating continuous access to learning materials, particularly when stable internet connectivity was available. Laptops complemented this process by enabling students to review course documents and comply with institutional learning requirements more effectively.

Similarly, Extract 9 illustrates how learning management systems such as Moodle supported resource accessibility and learning autonomy. The availability of course materials and practice exercises online helped students minimize reliance on printed materials and promoted self-paced learning. This shift not only optimized students' study habits but also reflected an adaptive transition toward digitally mediated learning environments.

Overall, the integration of digital tools aided students in overcoming spatial and logistical barriers, enabling learning to continue regardless of physical location. These findings underscore the pedagogical value of digital technology in enhancing flexibility, convenience, and engagement in remote education. Importantly, they also indicate that when technological infrastructure and connectivity are sufficient, students are more likely to perceive online learning as effective and sustainable.

From an educational management perspective, such results emphasize the necessity of strengthening digital infrastructure and expanding access to online platforms to ensure equitable participation in technology-enhanced learning. The experiences reported by students affirm that digital technologies, when appropriately integrated, can significantly contribute to maintaining educational continuity and improving learning outcomes in times of disruption.

4.4. Impact on Skill Development

The findings indicate that the integration of digital technologies significantly contributed to the enhancement of students' learning skills, particularly in typing, information searching, and research practices. These competencies are closely aligned with the broader objectives of technology-mediated education, which emphasize learner autonomy and academic efficiency.

Extract 10: "*Yes, it has really helped me become more adept at conducting research and finding information on a variety of topics*." (Participant 25)

This reflection exemplifies how the use of digital tools improved students' capacity to locate, evaluate, and synthesize information from multiple online sources. As shown in Table 5, the most frequently mentioned skill was information seeking, followed by conducting research and typing - indicating that students not only developed technical proficiency but also refined higher-order cognitive skills associated with academic inquiry.

Table 5. Skills Enhanced by Digital Technologies

Skill	Number of Responses
Typing	12
Conducting Research	18
Information Seeking	20

The data further suggest that exposure to digital platforms fostered a more efficient and self-directed approach to learning. By leveraging digital resources, students could access academic materials, journals, and databases more conveniently, thereby enhancing their capacity for independent study. The transition from traditional to digital environments encouraged learners to adopt effective study habits, such as online exploration, note-taking, and synthesis of digital texts.

From an educational perspective, the improvement in these skills reflects not only the functional benefits of technology but also its transformative role in shaping students' learning behaviors. The findings are consistent with global research highlighting that digital literacy and information fluency are core competencies for 21st-century learners. Students' ability to conduct online research and manage digital information demonstrates the interconnection between technological engagement and academic skill development.

Overall, these results underscore the value of integrating digital technologies into teaching and learning to strengthen learners' cognitive and technical competencies. This alignment between skill development and digital engagement provides empirical support for promoting technology-enhanced learning strategies in higher education, particularly in contexts where independent inquiry and research are essential learning outcomes.

4.5. Challenges

Among the challenges identified, network connectivity emerged as the most critical issue affecting students' participation in online learning (Table 6). This difficulty was recurrently emphasized by several respondents:

Extract 11: "*A network issue occurred. We understand that network outages are inevitable in areas with inadequate internet service, which occasionally makes it impossible for us to conduct online learning*." (Participant 28)

Extract 12: "*Network issues, indeed. My connection to the network was not very good. On occasion, it was fine. There are also occasions when the connection was bad*." (Participant 27)

Extract 13: "*Network connectivity was the main issue I ran into. Furthermore, the problem with my network connectivity was related to my physical location, specifically my place of residence*." (Participant 28)

Table 6. Main Challenges Faced by Students

Challenge	Number of Responses
Network Connectivity	20
Cost of Internet Packages	10
Lack of Technical Support	8
Limited Device Access	5

As shown in Extracts 11–13, poor internet connectivity was a persistent obstacle for many students, particularly those living in areas with inadequate broadband infrastructure. Unstable network conditions disrupted synchronous classes, delayed access to course materials, and hindered real-time interaction between learners and instructors. These limitations directly affected students' engagement and reduced the overall quality of their online learning experiences.

Another significant challenge involved the high cost of internet data packages, which placed a considerable financial strain on the students (Table 7).

Table 7. Costs of Internet Packages

Cost (per month)	Number of Responses
Less than $10	5
$10 - $20	15
More than $20	10

Extract 14: "*The cost of internet packages is very high. It has become a significant burden on my finances*." (Participant 15)

Extract 15: "*I had to limit my internet usage because the packages were expensive. This affected my ability to attend all online classes and access learning materials*." (Participant 22)

The high prices of data packages often compelled students to restrict their internet use, thereby limiting access to essential resources and participation in online classes. Combined with technical issues and insufficient support, these constraints resulted in unequal learning opportunities among students.

In addition, the absence of technical support and the limited availability of digital devices further exacerbated these difficulties. The students with only smartphones or shared devices faced challenges in completing assignments or participating in video-based lessons. These findings highlight the interdependence of infrastructure, cost, and support systems in shaping students' online learning experiences.

From an educational management perspective, addressing these issues requires system-level interventions, including investment in digital infrastructure, subsidized internet plans for students, and the establishment of dedicated technical support services. Such measures would not only alleviate connectivity-related burdens but also ensure equitable access to digital learning environments.

Overall, the qualitative evidence underscores the complex and multifaceted nature of the challenges students faced during the pandemic. While digital technologies expanded learning possibilities, structural inequalities in access and affordability remained critical obstacles. Institutional efforts to mitigate these disparities will be essential to achieving inclusive and sustainable digital education in the post-pandemic era.

4.6. Discussion

The findings of this study revealed that during the COVID-19 pandemic, the students at Nguyen Tat Thanh University actively utilized a range of digital devices, particularly smartphones and computers, to support their learning. This result is consistent with prior research emphasizing the growing role of digital technology in higher education. For instance, Papadakis and Kalogiannakis (2017) highlighted that mobile phones have created opportunities to renew educational practices, while Agyei and Voogt (2011) demonstrated that integrating mobile technologies can enhance learners' engagement and self-efficacy. Similarly, Mailizar et al. (2020) found that the use of digital tools in Indonesia played a significant role in maintaining instructional continuity during school closures caused by the COVID-19 pandemic.

Another noteworthy finding is that students' devices were equipped with various learning-facilitating softwares, including Moodle, Zoom, WhatsApp, Google Meet, and YouTube. This aligns with Pokhrel and Chhetri (2021), who identified similar platforms - such as Microsoft Teams, Google Classroom, Canvas, and Blackboard - as essential for teaching during the pandemic. Likewise, Petrie (2020) and Crawford et al. (2020) underscored that synchronous and asynchronous digital systems across Europe supported the development of both pedagogical and skill-based learning modules. These findings collectively affirm that the adoption of educational technology was instrumental in ensuring the continuity and adaptability of teaching and learning during crisis conditions.

However, the study also identified several challenges associated with digital technology use, including limited technical proficiency, network instability, and inadequate support systems. Some students expressed difficulty navigating certain software applications due to their unfamiliarity with digital platforms. This observation corroborates the findings of Bansah and Darko Agyei (2022), who noted that integrating digital tools into classroom instruction can be complex and context-dependent. Moreover, Zhu and Liu (2020) identified multiple barriers - technological, institutional, personal, and sociocultural - that may impede effective technology adoption. In the same vein, Agyei and Voogt (2011) noted that poor time management, limited internet access, insufficient professional training, and limited awareness of pedagogical integration often constrain the successful implementation of digital learning initiatives.

Beyond empirical insights, the current research contributes to the theoretical understanding of digital learning through the lens of three interrelated frameworks: the Technology Acceptance Model (TAM), Constructivism, and Connectivism. These models collectively form a conceptual triad explaining how digital technologies facilitate a shift from teacher-centered to learner-centered education.

From the TAM perspective, Nguyen Tat Thanh University students recognized the perceived usefulness of digital technology as a key driver of their engagement, although the perceived ease of use remained relatively low, indicating that students are still in the process of developing digital fluency. This is consistent with the transition phase of technological adaptation in educational contexts.

From a constructivist perspective, digital learning platforms offer students opportunities for active engagement, feedback, and knowledge construction. Online materials and interactive environments encouraged learners to explore, respond, and co-construct meaning collaboratively - an approach consistent with Akpen et al. (2024), who emphasized that digital feedback loops promote deeper understanding and learner autonomy.

Finally, through the lens of connectivism, students' participation in online networks during the pandemic reflected a new paradigm of knowledge acquisition. By using digital platforms to connect, share, and co-learn, students extended their learning environments beyond traditional classrooms. As connectivist theory suggests, learning effectiveness depends not only on internalized knowledge but also on the ability to access, update, and exchange information across a dynamic network of knowledge sources. Open learning communities, social media platforms, and collaborative digital spaces thus became expanded learning ecosystems, allowing students to sustain intellectual and social interaction even in isolation.

In sum, the findings reaffirm that Nguyen Tat Thanh University's integration of digital technologies supported the transformation of learning practices toward interactivity, autonomy, and connectivity. However, they also emphasize the ongoing need for institutional support - particularly to improve students' digital literacy, technical infrastructure, and pedagogical capacity - to ensure that technology adoption translates into sustainable educational innovation.

5. CONCLUSION

This study explores how students at Nguyen Tat Thanh University utilized digital devices to support learning during the COVID-19 pandemic. Grounded in the Technology Acceptance Model (TAM), the research employed a qualitative design through semi-structured interviews with 30 students. The findings indicated that the students primarily relied on computers and smartphones as their main learning tools. These devices were used to access and interact with various educational applications, including YouTube, Moodle, Zoom, Google Meet, and Zalo, which played a central role in facilitating online learning.

The study also identified several challenges that hindered the effectiveness of digital learning. These included unstable network connectivity, high internet costs, limited device quality, and insufficient experience with educational software. Such barriers reduced the accessibility and quality of learning experiences for many students, particularly those from disadvantaged backgrounds or areas with poor infrastructure.

One of the key implications of this research is the urgent need to strengthen students' digital literacy to ensure effective engagement with technology. Educational institutions should implement comprehensive digital literacy programs focusing on both technical and pedagogical competencies - helping students not only use digital tools proficiently but also apply them purposefully for learning. Such programs could be integrated into general education curricula or offered as short-term training modules.

In parallel, universities should establish robust technical support systems to help students resolve technological issues and navigate online learning environments. This support may take the form of dedicated help desks, real-time troubleshooting services, or digital learning centers providing guidance on software use and data security. Reliable technical assistance can significantly reduce frustration and improve the continuity of online learning.

From a policy perspective, ensuring equitable access to digital education remains a national priority. Policymakers should consider subsidized data packages, university–telecom partnerships, or education-specific internet discounts to alleviate students' financial burden. Moreover, sustained investment in internet infrastructure, particularly in rural and remote areas, is essential to ensure consistent, high-quality connectivity - an indispensable condition for effective digital learning implementation.

In addition to addressing immediate challenges, future research should expand on these findings through longitudinal studies assessing the long-term impact of digital technology use on students' academic performance, learning behaviors, and skill development. Comparative research across different institutions, disciplines, and regions could identify best practices and systemic barriers, thereby informing evidence-based strategies for integrating technology in higher education. Furthermore, the exploration of emerging technologies - such as artificial intelligence (AI), virtual reality (VR), and augmented reality (AR) - offers promising directions for enhancing engagement, interactivity, and personalization in digital learning environments.

In summary, this study underscores the transformative potential of digital technologies to maintain educational continuity amid unprecedented disruptions. However, it also reveals persistent inequalities in access, literacy, and institutional support. Addressing these gaps requires coordinated efforts among educators, administrators, and policymakers to create inclusive, resilient, and future-oriented digital learning ecosystems. By fostering digital competence, expanding connectivity, and promoting equitable access, higher education institutions can ensure that technological innovation continues to serve as a catalyst for sustainable educational development in the post-pandemic era.

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