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E-Learning Platform Usage and Acceptance of Technology after the COVID-19 Pandemic: The Case of Transilvania University

Cristina Dimulescu 

Faculty of Letters, Transilvania University of Brasov, 25 Eroilor Bd., 500030 Brasov, Romania;
cristina.dimulescu@unitbv.ro

Abstract: This research aims to examine the evolution of student attitudes toward the Transilvania University e-learning platform over a three-year period, encompassing the time before and after the COVID-19 pandemic. The study collected both quantitative and qualitative data through a structured online survey. Quantitative data were analyzed using descriptive statistics (frequency distribution) to measure changes in perceived ease of use, experiences, or degree of satisfaction, while qualitative responses were thematically analyzed to capture students' comments about the platform within the Technology Acceptance Model (TAM) framework. The findings indicate an increased usage of the e-learning platform and satisfaction with the user interface post-pandemic, along with a reduction in reported technical issues. Moreover, a predominantly positive sentiment emerged from the thematic analysis of student feedback. These results provide universities with evidence that higher education facilitated by an e-learning platform is sustainable and capable of offering enriched learning experiences, extending beyond the pandemic context.

Keywords: e-learning platform; TAM; user satisfaction; ease of use



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1. Introduction

As the digital transformation of education accelerates, understanding the factors that influence the acceptance and usage of e-learning platforms has become increasingly important. The pivot to online learning environments, significantly hastened by the COVID-19 pandemic, has placed e-learning platforms at the forefront of educational continuity. This study is situated within the context of Transilvania University, a higher education institution that, like many others, has faced the challenge of rapidly adapting to an online mode of instruction.

The significance of this research lies in its examination of the Technology Acceptance Model (TAM) constructs—perceived usefulness (PU), perceived ease of use (PEOU), attitude towards using (ATU), intention to use (ITU), and actual use (AU)—to understand post-pandemic technology acceptance among Romanian students. The paper examines the extent to which the pandemic has changed the frequency and nature of usage, enhanced perceptions of the platform's utility, and influenced overall student satisfaction with e-learning experiences at Transilvania University. It also assesses the efficacy of the university's e-learning platform in adapting to the changes experienced over the past three years.

Given the abrupt shift to online learning and the consequent reliance on e-learning platforms, this study aims to fill a gap in the literature by exploring these constructs in the aftermath of a crisis situation that forced an unprecedented global trial of e-learning technologies. Furthermore, this research addresses a significant lacuna by shedding light on the unique cultural, pedagogical, and technological nuances of the Romanian higher education system, which remain underexplored in this discourse.

The objectives of this study are twofold: to analyze the impact of the COVID-19 pandemic on the acceptance and usage of the e-learning platform at Transilvania University

and to assess how improvements to the platform post-pandemic may have influenced students' perceptions and usage behaviors. The scope of the study is confined to the experiences of a sample of students at Transilvania University, with the intention of deriving insights that may be applicable to similar contexts elsewhere, albeit with caution given the limitations inherent in the study's design and context.

The research addresses a critical gap in the existing literature by providing empirical evidence of the changes in Romanian students' technology acceptance and usage before and after the COVID-19 pandemic. Additionally, the study contributes to the refinement of TAM by examining its applicability in a post-crisis educational environment, offering insights that may inform future iterations of the model.

The structure of this paper is outlined as follows: following this introductory section, we engage with a detailed literature review which provides the foundation for our hypotheses. In this section, we dissect TAM and its pertinence to e-learning systems, as well as consider the widespread ramifications of the COVID-19 pandemic on digital learning environments. Building on this theoretical background, the subsequent hypotheses section delineates our predictive statements, each drawing from insights gained in the literature review. The methodology section then details the mixed-methods approach employed in harvesting data from the student body at Transilvania University. In the results section, we lay out the empirical findings relative to each TAM construct, while the discussion section situates these findings within the broader scholarly context. The paper culminates in a conclusion that encapsulates the principal discoveries of the study, acknowledges its constraints, and proposes avenues for subsequent inquiries.

This investigation builds upon a rich body of research exploring the determinants of e-learning acceptance and utilization, particularly under the extraordinary circumstances imposed by the COVID-19 pandemic. The shift to online learning environments across the globe has catalyzed an urgent need to assess and understand the factors that influence students' acceptance and use of such platforms. This study, therefore, is situated within the unique context of Romania's higher education system during a period of rapid transition and adaptation. It aims to contribute to the international discourse by providing insights from a Romanian university, thus enhancing the generalizability and depth of existing literature. Against this setting, the study is guided by the following central research question:

How have students' perceptions and experiences related to the e-learning platform at Transilvania University evolved in the post-pandemic era in terms of technology acceptance?

This question directs the ensuing examination of existing scholarly works in the literature review section, which sets the stage for a detailed exploration of the study's theoretical foundation and justifies the rationale behind employing TAM as the framework for analysis.

2. Literature Review

The advent of COVID-19 has undeniably transformed the educational landscape, necessitating an abrupt transition to online learning modalities across the globe. In examining these changes, researchers have primarily focused on two streams of inquiry: the technological adaptation of universities and the psychological and academic impact on students. Studies have found that educational development, leadership, and innovation play crucial roles in the ability of institutions to adapt and sustain successful practices [1–4]. Furthermore, research into student attitudes has revealed a complex landscape of acceptance and resistance, shaped by factors such as technological readiness, the quality of e-learning platforms, and the adequacy of support provided by educational institutions. Researchers studied the impact of COVID-19 on the teaching–learning process and aimed to discover students' attitudes to online instruction and their intention to use and their actual use of e-learning platforms in various countries around the globe: Cambodia [5], China [6,7], Egypt [8], Ethiopia [9], Germany [10], Indonesia [11], Iraq [12], Japan [13], Jor-

dan [14–18], Kenya [19], Mauritius [20], Malaysia [21–23], Morocco [24], New Zealand [25], Palestine [26], Poland [2], Saudi Arabia [4,27–31], South Africa [32], and Uganda [33].

The concept of e-learning involves the use of technology in the teaching-learning process [1], and facilitates the delivery of educational materials outside of the traditional classroom setting, creating an engaging and interactive learning environment. A technology-mediated learning approach of great potential from the educational perspective, e-learning includes web-based and mobile applications, learning techniques, and processes [4]. It can be used for a variety of educational purposes, such as online courses, supplemental instruction, research, continuing education and professional development, and certification. The use of e-learning technology allows learners to access educational content anytime, anywhere [32], it is also cost-effective and facilitates convenient self-paced learning [25]. E-learning is becoming increasingly popular due to its flexibility in terms of availability and access to resources. Additionally, learners can pick up new skills quickly and easily, while the use of e-learning technology enables educators to create a more engaging and interactive learning environment.

The COVID-19 pandemic determined teachers to use technology with ever-growing frequency [2,34]. The essential role of online platforms during the pandemic has resulted in their enhanced quality, which may naturally lead to their increased utilization by both students and faculty members [35]. Online platforms have shifted from being an additional resource to becoming the main method of delivering education, requiring a swift development of interface designs to cater to the emerging needs and expectations of users [36]. Funds have been allocated towards enhancing technological frameworks, and swift advancements in the architecture and deployment of these systems occurred to support widespread online learning [37]. The imperative to sustain uninterrupted education during lockdown periods spurred institutions to resolve longstanding technical problems, resulting in enhanced environments for online learning [38,39]. Examining, diagnosing, and refining these platforms have contributed to a reduction in technical difficulties [2]. Teaching online requires a different set of pedagogical content knowledge than face-to-face instruction. The success of implementing e-learning was found to be dependent on many factors, including organizational culture and policies, technological availability reliability, accessibility, usability, and content, and human resource capacity in terms of knowledge, skills, and attitude [40].

The world of higher education is changing rapidly after the COVID-19 pandemic, with many students relying on remote learning; consequently, the sustainability of higher education has become a significant challenge [2,4]. In order to sustain higher education, universities must adjust their teaching methods to suit the digital world. Many universities have already begun to implement online course delivery and assessment systems, while others are developing mobile applications to facilitate both teaching and assessment [34]. Additionally, universities must invest in the necessary hardware and software to ensure that their online learning systems are up-to-date and secure [18].

Online learning provides considerable flexibility to students' schedules, enabling them to learn at anytime, anywhere. The most popular tools for eLearning are Learning Management Systems (LMS) such as Moodle, video conferencing solutions like Zoom, virtual tutoring, and digital libraries [41]. The utility of an e-learning platform is two-fold: it facilitates visibility and transparency in communication and provides administrative management. Educational documents, communication applications between students, professors, and students, and tests can all be generated and posted online, and users can be notified of updates with signals [42].

A 2020 study on e-learning discovered a number of five factors influencing e-learning system usage: technological, e-learning system quality, trust, self-efficacy, and cultural aspects [17]. Technological factors refer to hardware, software and apps, technical skills for maintenance, support to users, and upgrading the infrastructure. E-learning system quality factors include accessibility, availability, reliability, and usability. These elements must be taken into account to ensure that learners have access to the resources they need, that the

content is always available, and that the system meets industry standards for reliability and usability. Culture factors and self-efficacy [7,43] refer to information and communication technology (ICT) literacy as the ability to use, manage, understand, and evaluate ICTs such as computers, the internet, software, hardware, and other digital and communication devices [14,43,44]. The trust factor refers to system protection and reliability as well as information privacy [7,17].

E-learning is different from blended learning [45], which is the combination of both face-to-face and online instruction, tailored to the educational purpose and requirement [1] in order to extend the time spent in class and add to the explanations provided during face-to-face lectures [46]. Since the outbreak of COVID-19, educational institutions have been utilizing blended learning, in which virtual instruction is coupled with traditional classroom teaching. This combination allows for students to be exposed to both technological advancements and instructor-led lessons [46].

The theoretical framework of the present study is based on the Technology Acceptance Model (TAM), developed by Professor Fred Davis in the late 1980s [8]. The model posits that the perceived usefulness and ease of use of a technology predict user acceptance [6,18,21,47–49]. The TAM is based, in turn, on Ajzen and Fishbein's psychological Theory of Reasoned Action, which assumes that people can act on their intentions when they are sufficiently motivated to do so [2,6,27,32,50]. TAM is a widely used theoretical model in information systems to understand and explain user acceptance of technology, and it was discovered to be one of the most frequently used theoretical frameworks in research papers about e-learning [13,25] within the timespan 2009–2018 [1].

TAM consists of two major independent constructs [4]: perceived ease of use (PEOU), and perceived usefulness (PU) which are both directly related to user acceptance behavior [18,47,49]. The theory suggests that when users perceive a system as being useful and easy to use, they will be more likely to accept it [2,3,6,27,31]. TAM also suggests that users are more likely to abandon a technology if they perceive it as being too difficult to use or not useful for their needs [47].

PEOU is a key factor in user acceptance of certain technologies, representing the personal belief that the use of certain technologies can reduce task performance effort [1,22]. It is one of the most important factors within TAM, which explains why and how people will use a technology product. This model suggests that if users perceive a system to be easy to use, they will be more likely to adopt and use it [43]. PEOU is often observed to have an outstanding effect on PU [2]. Factors such as intuitive design or features that enable quick access to relevant information, and providing students with good instructions on how to interact with the information can have a strong positive impact and can help create high levels of PEOU. The shift to virtual classrooms brought on by the pandemic has prompted a more profound interaction with e-learning systems among teachers and students. The continuous use and the essential incorporation of these platforms into everyday scholarly activities are expected to enhance the perceived simplicity of their operation [51]. Supporting this, existing studies suggest that consistent interaction with technological tools heightens familiarity and the perception of their user-friendliness [52].

PU refers to the personal belief regarding the improvement of professional performance as a consequence of technology use [1,5,43], or an individual's evaluation of how useful a given technology is for them in their work [11,31,50]. It is one of the two main psychological factors that determine whether or not someone will use and adopt a particular technology. In TAM, perceived usefulness is measured using scales that assess how helpful a particular technology would be and how likely it is to make daily tasks easier. The higher the score on the scale, the more likely individuals are to find the technology useful, thus increasing their intention to use it.

In addition to PU and PEOU, TAM incorporates three other variables that are derived from the former ones: attitude, intention, and actual use [2].

Intention to Use (ITU) is a core construct of TAM, and it is defined as the degree to which an individual intends to use and continue using [43] a given technology or system.

According to TAM, behavioral intention can be predicted by the two main drivers, PU and PEOU [2,31,32]. The satisfaction with the user interface is an essential factor, as it substantially impacts the learners' involvement and their ongoing engagement with the platform [53]. Some previous studies mention ITU as depending on factors, such as device connectivity, compatibility, memory or performance, network coverage, and speed [48].

Attitudes toward Using (ATU) a certain technology are strongly influenced by both PU and PEOU [2,43,54] and can be assessed through surveys or questionnaires, or by observing user behavior. Studies have shown that people who perceive an information system to be useful and easy to use are more likely to adopt it than those who do not have these attitudes. Moreover, attitudes toward using technology tend to change over time as features or technologies become increasingly familiar to users.

Finally, the Actual Use (AU) construct in TAM is concerned with how the actual users of a system interact with and use the system, and it is highly influenced by ITU [54,55] and all the other interconnected elements of TAM [2]. AU includes factors such as ease of use, frequency of use, task performance, and other related variables, which can contribute to or detract from the user experience. AU measures how often a user actually uses a system and also examines how effectively they are using it. It looks at whether users experienced any difficulties in using the system as well as their level of engagement with the system.

Within the scope of research on e-learning system usage, various theoretical frameworks offer perspectives on the multifaceted elements that influence user acceptance and interaction with technology. Among these, the Unified Theory of Acceptance and Use of Technology (UTAUT) stands out by incorporating concepts from multiple acceptance models, including TAM, and centers on performance expectancy, effort expectancy, social influence, and facilitating conditions as core determinants of usage intention and behavior. It also considers the moderating effects of individual differences such as gender, age, experience, and voluntariness of use [54]. The Technology Acceptance Model 2 (TAM2) is an update to the original TAM and adds new variables (subjective norm, image, job relevance, output quality, result demonstrability, voluntariness, and experience) to the original two primary variables of PU and PEOU [56], providing a richer context for assessing technology acceptance behaviors.

In selecting a theoretical model for the current study, we have chosen to employ the original TAM due to its focused approach on perceived ease of use and perceived usefulness, factors particularly salient to e-learning adoption. TAM's streamlined and well-validated constructs facilitate an examination that is both rigorous and relevant to the e-learning domain. While acknowledging the breadth and depth added by UTAUT, TAM2, and the further refined Technology Acceptance Model 3 (TAM3)—which encompasses additional variables such as computer self-efficacy and perceived enjoyment [57]—TAM was deemed most suitable for this investigation. Nevertheless, the extended constructs within UTAUT, TAM2, and TAM3 merit attention for future research endeavors as they may reveal additional layers of user behavior and preferences, thereby enriching the discourse on e-learning technology adoption in the emerging post-pandemic educational milieu.

The review of literature delineates the theoretical and empirical contours of TAM as applied to e-learning platforms, while also capturing the unprecedented shift in educational dynamics due to the COVID-19 pandemic. It is within this scholarly landscape that the current study anchors its subsequent investigation.

The literature has illuminated various factors that influence students' acceptance and use of technology-mediated learning, emphasizing the dual significance of perceived usefulness and perceived ease of use. Additionally, the pandemic's role as a catalyst for rapid technological adaptation in education has been noted [38]. These considerations form the basis upon which the empirical inquiry of this study is constructed.

As we transition from a theoretical foundation to empirical analysis, the forthcoming section delineates a series of hypotheses. These are implicitly informed by the established research and seek to explore the specific dimensions of e-learning platform adoption and satisfaction at Transilvania University. By interrogating these hypotheses, the study aims to

contribute nuanced insights into the interplay between student attitudes and technological adaptation in a post-pandemic educational context.

The ensuing hypotheses, therefore, arise as natural continuations of the discourse established in the literature, each seeking to quantify and qualify the ways in which TAM constructs manifest within the unique environment of Transilvania University.

3. Hypotheses

The literature review has provided a comprehensive background for understanding the multifaceted impact of the COVID-19 pandemic on online learning environments. Drawing from an extensive body of research, it is evident that the pandemic has catalyzed significant shifts in higher education, particularly in the utilization and perception of e-learning platforms. The emergent trends highlight variations in usage frequency, alterations in usage types, and changing student attitudes toward the functionality and effectiveness of digital learning tools.

Within this context, this study seeks to quantify and interpret these changes specifically within Transilvania University's e-learning environment over the preceding three-year period. It aims to dissect the nuances of students' engagement with the platform, discerning not only how their usage patterns have evolved but also how their satisfaction levels and perceived value of the e-learning experience have transformed in response to the pandemic's exigencies.

Accordingly, the forthcoming hypotheses are formulated to capture the essence of these changes, reflecting a synthesis of the literature review's insights. Each hypothesis is constructed to test a specific aspect of the e-learning experience, grounded in the theoretical framework of TAM, and informed by the preliminary data suggesting pandemic-induced shifts in educational paradigms. In the following, we will state the hypotheses, elucidating their significance and expected contributions to the discourse on pandemic-influenced education.

In developing the first hypothesis (H1), we anchor our prediction in TAM, which postulates that perceived ease of use and perceived usefulness are fundamental determinants of technology acceptance and usage behavior [6,18,21,47–49]. The sudden shift to online education during the COVID-19 pandemic has arguably accelerated user adaptation and familiarity with e-learning technologies. As such, we posit:

H1. *After the COVID-19 pandemic, there will be an increase in the e-learning platform's ease of use at Transilvania University.*

The confirmation of H1 would indicate that pandemic-driven intense technology usage may lead to a sustainably efficient e-learning experience. It addresses the study's objective to understand how a crisis can foster rapid technological adoption and result in enhanced user experiences [51,52]. Confirming H1 would support the study's objective to understand the lasting impacts of the pandemic on e-learning at Transilvania University. It would suggest that the intense period of technology usage has had a transformative effect on the educational environment, potentially leading to a more efficient and user-friendly e-learning experience. This, in turn, reinforces the notion of sustainability in educational technology adoption, an important aspect given the university's commitment to long-term e-learning strategies. In the broader context of e-learning, validating H1 would contribute to the discussion on how crises can catalyze rapid technological adoption and lead to a more positive user experience.

H2. *After the COVID-19 pandemic, there will be an increase in the e-learning platform user interface satisfaction at Transilvania University.*

User interface satisfaction is a key determinant of system usage and acceptance, as indicated by the extended versions of TAM. A user-friendly interface can enhance the perceived ease of use and overall satisfaction with an e-learning platform [51]. In the

context of e-learning, user interface satisfaction is critical as it directly influences learners' engagement and their continuous use of the platform [53].

The implications of H2 for the study are manifold. Firstly, it will examine the role of user satisfaction in the sustained use of e-learning platforms in higher education. Additionally, it will contribute to the broader field of e-learning by providing insights into how interface design adaptations, driven by the necessities of pandemic-induced online education, have potentially improved student satisfaction.

The expected trend, based on H2, is an increase in positive feedback regarding the user interface, which may be indicated by fewer complaints about navigation difficulties or technical issues, as consistent use over time leads to greater familiarity and adjustment to the platform. These changes are particularly pertinent within the pandemic context, which has transformed online platforms from supplementary to primary modes of educational delivery, necessitating a rapid evolution of interface designs to meet new demands and user expectations [36].

H3. *After the COVID-19 pandemic, there will be a decrease in technical issues experienced by students when using the platform.*

The justification for H3 centers on the expectation that subsequent to the COVID-19 pandemic, there will be a reduction in technical issues encountered by students utilizing e-learning platforms.

Literature supporting this hypothesis can be seen in studies that examine the evolution of e-learning during the pandemic. For instance, the necessity to maintain educational continuity during lockdowns acted as a catalyst for institutions to address pre-existing technical issues, leading to improved online learning environments [38]. Moreover, the extended period of reliance on e-learning allowed for iterative testing, troubleshooting, and enhancement of these platforms, contributing to a decline in technical difficulties [2]. In response to the pressing demands for educational institutions to provide stable and reliable e-learning platforms, investments were made in technological infrastructure, and there was rapid innovation in the design and implementation of these platforms to accommodate large-scale online education [37]. The immediate and far-reaching improvements made to address these challenges are likely to have long-term positive effects on the stability and robustness of e-learning technologies.

The implications of H3 are significant for the objectives of the paper, as a decrease in technical issues may correlate with an increase in user satisfaction, which in turn could lead to enhanced learning outcomes—a primary goal of e-learning initiatives. Moreover, a reduction in technical problems could influence the long-term sustainability of e-learning platforms, signifying a crucial advancement in the field.

In the broader scope of e-learning, confirmation of H3 would highlight the industry's resilience and capability to adapt to sudden increases in demand. This adaptability is a crucial quality that ensures the scalability and sustainability of e-learning platforms, especially in crisis situations. The expected trend, therefore, would be a continuation of the use of these improved platforms even as the necessity for remote learning decreases, demonstrating a permanent shift in educational delivery models.

H4. *After the COVID-19 pandemic, at Transilvania University, there will be an increase in the number of positive comments about the e-learning platform compared to the number of negative comments.*

This surge in positive commentary is hypothesized based on TAM, suggesting that increased satisfaction with technological innovations leads to more favorable user feedback [11,31,50]. Studies have shown a tendency for improved perceptions as educational institutions iterate on their e-learning offerings [38,39]. The validation of H4 would affirm the notion that continuous user feedback has been integral to the enhancement of the e-learning experience during the pandemic, suggesting a shift in the culture towards

embracing online education. This, in turn, can lead to higher rates of continued use and could potentially affect overall academic performance positively.

Expected trends that may emerge from this hypothesis include an ongoing enhancement of the quality and effectiveness of e-learning platforms as institutions continue to refine their offerings. This could be particularly evident in the way universities collect and respond to user feedback, integrating it into their development processes for e-learning systems.

H5. *After the COVID-19 pandemic, there will be a reported increase in the use of the e-learning platform at Transilvania University.*

This prediction is informed by the Technology Acceptance Model (TAM), which argues that user adoption of new technologies is influenced by their perceived usefulness and ease of use [2,3,6,31,47]. The compulsion towards remote learning during the pandemic has likely resulted in more robust and user-friendly e-learning platforms, as institutions endeavored to adapt to the new norm of education delivery. The necessity of online platforms during the pandemic has led to an improvement in their quality, which could naturally encourage more frequent use among students and faculty [35]. Five key factors were found to influence the use of e-learning systems: technology, quality of the e-learning system, trust, self-efficacy, and cultural elements [17].

The implications of H5 are significant for the objectives of the paper as an increase in platform usage could correlate with improved educational access and flexibility, thereby potentially enhancing overall academic outcomes. For the broader field of e-learning, an increase in usage post-pandemic could signify a permanent shift in educational delivery methods and a validation of online platforms as a mainstay in higher education.

Expected trends that may be highlighted by this hypothesis include continued investment in e-learning technologies by educational institutions and a growing preference for blended learning approaches that combine traditional and online education. Additionally, the pandemic's impact on online education may elucidate patterns of behavior where students and educators are more inclined to engage with digital resources, fostering a more technology-integrated learning environment in the long run.

Together, these hypotheses aim to address the transformation of the e-learning landscape in the wake of COVID-19, adhering to the call for a more nuanced understanding of digital learning's evolution. They engage with the theoretical aspects of TAM while also grounding the investigation in practical, observable changes within the university's learning environment. By examining these dimensions, the research will contribute valuable insights into the long-term effects of the pandemic on e-learning and inform future strategies for technology integration in education.

4. Materials and Methods

4.1. Method

This study adopted a mixed-methods research design, combining quantitative measurements with qualitative insights to provide a holistic understanding of the student attitudes and experiences towards the e-learning platform of Transilvania University, both before and after the COVID-19 pandemic. Employing a retrospective cross-sectional study approach, this research utilized a structured online survey (provided in Appendix A) anchored in the Technology Acceptance Model (TAM) to elicit responses from a targeted group of 127 third-year and master's students. This survey gathered both quantitative metrics—such as frequency of platform interaction, ease of use, satisfaction with the user interface, and technical problems—and qualitative insights into user experiences. The survey instrument, designed as a quasi-experimental and non-randomized measure and administered via Google Forms, lacked experimental controls or manipulations, which served to elucidate shifts in student attitudes toward the e-learning platform amidst the COVID-19 pandemic's upheaval.

To capture quantitative data, the survey employed Likert-scale questions that charted usage patterns, technical challenges, and levels of user satisfaction across the time span delineating the pre- and post-pandemic periods. These quantitative aspects were augmented with qualitative feedback to gain a more textured understanding of user experiences. Analytical methods spanned descriptive statistical analysis to highlight usage changes and thematic analysis to distill emergent themes from the qualitative comments. The adoption of these methodologies afforded a comprehensive perspective on e-learning experiences, sustaining a deeper exploration of technology acceptance and the enduring implications for digital education in the wake of the pandemic.

This design facilitated a juxtaposition of pre- and post-pandemic perceptions, enabling an analysis of longitudinal trends within a single point of data collection. Recognizing the limitations imposed by the unforeseen nature of the pandemic, which precluded a traditional longitudinal approach, we gathered data at a single point in time, asking participants to reflect on their experiences across the two distinct periods. This allowed for temporal comparisons to be drawn, albeit with the understanding that such comparisons rely on the accuracy of participants' memories. The retrospective approach, while a deviation from real-time data collection, was used for understanding past behaviors as real-time data was not available, thus still offering a valuable lens through which to view the pandemic's impact. This method, while not longitudinal in the conventional sense, provided a practical means to discern changes in student attitudes and behaviors toward e-learning platforms, leveraging the recency of events to minimize recall bias. Through this approach, the research sought to address the gap in the literature concerning the long-term effects of sudden digital transitions in higher education, particularly within the Romanian university context.

To quantify the evolution in student engagement and satisfaction with the e-learning platform, we calculated percentage changes using the following formula: $\text{Percentage Change} = \frac{(V2-V1)}{V1} \times 100$, where V1 represents the value (such as user satisfaction levels, ease of use ratings, number of positive comments, etc.) before the pandemic, and V2 represents the value after the pandemic.

This formula provided a clear metric for assessing the magnitude of change between the two timeframes. The resulting data enabled us to establish a baseline for future studies while offering immediate insights into the adaptation and resilience of educational practices in the face of such a global disruption. The comparative data provide a basis for understanding not only the immediate shifts that occurred but also set a precedent for longitudinal investigations that may follow.

By quantifying the changes in percentages, we offer a precise and normalized way of presenting the data, enabling us to determine not just the direction but also the scale of changes in perceptions and behaviors regarding the e-learning platform.

4.2. Participants

A convenience sample of 127 third-year students enrolled in the academic year 2022–2023 participated in the empirical research (Table 1). The students were enlisted with four faculties of Transilvania University: the Faculty of Letters (75 students or 59.1% of the total number), the Faculty of Psychology and Education Sciences (22 students or 17.3% of the total number), the Faculty of Law (21 students or 16.5% of the total number), the Faculty of Economic Sciences and Business Administration (9 students or 7.1% of the total number). The target categories were enrolled in Bachelor's degree study program, third-year only (81 students or 63.8%), and Master's degree study program first and second years (46 students or 36.2%), as they were the only students who used the e-learning platform before and after the pandemic that started in April 2020 in Romania. The third-year students were enrolled in the second semester of their first year at the time of the pandemic start in Romania. The majority of the participants were primarily between the ages of 20 to 22 years old. The participant pool included both male and female students. Although we did not collect specific gender distribution data, the gender ratio in our sample is reflective of the broader student population at Transilvania University. The majority of our participants

were ethnic Romanians, reflecting the demographic composition of Transilvania University and the surrounding region. All students had experienced traditional, in-person learning at Transilvania University before the COVID-19 pandemic and had transitioned to e-learning during the pandemic. This prior experience with both learning modalities provides a unique and valuable perspective for our study.

Table 1. Participants.

Faculty	Number of Participants	Percentage Out of the Total Number of Participants
Faculty of Letters	75	59.1%
Faculty of Psychology and Education Sciences	22	17.3%
Faculty of Law	21	16.5%
Faculty of Economic Sciences and Business Administration	9	7.1%

The research teacher delivered classes at the Faculty of Letters, so anonymity was heeded to ensure the students felt safe. An electronic form omitting personal information (name, initials, e-mail address) was used. Participation in the research was voluntary, and students had the option not to complete the form sent by the teacher; however, as shown in Table 1 below, the participation percentage was very high; 127 students out of 127 filled in the questions 1–11 in the electronic form, only one student opting out from completing questions 12 and 13, 91, 90, 87 and 90 students answered the open-ended questions 14, 15, 16 and 17.

Instead of drawing a sample from a larger population, we employed a census sampling method, distributing our questionnaire to the entire population of students that we had direct access to in the context of our research. This population consisted of students enrolled in the academic year 2022–2023 who were reachable and willing to participate.

The sample size of 127 participants was not determined through traditional sample size calculation methods (like power analysis) but was rather the total number of students we had at our disposal. This approach ensured that we captured the perspectives of all the available students, providing a holistic view of e-learning platform usage and acceptance among our study population. The sample size, while derived from four faculties of a single institution, Transilvania University, enabled a focused exploration of technology acceptance that considered the unique blend of contextual factors inherent to our setting. These include the predominant language spoken, ethnic composition, the distinctive features of the Romanian cultural area, and the specific socio-economic status that characterizes our academic environment. Such an approach permits a detailed understanding of user behavior and attitudes towards e-learning platforms, which could be obscured in broader studies. This institution-specific study, therefore, provides essential insights that, though stemming from a particular environment, resonate with the realities of similar contexts where these factors play a significant role.

The results offer an important case study for the implementation and acceptance of e-learning technologies within environments shaped by similar linguistic, cultural, and socio-economic dynamics. They also furnish a comparative framework for other institutions within the Romanian cultural sphere, or similar settings, to examine the applicability and resonance of these findings in their own milieu, thus enriching the broader discourse on technology acceptance in diverse educational landscapes. The targeted demographic composition of our sample reinforces the study's relevance, as it captures a variety of user experiences within a specific cultural and linguistic context. This demographic specificity does not limit the applicability of our findings but rather enriches the discussion around e-learning systems by highlighting how particular settings influence usage and acceptance.

4.3. Materials

Data was collected via an online survey (the questions can be found in the Annexes) designed using Google Forms and hosted on the university website. It included a combination of closed-ended and open-ended questions structured around topics such as the platform's ease of use, level of interactivity, availability of course materials, and overall satisfaction with the platform. The survey data were analyzed with Google Forms' built-in visualization features like pie charts, which aided in a clearer depiction of the responses. While these charts played a secondary role in data analysis and are not presented as figures in the publication, they helped clarify response trends and distributions, supporting the accuracy and consistency of our data interpretation.

The questionnaire was comprised of 17 items probing students' satisfaction, experiences, and engagement with the e-learning platform. The initial two items gathered demographic information regarding participants' faculty and level of study. Subsequent items, specifically from the third to the eighth and tenth to the thirteenth, were bifurcated to contrast user interaction with the platform across two timelines: before and after the onset of the pandemic. These questions focused on usage frequency, file upload habits, satisfaction levels, navigational ease, and any technical challenges encountered. The ninth item was designed to gauge perceptions of overall platform enhancement post-pandemic. The survey culminated with open-ended questions, numbered 14 through 17, soliciting detailed feedback on the platform, including aspects that users found beneficial or problematic, user-unfriendly features, and proposed improvements. For selected items assessing satisfaction (questions 7 and 8) and agreement with statements (questions 9–11), a five-point Likert scale was employed, ranging from 'dissatisfied' to 'very satisfied' or 'strongly disagree' to 'strongly agree', respectively. Usage frequency assessments (questions 12 and 13) also utilized this scale, ranging from 'very often' to 'never'.

5. Results

Investigation into the usage patterns of the Transilvania University e-learning platform revealed important changes post-COVID-19. Prior to the pandemic, student engagement with the platform was moderate and displayed significant variability in frequency. Table 2 illustrates these usage dynamics, with 19.7% of the student body accessing the platform multiple times per day, and a notable proportion, 26%, refraining from any engagement.

Table 2. Frequency of students' accessing the platform.

Frequency	Before COVID-19		After COVID-19		Percentage Change *
	Number of Responses	Percentage V1	Number of Responses	Percentage V2	
Several times a day	25	19.7%	20	15.7%	−20.30%
Daily	39	30.7%	66	52%	69.38%
Weekly	30	23.6%	39	30.7%	30.08%
Never	33	26%	2	1.6%	−93.84%

* $(V2 - V1)/V1 \times 100$.

In the wake of the pandemic, the landscape of e-learning utilization underwent a substantial transformation. The data reveals a marked escalation in daily usage to 52%, indicating a robust pivot to virtual learning environments catalyzed by the pandemic-induced necessity. The prevalence of weekly access also increased to 30.7%. Concurrently, those engaging several times daily declined by 20.30%, suggesting a consolidation of usage patterns into regular, albeit less frequent, interactions. Notably, the near eradication of non-usage, plummeting to 1.6%, highlights a comprehensive shift to e-learning reliance.

These shifts represent not merely reactive adjustments to extraordinary circumstances but also point to a potential recalibration of educational engagement models. The amalgamated increase in regular access (totaling daily and weekly use) denotes a 32.97% surge,

from 74% to an emphatic 98.4%, demonstrating a strengthened integration of the e-learning platform in students' academic routines.

The COVID-19 pandemic, while profoundly disruptive, inadvertently precipitated a strategic shift towards a sustainable model of education delivery. As illustrated in subsequent tables, there was a tangible increase in platform utilization for project submission and other academic activities. This adaptive response not only facilitated the continuity of education during crisis conditions but also proffered insights into the extended utility of virtual learning systems. The transition to the ubiquitous usage of e-learning tools suggests an irreversible step towards embedding digital resilience in higher education.

Table 3 details the statistical analysis of project submission patterns by Transilvania University students on the e-learning platform, providing insight into the behavioral shift due to the pandemic's impact. A significant upturn was noted in the complete submission of projects through the platform, with an increase of 36.95% post-pandemic. The change is notably less pronounced than the increase observed among students who submitted some projects, which saw a 64.55% hike.

Table 3. Students' project upload behavior.

Upload	Before COVID-19		After COVID-19		Percentage Change
	Number of Responses	Percentage V1	Number of Responses	Percentage V2	
All projects	35	27.6%	48	37.8%	36.95%
Some projects	48	37.8%	79	62.2%	64.55%
No projects	44	34.6%	0	0%	−100%

Pre-pandemic, a distinct fraction of students refrained from utilizing the online submission system, a behavior that was entirely absent in the survey period following COVID-19. This drastic shift to 0% non-usage indicates a universal adoption of the digital submission process, suggesting a critical reliance on digital infrastructure for academic continuity during and after the pandemic.

These findings highlight the role of the e-learning platform as a progressively indispensable tool in the academic framework of Transilvania University. The escalated adoption rates postulate the platform's integral function in the institution's strategic response to delivering uninterrupted education amidst global disruption.

In the aftermath of the pandemic, it is apparent that the e-learning platform's strength has been key in facilitating a transition to a more dynamic and resilient educational model. This transformation bodes well for future academic endeavors, with the platform's ongoing refinement promising an adaptive and enhanced learning environment. Such enhancements are poised to align well with the evolving academic and professional landscapes, equipping students with the requisite tools to achieve their career objectives efficiently.

The widespread satisfaction with the e-learning platform, as reported in the Likert-scale survey outcomes (Table 4), further corroborates the positive reception of these changes by the student body. With a leap from 12.6% to 33.1% in students reporting high levels of satisfaction, the university's efforts to improve the e-learning experience have been well-received, reflected in a substantial 162.69% increase in satisfaction levels. Concurrently, the elimination of dissatisfaction to 0% post-pandemic is a testament to the platform's enhanced efficacy and user experience.

Table 4. User interface satisfaction.

Likert Scale Items ¹	Before COVID-19		After COVID-19		Percentage Change
	Number of Responses	Percentage V1	Number of Responses	Percentage V2	
1	11	8.7%	0	0%	−100%
2	14	11%	4	3.1%	−71.81%
3	49	38.6%	25	19.7%	−48.96%
4	37	29.1%	56	44.1%	51.54%
5	16	12.6%	42	33.1%	162.69%

¹ 1 = dissatisfied; 5 = very satisfied.

These results not only illustrate a reactive adaptation to an unexpected global health crisis but also reflect an enduring strategic advancement in educational delivery at Transilvania University.

Table 5 presents the assessment of user experience concerning the perceived ease of use of the e-learning platform at Transilvania University before and after the onset of the COVID-19 pandemic. A significant transformation in student satisfaction levels is evident. Previously, 3.1% of students expressed dissatisfaction with the platform, which transitioned to a complete absence of discontent post-pandemic, indicating a decrease by the full 100%. This stark improvement highlights the university's successful enhancement of the user experience in the transition to a pandemic-induced online learning modality.

Table 5. Ease of use.

Likert Scale Items ¹	Before COVID-19		After COVID-19		Percentage Change
	Number of Responses	Percentage V1	Number of Responses	Percentage V2	
1	4	3.1%	0	0%	−100%
2	14	11%	4	3.1%	−71.81%
3	40	31.5%	13	10.2%	−67.61%
4	40	31.5%	42	33.1%	5.07%
5	29	22.8%	68	53.5%	134.64%

¹ 1 = dissatisfied; 5 = very satisfied.

The proportion of students who rated their satisfaction as 'somewhat satisfied' experienced a considerable decrease from 11% to 3.1%, reflecting a shift towards more positive attitudes with a 71.81% reduction in moderate satisfaction. More striking is the surge in the 'very satisfied' cohort, which more than doubled, increasing by 134.64% from 22.8% to 53.5%. Such findings indicate a notable elevation in the overall user experience of the platform post-COVID-19, implying the institution's adeptness at scaling and refining the e-learning infrastructure in response to heightened demand and scrutiny.

In terms of technical reliability, as outlined in Table 6, a pronounced decrease in the frequency of reported technical problems was observed. The occurrence of frequent technical issues declined substantially, with the 'very often' category witnessing a 63.96% reduction. Similarly, the 'often' category saw a decrease from 40% to 17.5%—a 44.79% reduction. Conversely, students reporting seldom encounters with technical issues rose to 70.6%, reflecting an over twofold increase (107.03%). Despite an apparent decrease in those reporting 'never' encountering problems, which fell by 65.65%, the overall trend signals a marked advancement in the platform's technical robustness.

Table 6. Frequency of technical problems occurrence.

Frequency	Before COVID-19		After COVID-19		Percentage Change
	Number of Responses	Percentage V1	Number of Responses	Percentage V2	
Very often	14	11.1%	5	4%	−63.96%
Often	40	31.7%	22	17.5%	−44.79%
Seldom	43	34.1%	89	70.6%	107.03%
Never	29	23%	10	7.9%	−65.65%

These results collectively infer an enhanced reliability and efficacy of the e-learning platform. The decline in the user-reported frequency of technical issues and the significant uptick in satisfaction levels highlight the university's commitment to quality in online education. It also suggests that investments in technology and process improvements during the pandemic have borne fruit, yielding a strong platform capable of supporting increased user loads with fewer disruptions.

The amelioration in technical performance and user satisfaction posits that the platform has evolved into a more user-centric and stable service, crucial for uninterrupted learning. These enhancements resonate with global shifts toward digital solutions in education, where technological reliability and user experience are paramount.

Table 7 synthesizes the qualitative feedback from open-ended survey questions designed to elicit students' perspectives on the e-learning platform's functionality and usability post-COVID-19 adjustments at Transilvania University. This section distills the essence of the students' feedback, focusing on prevalent themes and significant insights drawn from the narrative responses.

Table 7. Participation in the open-ended questions.

Question Number	Number of Responses	Percentage of the Total Number of Survey Participants
Q14	91	71.65%
Q15	90	70.87%
Q16	87	68.5%
Q17	90	70.87%

Responses to Question 14, which probed for positive feedback, indicate substantial endorsement of the platform's improvements during the pandemic. The recurrent mention of "easy" in 41.76% of responses underscores the platform's enhanced navigability and accessibility. The qualitative evidence reflects a wide appreciation for the platform's intuitive design and its capabilities for course access, project submission, and communication. Notably, students frequently acknowledged the platform's adaptability to various devices and the efficient organization of courses, which echoes the quantitative trend of increased user satisfaction documented earlier.

Question 15 revealed critical insights into the platform's functionality, with 61.11% of respondents highlighting connectivity as a primary issue, suggesting a need for improved infrastructure to handle peak usage times. The desire for a more personalized and aesthetically engaging interface suggests that while functional needs are met, there's room for enhancing the user interface to cater to diverse student preferences.

Question 16 explored user challenges, where a minority (14.94%) reported specific usability concerns mirroring previous connectivity and accessibility issues. The dominant sentiment, however, reflected satisfaction with the current feature set and usability, aligning with the earlier quantitative findings of improved user satisfaction.

Finally, responses to Question 17 offered constructive suggestions, prominently advocating for performance optimization, particularly in terms of platform speed and robustness

under high load conditions. Requests for more dynamic content management and customizable interface options present actionable feedback for ongoing platform development.

The feedback compiled from the open-ended questions directs attention to the interconnectedness of functionality, aesthetics, and performance in shaping user experience. The input calls for a balanced approach to e-learning platform development at Transilvania University, considering technical, visual, and user engagement aspects in future iterations. Implementing such recommendations can potentially translate into continued upward trends in user satisfaction and engagement, aligning with the university's strategic vision for accessible and inclusive digital education.

In conclusion, the results delineate a multifaceted portrait of the evolution in user engagement and satisfaction with the Transilvania University e-learning platform during the COVID-19 pandemic. Quantitative data suggest a substantial increase in the platform's use and perceived ease of use, while qualitative responses reveal nuanced views on the platform's functionality, uncovering prevailing issues and areas ripe for enhancement. Collectively, these findings highlight the integral role of e-learning as an educational facilitator in the pandemic era, presenting a critical opportunity for the institution to leverage student feedback for continuous improvement. As we transition to the Discussion section, we will contextualize these results within the broader landscape of online learning, dissect the implications of these trends for academic policy and practice, and propose strategies for addressing current challenges to optimize e-learning outcomes. This exploration aims to offer a comprehensive understanding of the adaptive measures that can be instrumental in shaping the post-pandemic educational environment at Transilvania University and beyond.

6. Discussion

The robust findings from the preceding Results section set the stage for a comprehensive discussion of the research question and hypotheses proposed at the outset of this study. The sweeping transition to e-learning platforms at Transilvania University, necessitated by the COVID-19 pandemic, has yielded significant insights into technology acceptance among students. The enhanced use and frequency, augmented user satisfaction, and reduced technical difficulties reported in the survey reflect a notable shift in the post-pandemic e-learning experience.

A crucial factor underlying this shift appears to be the enhanced PEOU and PU of the platform, tenets central to TAM [6,18,21,47–49]. Before the pandemic, e-learning platforms were often viewed as supplementary educational tools; however, the data indicate a paradigm shift with platforms now considered essential to educational delivery [2,4,36]. This acceptance is further evidenced by the increase in 'very satisfied' students from 22.8% to 53.5% and the elimination of dissatisfaction to 0%, underscoring the platform's efficacy and essential role during and after the pandemic (Table 5).

The dramatic reduction in reported technical problems—decreasing as much as 63.96% for frequent issues (Table 6)—highlights the university's efforts in scaling and refining the technological infrastructure. This not only mirrors the increased dependency on digital solutions for education but also reflects broader trends in technological improvement and system optimization in response to high demand [38,39]. The high percentage of positive feedback suggests the university's success in providing a more streamlined and user-centered e-learning experience.

Moreover, the modifications made to the platform in response to user feedback and technical challenges have not only met but surpassed the standard requirements of remote learning environments. Students' positive reception and suggestions for future improvements, such as enhanced design and system stability under heavy load, provide valuable direction for continued development. The results echo a wider educational context where e-learning is not a transient necessity but a permanent fixture in the landscape of higher education.

The analysis also indicates that the pandemic has served as a catalyst for educational institutions to reconsider and revamp their digital learning platforms [38]. This reinvention has facilitated a more resilient and adaptable framework for education, which may set a precedent for future e-learning initiatives across academia. The transformation witnessed at Transilvania University may serve as a case study for other institutions looking to evaluate and improve their e-learning platforms, ensuring that they are prepared to meet both current and future educational challenges.

In light of these findings, it is imperative to consider how this accelerated adoption and satisfaction with e-learning platforms will shape the educational experiences of future generations. The implications extend beyond the scope of the current pandemic, suggesting a sustained trajectory toward an integrated digital learning environment. As the discussion progresses, we will explore how the evidence gathered aligns with established theories and what the emergent trends suggest for the evolving narrative of e-learning.

The positive shift in the acceptance and satisfaction with the e-learning platform at Transilvania University, as reported in the current study, finds resonance with extant literature which posits that crisis situations can act as catalysts for accelerating technological adoption and enhancing user experience [38]. Previous studies have emphasized that satisfaction levels with e-learning systems are often correlated with perceived ease of use and platform reliability [53], which aligns with the decrease in technical issues and increased ease of use reported in our findings (Tables 5 and 6). For instance, the literature suggests that technical challenges are a significant barrier to e-learning satisfaction [38,39], an issue that seems to have been mitigated at Transilvania University post-pandemic. Moreover, the reported increase in 'very satisfied' users and the corresponding decline in dissatisfaction are consistent with trends observed in similar contexts where e-learning has shifted from a supplementary to a primary mode of instruction. Our findings also corroborate the literature that underscores the importance of a user-friendly interface and well-organized content in fostering positive educational experiences [51,53], as emphasized by the frequency of terms like "easy" and "interface" in student feedback (response to Question 14). These parallels between our results and previous studies not only validate our observations but also contribute to the broader understanding of e-learning efficacy in higher education's emergent paradigms.

Hypothesis H1 predicted an enhancement in the perceived ease of use of the e-learning platform post-pandemic. The surge in user satisfaction levels and the precipitous decline in reported technical issues validate this hypothesis and support the contention that PEOU is a significant determinant of technology acceptance (Tables 5 and 6). Notably, the absence of difficulty in platform features, as reflected by the responses to Question 16, underscores the successful adaptation and usability improvements made by Transilvania University, which is in line with the TAM premises. Within the framework of TAM, user acceptance of technology is determined by five interrelated constructs [4]: PEOU [2,43], and PU [11,31,50], both directly related to acceptance behavior [18,47,49], ATU [2,43,54], ITU [2,31,32], and AU [55]. If a system is perceived as useful and easy to use, users will be more likely to accept it [2,3,6,27,31].

The survey results summarized in Table 5 demonstrate that the ease of use of the e-learning platform has significantly improved since COVID-19. For instance, dissatisfaction with the platform decreased by 100%. Conversely, the quantity of students who were 'very satisfied' went up from 22.8% to 53.5%, a change of 134.64%. These results suggest that users had a much better experience with the e-learning platform compared to the pre-pandemic time and that the platform has become more user-friendly. The figures

slow login, or upload. Although users were found more likely to abandon a technology if they perceived it as being too difficult to use or not useful for their needs [47], the percentage of the complaining students was rather low.

The PU of the Transilvania University e-learning platform can be seen as increasing due to the survey results which indicate an increase in ease of use by 134.64%, as previous research indicated an increase in PU determined by PEOU increase [2]. This could lead to an improvement in ATU, the cognitive factor that influences the intention to use a system, and is strongly influenced by both PU and PEOU [2,43,54]. Additionally, the behavioral factor that influences the usage of a system, ITU, is likely to increase as previous studies demonstrated that it can be predicted by the two main drivers, PU and PEOU [2,31,32]. Increased levels of ITU were previously proved to result further in increased AU [54,55].

The significant post-pandemic percentage change of 134.64%, together with the other values, validate not only hypothesis H1 but also contributes to the demonstration that the five TAM constructs, as they were found on the rise at the time of the survey, in the period after COVID-19, led to the increase of students' technology acceptance.

Hypothesis H2 posited an increase in user interface satisfaction after the pandemic. The reported satisfaction (Table 4) and the positive responses to Questions 9 and 17 corroborate this prediction, aligning with TAM's stipulation that PEOU positively influences user satisfaction and subsequent technology use. The discussion can be further enriched by synthesizing these findings with the broader body of TAM research, noting the reciprocity between ease of use and satisfaction—a dynamic evidenced by the post-pandemic user experience at the university.

Validation of hypothesis H2 is directly linked to the students' perception regarding the ease of use of the platform that is connected to user satisfaction. PEOU of the TAM model is directly connected to increased user satisfaction with a system [31]. The TAM model is based on the idea that users' perceptions of ease of use will influence their attitude (ATU) and usage behavior (AU) of a system [2]. Therefore, if the PEOU is high, users are more likely to be satisfied with the system and use it more frequently [31]. The rise in PEOU is also supported by the answers to Question 9, inquiring whether students thought the platform improved after COVID-19. A high percentage, 38.6% of students, chose a Likert-scale 4, whereas 39.4% chose 5, namely "strongly agree". Additionally, Question 17 elicits recommendations on the desired platform improvements. Of the 127 participants, only 70.85% of students provided an answer and offered some suggestions documented in the previous section of the present paper.

Moreover, the variation in user satisfaction with the e-learning platform at Transilvania University (Questions 7 and 8, summarized in Table 4) displayed a 162.69% percentage change after COVID-19, thus demonstrating the second hypothesis. As from Table 4 in the previous section, the percentage changes after COVID-19 demonstrated that students' satisfaction improved greatly, consequently, their levels of PEOU were high as well. Hypotheses H2 and H1 are interconnected as they target PEOU and user satisfaction which are subject to a bidirectional relationship and depend upon each other [2].

As for Hypothesis H3, which anticipated a reduction in technical problems experienced by users, the data reflect a nuanced reality. While there is a marked reduction in frequent technical issues, the increase in seldom encountered problems suggests a diversification in user experience that requires more granular analysis. However, the overarching trend towards improved reliability and performance lends weight to the argument that perceived reliability enhances PEOU, potentially amplifying technology adoption.

The experimental findings summarized in Table 6 indicate that Transilvania University's e-learning platform has seen improved performance since the COVID-19 pandemic began, thus validating hypothesis H3. Specifically, there was a 62.96% decrease in the number of students who reported encountering technical problems "very often". A lower, but still significant 44.79% decrease was observed in the segment having chosen "often". In the same vein, the percentage of those who seldom encountered problems rose from 34.1% to 70.6%, a 107.03% increase. On the other hand, the percentage of those never encoun-

tering technical problems seemed to be higher before COVID-19 than in post-pandemic times: 29 students (or 23%) as against 10 students (or 7.9%), a 65.65% decrease. Despite the decrease of 65.65% in the category of those who never encountered technical problems, the changes in the other three variables suggest that Transilvania University's e-learning platform has become more efficient and reliable since the pandemic began, likely due to improved technology and alterations in organizational processes. Therefore, the overall conclusion is that the e-learning platform has improved its services since the pandemic began. The PEOU construct in TAM states that the perceived ease of use, or PEOU, is an important factor in determining the level of acceptance of technology. In this case, a decrease in technical problems would increase the PEOU, the most important of the TAM model, making it easier for users to adopt the technology and accept it. Previous studies determined that technology is likely to be forgotten by users if they perceive it as being too difficult to use or not useful for their needs [47]. Consequently, the proven decrease in technical issues could lead to an increase in overall user acceptance and utilization of the technology and consequently an increase in AU [2].

In evaluating Hypothesis H4, the shift towards more positive feedback about the platform is demonstrative of improved user perceptions. It is prudent to consider how these perceptions are not only shaped by PEOU and PU but are also reflective of the enhanced content delivery and academic support facilitated by the platform. This positive sentiment is consistent with prior literature, which outlines a positive correlation between user feedback and continued technology engagement [2,31,32].

The high frequency of positive comments can be linked to the PEOU construct. If a large percentage of respondents (71.65% of the total) chose to participate and share opinions about the platform, and an overwhelming majority of these comments are of a positive, appreciative nature, repeating the word "easy" in various structures of 38 answers, as stated in the previous section, the conclusion that may be reached is that increased levels of PEOU determine a positive user attitude, or ATU [2,43,54]. If users believe the platform to be easy to use and understand, they are more likely to have a positive opinion of the platform and leave positive comments about it.

The increase in positive comments about the e-learning platform can be linked to the PU construct as well, given that previous research highlighted the fact that individuals will use a certain technology if they perceive it to be useful for addressing their needs and goals [11,31,50]. Therefore, the increase in positive comments about the e-learning platform could be an indication that users perceive the platform to be useful and helpful. This, in turn, could lead to increased levels of ITU PEOU [2,31,32,43], and, as a consequence of increased behavioral intention, increased probability of actual usage (AU) [54,55] of the platform.

Finally, the support for Hypothesis H5 is evident in the increased utilization of the platform, a testament to the interplay between TAM constructs—PEOU, PU, ITU, and AU [2,54]. This reinforces existing literature positing the centrality of these constructs in fostering technology acceptance and habitual use in academic settings.

The summarized results in Table 2 (Questions 5 and 6, regarding the frequency of accessing the platform) and Table 3 (Questions 7 and 8, regarding students' project upload behavior) prove the validity of hypothesis H5.

After COVID-19, the overall frequency of access, that is, students who accessed the platform several times a day, daily and weekly, increased by 32.97%, whereas the percentage change of students who accessed daily was 69.38%. There was a considerable decrease, of 93.84%, of the students who never accessed it. After the pandemic, "no upload" behavior no longer appears in the results, and all participants in the survey declared that some or all their projects were uploaded on the e-learning platform.

These outstanding results aim to demonstrate that the AU construct of the TAM model in the particular case of Transilvania University was proved to derive from the four other constructs, PEOU, PU, ITU, and ATU [2,15,55].

The findings reveal that PU and ATU have a positive influence on the intention to use an e-learning instrument [26]. Perceived usefulness is the most important predictor of attitude towards adopting e-learning, followed by perceived ease of use [26]. These factors influence attitude, which in turn affects adoption intention. Therefore, it is important to ensure that users perceive e-learning tools as useful and easy to use, and that they feel capable of using them in order to increase adoption intention [26]. Building on these established correlations, our study has effectively addressed the central research question by demonstrating that the transition to e-learning platforms, expedited by the pandemic, has significantly altered students' perceptions at Transilvania University. The quantitative data we gathered showed a shift in the frequency and way students interact with Transilvania University's platform, bolstered by qualitative insights into their experience. The survey results indicate that students have not only grown accustomed to the practicality and utility of e-learning in a post-pandemic setting but have also developed a more favorable attitude towards its use. Consequently, we found that the heightened recognition of the e-learning tool's usefulness and the improved perception of its ease of use directly influence students' attitudes and their intention to adopt these technologies for learning. Hence, the study provides concrete evidence that the pandemic has played a catalytic role in enhancing the acceptance of e-learning, validating the TAM's applicability in analyzing student behavior in emergent educational paradigms.

While the present study offers insightful revelations into the post-pandemic e-learning experience at Transilvania University, it is not without limitations that could impact the generalizability and interpretation of the findings. First, the demographic scope of the survey respondents may not be representative of all student cohorts. Given that the survey was distributed among a narrow academic population, the results may reflect the technology acceptance and utilization behaviors of this group, but may not necessarily extrapolate to other universities with different demographic profiles.

The timing of data collection also presents a limitation. The survey was conducted in a period of global transition when users were possibly more adaptive to e-learning out of necessity, which may have affected their perceptions of ease and usefulness. As such, these results could represent a temporal snapshot colored by the extraordinary circumstances of the pandemic, rather than a stable trend in e-learning adoption and satisfaction.

Furthermore, the study's focus on the e-learning platform specific to Transilvania University may limit its application to other institutions. The unique features, resources, and support systems of the platform, which cater to the specific pedagogical and administrative context of one university, may not be present elsewhere, thus constraining the transferability of the study's conclusions.

Moreover, the use of a retrospective cross-sectional study design inherently restricts the ability to establish causality. While significant associations were found between the surveyed variables and user satisfaction or technology adoption, it cannot be definitively stated that improvements in the platform's usability directly caused these outcomes. Other unmeasured factors, such as increased familiarity with digital learning or enhancements in instructional quality during the pandemic, could also contribute to these perceptions.

Finally, the study's scope was confined to user perspectives on the e-learning platform, omitting broader external variables like technology access and internet connectivity. Future studies should extend to these areas, potentially through expanded surveys, interviews, or focus groups, to evaluate their influence on user satisfaction. Analyzing student feedback from various post-pandemic communication channels may also yield deeper insights into the e-learning experience.

To surmount these limitations in future research, longitudinal studies could provide a more dynamic view of e-learning evolution and a greater understanding of long-term user engagement trends. Expanding the participant base to include a more diverse array of educational institutions and demographic backgrounds would also enhance the robustness of the findings. Moreover, comparative studies with platforms used by other universities

could offer broader insights into the generalizability of the TAM in diverse educational contexts.

Building on the current study's findings and its limitations, there are several areas where future research is needed to deepen our understanding of e-learning post-pandemic evolution.

Reflecting on the theoretical foundations of this study, we anchored our analysis within the original TAM. However, alternative models exist that could potentially enrich the understanding of e-learning platform acceptance in diverse educational contexts. For instance, the Unified Theory of Acceptance and Use of Technology (UTAUT) [54] could offer deeper insights into the role of social influence and facilitating conditions, especially pertinent in post-pandemic educational reforms. Similarly, TAM2 [56] and TAM3 [57] introduce variables such as subjective norm and computer self-efficacy, which may play a significant role in technology acceptance in contemporary academia. While these models were beyond the scope of the current study, they represent valuable avenues for future research to explore.

Subsequent studies could address the demographic representativeness issue by including a wider range of participants from various academic disciplines and universities in the Romanian cultural area or beyond. This would enrich the dataset and provide a more nuanced view of how different groups adopt and perceive e-learning technology.

A longitudinal study design would be particularly beneficial to assess how perceptions and usage of e-learning platforms evolve over time, beyond the immediate effects of the pandemic. This could help differentiate between temporary changes in behavior prompted by the pandemic and permanent shifts in the educational landscape. Further research could also examine the impact of specific platform features on user satisfaction and learning outcomes, which could guide developers in creating more user-centric e-learning environments.

In addition to broadening the scope of the research population and methodology, future studies should also investigate the reasons behind the persistence of technical issues reported by a minority of users, despite overall improvements in the platform. Understand-

ments in a Romanian context. It suggests that university administrators should allocate resources judiciously to enhance e-learning systems, drawing on local user feedback for targeted updates. For software developers in Romania and other similar cultural areas, these findings highlight the importance of crafting strong and user-friendly e-learning solutions, taking into account local internet bandwidth considerations and the digital proficiency of the student population. Furthermore, these results advocate for Romanian educational policymakers to establish standards that ensure the technological frameworks support inclusive and sustained student engagement, factoring in the unique educational culture and practices prevalent in Romania. Such actions will not only bolster the effectiveness of e-learning but also contribute to long-term educational resilience not only in the Romanian academic landscape but also in other similar cultural areas.

In summary, this study's validation of increased PEOU and user satisfaction at Transilvania University provides valuable insights into post-pandemic educational technology adoption. The significant correlation found between PEOU, PU, and AU emphasizes TAM's relevance in understanding and predicting user engagement with e-learning platforms. The contribution of this research to the field of e-learning and educational sustainability is multifaceted: it offers empirical evidence from a Romanian university to support the evolution of e-learning in response to a global crisis, sheds light on the criticality of user-centered design, and prompts ongoing academic discourse on digital learning efficacy and accessibility. By doing so, it underlines the potential for e-learning platforms to continue facilitating education in varying contexts, thereby ensuring educational continuity in the face of disruptions and fostering long-term resilience in the educational sector.

7. Conclusions

The present study was conducted using the TAM model and analyzing the interconnected constructs of PU, PEOU, ATU, ITU, and AU to investigate the changes in terms of technology acceptance of students at Transilvania University concerning the e-learning platform after the COVID-19 pandemic. By surveying 127 students and analyzing data gathered through 17 questions mainly divided into Likert scale and open-ended questions, the hypotheses were tested, and the research question was answered. The results demonstrate that the primary goal of this experiment has been accomplished: there were increases in ease of use, decreases in technical issues, increases in user interface satisfaction, in the number of positive comments compared to the number of negative comments, and in reported usage levels after the COVID-19 pandemic. Despite the unfavorable circumstances of COVID-19 on higher education, Transilvania University managed to improve the platform, making it easier for students to accept and adopt the technology.

Since the onset of the COVID-19 pandemic, the e-learning platform of Transilvania University has seen many improvements. To ensure student safety and continuity of learning, the university has implemented various strategies to enhance its online learning environment. First, the university has upgraded its e-learning platform to make it more user-friendly and accessible to all students. It has incorporated new technologies such as video conferencing, online course management systems, and interactive resources to make learning accessible to students from anywhere. Second, the university has also implemented new tools and strategies to facilitate better communication between students, teachers, and administrative staff. This includes the use of online discussion forums, chat rooms, and virtual classrooms, which allow for real-time interaction among all participants. One of the main benefits of the platform is its flexibility. Students can access course materials and lectures from any location, allowing them to learn at their own pace and on their own schedule. This is particularly useful for those who have to balance their studies with other commitments or those who are unable to attend physical classes. This was especially useful during the COVID-19 pandemic, as it has enabled students to stay connected and continue their studies despite physical restrictions. The platform also provides an array of multimedia resources, including audio and video recordings, images, and interactive

elements. This allows students to engage with the material in a more dynamic way, which can be particularly useful for visual learners.

Within the timespan 2020–2023, the University introduced a suite of new features to the online platform to improve user experience, such as a drag-and-drop feature for assignment submission, a discussion board for communication and collaboration among students, an academic calendar for tracking academic progress, a user-friendly interface with simplified navigation, and an intuitive design. Additionally, a custom profile feature was added to store documents, connect with other students, and access learning materials. Furthermore, notifications for upcoming events and announcements were implemented.

The University's investment in these features has been met with favorable reactions from users, which prompted further upgrading of the platform through persistent addition of features and usability modifications. The recount presented in the conclusion of the research article underlined the technical advancements made by Transilvania University for their e-learning platform, and how these improvements heightened students' contentment with using the platform, as well as their inclination to use it. This recount furnished tangible proof of the success of Transilvania University's technological improvements and indicated that these changes have had a positive effect on student participation in e-learning. This evidence was valuable in demonstrating both the effectiveness of the TAM model survey, as well as the success of Transilvania University's endeavors to advance the e-learning platform.

The theoretical implications of our study are significant, as they contribute to the broader discourse on technology adoption in education. By utilizing the TAM model, this study reinforces the model's relevance in the post-pandemic educational context, suggesting its constructs remain robust predictors of technology acceptance. Our findings suggest that perceived usefulness and perceived ease of use continue to be vital factors in students' acceptance and use of e-learning platforms. Furthermore, the adaptation and extension of the TAM in the context of pandemic-induced educational disruption provide a valuable template for future research in similar crises.

Practically, the research has several implications for the management of e-learning systems at Transilvania University and potentially at other institutions. The positive reception of technological upgrades and the specific features valued by the university community should guide ongoing development priorities and user training programs. The clear preference for certain functionalities, such as the drag-and-drop feature for assignments and a more intuitive user interface, indicates a direction for future software enhancement efforts. Moreover, the strategic implementation of these features as a response to the COVID-19 crisis displays a successful model for rapid technological adaptation, a blueprint for other universities facing similar challenges.

In turn, the practice of continuous feedback collection and analysis, as exercised by Transilvania University, may become a standard process for academic institutions. This allows for agile responses to user needs and helps maintain the relevance and efficacy of e-learning platforms. In light of our findings, institutions may also consider investing in support structures that address external factors influencing e-learning success, such as student access to reliable internet service and technological resources.

Conclusively, this study not only evidences the effective application of TAM in a novel and challenging learning environment but also highlights the importance of user-centered design and iterative development in e-learning platforms. It points toward a future where educational technology is not only about the platforms themselves but also about the broader ecosystem of support, access, and design that must surround them to foster effective and inclusive digital learning.

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Informed Consent Statement: Informed consent was obtained from all students involved in the study and they were informed that they were free to choose not to participate in the research.

Data Availability Statement: The research database used in the present study is available on request from the corresponding author. The database is not publicly available.

Conflicts of Interest: The author declares no conflict of interest.

Appendix A

The Questionnaire

Q1: What is your faculty at Transilvania University?

Faculty of Letters ___ Faculty of Economic Sciences and Business Administration ___
Faculty of Law ___ Faculty of Psychology and Education Sciences ___

Q2: What study programme are you enrolled in?

Bachelor's degree, IIIrd year ___ Master's degree, Ist or IInd year ___

Q3: How often do you access the e-learning platform?

several times a day ___ daily ___ weekly ___ never ___

Q4: How often did you access the e-learning platform before the COVID-19 pandemic?

several times a day ___ daily ___ weekly ___ never ___

Q5: Do you upload your projects on the e-learning platform?

Yes, some of them ___ Yes, all of them ___ Never ___

Q6: Did you upload your projects on the e-learning platform before the COVID-19 pandemic?

Yes, some of them ___ Yes, all of them ___ Never ___

Q7: How satisfied are you with the user interface of the e-learning platform?

Dissatisfied 1 ___ 2 ___ 3 ___ 4 ___ 5 Very satisfied ___

Q8: How satisfied were you with the user interface of the e-learning platform before the COVID-19 pandemic?

Dissatisfied 1 ___ 2 ___ 3 ___ 4 ___ 5 Very satisfied ___

Q9: Do you think the e-learning platform improved during and after the COVID-19 pandemic?

Strongly disagree 1 ___ 2 ___ 3 ___ 4 ___ 5 strongly agree ___

Q10: Do you find it easy to work with the e-learning platform?

Strongly disagree 1 ___ 2 ___ 3 ___ 4 ___ 5 strongly agree ___

Q11: Did you find it easy to work with the e-learning platform before the COVID-19 pandemic?

Strongly disagree 1 ___ 2 ___ 3 ___ 4 ___ 5 strongly agree ___

Q12: How often do you experience technical issues with the platform?

Very often ___ often ___ seldom ___ never ___

Q13: How often did you experience technical issues with the platform before the COVID-19 pandemic?

Very often ___ often ___ seldom ___ never ___

Q14: Mention at least two positive aspects of the e-learning platform.

Q15: Mention at least two negative aspects of the e-learning platform.

Q16: Are there any features you find difficult to use?

Q17: Are there any improvements you would suggest for the e-learning platform?

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