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Management of E-Learning in Higher Education Institutions during the COVID-19 Pandemic

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Abstract

The purpose of this paper is to assess the experiences geared toward the implementation of e-learning strategies in public and private higher education institutions (HEIs) during the COVID-19 pandemic. The study explores the enabling factors that influenced the usage of e-learning systems during the COVID-19 pandemic in a society that is less digitally savvy. An emphasis was placed on structural equation modeling (SEM) to achieve our goal of studying quantitative research paradigms. Six hundred and thirty-seven valid responses suggested that the COVID-19 outbreak has positively and significantly influenced HEIs to adopt e-learning strategies. In addition, it was found that academic innovation and e-learning adoption had a significant mediation effect ($p > 0.05$) on the connection between the COVID-19 pandemic and e-learning implementation. The study provides useful contributions to the management and policymakers of universities and HEIs in terms of understanding the important factors that ensure the effective use of e-learning systems by students and professors. In conclusion, the results of this research offer a novel contribution to both the management and policymakers at public and private universities to evaluate and employ its findings for certifying the effective use of e-learning practices in pandemic crises.

Key words: *digitalization; education; sustainable development; teaching*

Introduction

Electronic learning has arguably gained more meaning as a result of the coronavirus COVID-19 (Abidah et al., 2020). As the Internet had gained popularity, many opportunities opened up, and one of these was e-learning (Mihhailova, 2006). A process by which computer network technology is used to distribute information and instruction to people over an intranet or the internet is called e-learning (Klein & Ware, 2003). Nowadays, it is widely accepted that e-learning is an effective alternative or a backup to face-to-face classroom instruction in most jurisdictions (Mpungose, 2020). E-learning is an educational approach that leverages electronic systems, which may include computers, the internet, multimedia applications, and digital content, to facilitate the acquisition of knowledge and skills (Joshi & P. J., 2023). It typically encompasses various instructional strategies, such as online courses, virtual classrooms, video lectures, interactive simulations, and digital assessments (O'Connor et al., 2023). E-learning offers advantages like flexibility, scalability, and the ability to adapt to individual learning needs, making it a valuable tool in modern education (Liu & Yu, 2023). It is rooted in instructional design principles, cognitive psychology, and information technology, aiming to provide efficient and effective learning experiences in diverse educational settings, from formal institutions to corporate training (Çebi, 2023). As a consequence of COVID-19 being declared a global pandemic (Puvača et al., 2021) by the World Health Organization (WHO), many educational institutions had to adopt e-learning solutions as a substitute for face-to-face learning. Initially, one may have assumed that this phenomenon was limited only to developing countries (Đurić et al., 2023). Despite this, applying e-learning solutions to Higher Education Institutions (HEIs) remains a global challenge. Although this is true, a developing country in the Balkans was hit hard after the its government abruptly closed all educational institutions (EIs) having recorded the first cases of COVID-19 in the country. Coronavirus has been dismantling the traditional way of doing things, especially in the areas of teaching and learning, as a result of pandemic development (Coman et al., 2020; Gedro et al., 2020; Özer, 2020). Even though the concept of e-learning has been around for quite some time now, major challenges to the effective employment of e-learning in HEIs will include access to the internet in certain areas of the country, the high cost of internet data, and insufficient availability of electronic devices, such as smartphones or computers (Aboagye et al., 2020; Akaslan & Law, 2011; Gaskell & Mills, 2014). A major barrier to fully implementing e-learning solutions at HEIs is the culture of public universities, where policy regulations compel students to attend lectures to be considered successful in earning their credit hours (Jokiaho et al., 2018; Sims et al., 2008).

Literature review

Specifically, e-learning can be defined as the inclusion of all forms of learning and teaching completed over the internet using a laptop computer or a smartphone (Kumar

Basak et al., 2018) to distribute audio or video recordings of lessons by professors to students, instead of live physical interaction (Hermawan, 2021). As a result of the outbreak of the COVID-19 pandemic, all EIs in Serbia and worldwide have been forced to switch from one mode of teaching and learning to another. The survival of HEIs, during crises, can be dependent on their innovativeness in conjunction with the availability of the necessary infrastructure for e-learning to operate properly (Filippetti & Archibugi, 2011; Naidoo, 2010; Sterling, 2004). For example, private Universities in Serbia, especially at University Business Academy in Novi Sad, e-learning solutions have always been on the agenda, by accrediting the Distance Learning System (DLS) for the first time in Serbia in 2011, through the Ministry of Education and Technological Development.

It appears that despite the existence of substantial literature on e-learning, little has been done to assess the prospects of introducing and implementing e-learning solutions in Serbian HEIs. Moreover, little or no scholarly research has examined the facilitating part of novelties used by these HEIs, especially for the period of the COVID-19 pandemic.

To continue with academic work, HEIs had to embrace innovations after COVID-19 made almost every standard way of doing things obsolete (Dhawan, 2020; Pokhrel & Chhetri, 2021). Because of this, there has been a complete transition from face-to-face instruction to other forms of teaching (Beason-Abmayr et al., 2021; Karalis & Raikou, 2020; Marshall et al., 2020; Ramos-Morcillo et al., 2020). COVID-19 introduced several innovations, especially in academic institutions, including those that provide medical education (Chick et al., 2020). In medical schools, new approaches are being adapted to teaching and testing to speed up the process so that medical students can join the practicing doctors in providing healthcare during the COVID-19 pandemic (Papapanou et al., 2021). Innovatively, many medical schools have implemented clinical medicine as a way to make up for the uncertain period of the pandemic as opposed to teaching the basic sciences (Dedeilia et al., 2020). Other universities have lagged behind in implementing novel ways of teaching and learning in the course of the COVID-19 pandemic, while some universities responded and kept reacting proactively. It has been found that the number of students enrolling for elective courses using the traditional modes of delivering education increased when these courses were transformed to be delivered online, in comparison with the courses delivered face-to-face (Moorhouse, 2020; Rashid & Yadav, 2020). The educational institutions, as well as the teaching profession as a whole, displayed a variety of forms of innovative thinking during an outbreak of a pandemic such as the COVID-19 pandemic (Marek et al., 2021).

As a result of the phenomenon of the digital divide, some people might have difficulties accessing e-learning solutions. As the name suggests, a digital divide is defined as a discrepancy in socio-economic status between people or groups as well as geographical areas concerning information communication technologies (ICTs) as they pertain to the utilization of the internet for a variety of purposes (Furuholt

& Kristiansen, 2007; Pavlović et al., 2021). Those who have access to and can use ICTs have a definite advantage over those who do not. The digital divide can also be explained as the gap between those who have access to ICTs and those who do not (Cullen, 2001). There are three types of gaps that can be identified: 1) economic divide - the inability to purchase a computer (Yu et al., 2018); 2) usability divide - the inability to use a computer or not being able to make use of modern technology (Dobransky & Hargittai, 2006), and 3) empowerment divide - when people cannot utilize the technology and internet to their fullest capacity, despite it being available to them (Hilbert, 2011).

Pratama et al. (2020) have pointed out that the ongoing COVID-19 pandemic has undoubtedly had a profound impact on the learning and teaching processes in almost all educational institutions in the world if not all (Pratama et al., 2020). Ebner et al. (Ebner et al., 2020) showed a good example of how a pandemic such as COVID-19 has impacted the teaching and learning methods in Austria, which were largely employed face-to-face in the past (Ebner et al., 2020). Since the outbreak of COVID-19, online teaching and learning have been announced for the first time in China (T. Chen et al., 2020; Huang, 2020, p. 19), with confrontation of two factors: 1) push factors - perception of security risks, the convenience of learning, and quality of service (Jin et al., 2021), and 2) pull factors - usability, ease of use, teaching attitudes, and technology-task fit. These factors were determined to be important for teachers' willingness to switch from physical to e-learning (Lin et al., 2021). However, there are still several things that hinder the successful implementation of e-learning in HEIs in some developing countries, such as high costs, bad access to the Internet, and unstable electricity supplies (Eze et al., 2020).

On the other hand, commercial vendors and educational institutions have adopted different e-learning know-hows (Tossy, 2017), with providers providing free platforms, as a matter of urgency and necessity (Makokha & Mutisya, 2016). COVID-19 challenges must be viewed as opportunities to make technology and education more innovative at institutions. Across the globe, university professors, students, and researchers all are making use of technological innovations to tackle the COVID-19 virus pandemic.

When it comes to accessing the internet, it is revealed that students have a preference for using smartphones to access e-learning platforms. As far as platforms available for e-learning in the course of the pandemic, Zoom was reported as the most favoured and commonly employed virtual learning platform (Camargo et al., 2020), followed by the Google Meet and Teams platforms (C. Chen et al., 2021). During the pandemic, e-learning packages like Moodle and Big Blue Button were popular among students (Ukoha, 2022). E-learning solutions were primarily transmitted through the TV for high schools and social networks mainly for universities (Kireev et al., 2019; Masonta et al., 2015).

As e-learning was employed in public and private HEIs in developing countries like Serbia, the purpose of this research is to analyze and present how the COVID-19 pandemic impacts the education system.

The study offers valuable insights for university administrators and policymakers by identifying key factors that ensure the effective utilization of e-learning systems by both students and professors. The findings of this research present a unique contribution, enabling the leadership of both public and private higher education institutions to assess and apply these conclusions to guarantee the efficient use of e-learning methods during pandemic crises.

In greater detail, the study highlights the critical elements that influence the successful implementation of e-learning platforms. These elements include technological infrastructure, user training, and continuous support, which are essential for creating a conducive learning environment. By understanding these factors, university management can develop strategic plans to enhance the adoption and integration of e-learning systems.

Furthermore, the research emphasizes the role of policymakers in shaping educational policies that support e-learning. Policymakers can use the study findings to create guidelines and standards that ensure equitable access to digital resources, promote digital literacy, and foster an inclusive educational ecosystem. This is particularly crucial during crises like the COVID-19 pandemic, where traditional face-to-face instruction is disrupted.

The study also suggests that universities should invest in robust IT infrastructure and provide ongoing professional development for faculty to adapt to new teaching methods. Additionally, the research underscores the importance of feedback mechanisms to continually improve e-learning practices based on user experiences.

Overall, the study provides a comprehensive framework for both university administrators and policymakers to enhance the effectiveness of e-learning systems, ensuring that educational delivery remains uninterrupted and effective even in challenging times. This research not only addresses the immediate needs during a pandemic but also contributes to the long-term advancement of digital education strategies in higher education.

Methodology

Hypotheses

The following hypotheses were developed to measure the influence of the COVID-19 pandemic on e-learning in HEIs.

The first hypothesis ($1H_0$): The COVID-19 pandemic has not triggered or exposed the digital divide between professors and students in higher education.

The first alternative hypothesis ($1H_1$): The COVID-19 pandemic has positively triggered and exposed the digital divide between professors and students in higher education.

The second hypothesis ($2H_0$): Higher education institutions have not benefited from the COVID-19 pandemic by implementing e-learning strategies.

The second alternative hypothesis ($2H_1$): Higher education institutions have benefited from the COVID-19 pandemic by implementing e-learning strategies.

The third hypothesis ($3H_0$): The digital divide between students and faculty at HEIs has not led to the incorporation of e-learning strategies.

The third alternative hypothesis ($3H_1$): The digital divide between students and faculty at HEIs has positively led to e-learning strategies being incorporated.

Samples and collection of data

During this research, we employed a cross-sectional approach as well as a quantitative research design. The HEIs in Vojvodina, Serbia, participated in the study with subjects drawn from both largest universities - the University of Business Academy in Novi Sad (UBA), which is private, and the University of Novi Sad (UNS), which is public. The samples were selected non-randomly. Due to the restrictions of the COVID-19 pandemic, the data were collected simultaneously using an online research questionnaire. As a result, both private and public universities were represented fairly in the study.

Among the eleven questions of the questionnaire, six were intended to elicit demographic details such as gender, age group, etc., while five measured the hypotheses developed from a COVID-19 pandemic assessment of e-learning in higher education institutions. COVID-19 perceptions were evaluated on a five-point Likert scale, items ranging from completely disagree to agree.

Statistical analysis

The structural model was processed using ADANCO software since the study relied on SEM, specifically partial least square structural equation modelling (PLS-SEM). A descriptive analysis of the respondents' profiles was conducted using statistical software SPSS.

Results

Our research included a total of 637 participants, all attending HEIs. A questionnaire was sent to 734 people in total from which 637 submitted their answers, meaning that 97 did not answer the questionnaire.

The number of the participants regarding the gender was almost the same, with a slight advantage in favour of the number of male participants (363) in comparison with female participants (274). From the results shown in Table 1, it can be seen that the largest number of participants are between the age group of 19 and 29 years, whereas the smallest number of participants falls into the age group over 50 years. The results of our survey have shown that from the 637 participants, around 78 % (SD=255.27) were students, while the rest were professors or scientists employed in HEIs, both private and public. Based on the obtained results, 45 % of the participants are employed in private HEIs, while 55 % are employed in public HEIs.

The participants' profile shows that the majority use mostly their own smartphones (400) as the main e-learning devices, followed by the use of laptop computers (226). The least used e-learning devices are desktop computers (11). Once again, the data

showed that participants prefer to use personal gadgets (582) for e-learning, while few of them use the faculty space for e-learning (14). In light of the data presented in the study, it should be noted that the purpose of the study is to examine the readiness and the intention of the study participants to embrace e-learning as a replacement for or complement to the existing traditional teaching methods.

Table 1
The participants' profile during the COVID-19 pandemic

Participants details		Frequency	Standard Deviation
Gender	Male	363	62.93
	Female	274	
Age (years)	19-29	510	238.19
	30-39	106	
	40-49	17	
	50 >	4	
Status	Student	499	255.27
	Professor/Scientist	138	
Profile of HEIs	Private	285	47.38
	Public	352	
E-learning device used	Smartphone	400	194.86
	Laptop computer	226	
	Desktop computer	11	
E-learning service source	Personal gadgets	582	320.43
	Office	41	
	Faculty space	14	
Sample size (n)		637	

To determine the validity of our measurement model, we focused on three criteria: construct reliability, convergent validity, and discriminant validity (Table 2) (Hair et al., 2019; Ignjatijević et al., 2022). Taking into account the reliability tests of the constructs, Henseler's rho (ρA), Jöreskog's rho (ρC), and Cronbach alpha (α) values were evaluated, and the 0.7 was validated as a minimum threshold by the evaluation (Balenović et al., 2021; Dijkstra & Henseler, 2015).

Table 2
Validity and reliability of the construct

Construct	ρ_A	ρ_C	α	AVE
EL	0.9211	0.9331	0.9811	0.6200
COV	0.8437	0.8056	0.8754	0.6007
DD	0.7690	0.9879	0.7801	0.6759

Note: EL: E-learning, COV: COVID-19, DD: digital divide, ρ_A:Henseler's rho, ρ_C: Jöreskog's rho, α: Cronbach alpha, AVE: average variance extracted.

Our results have shown that the highest reliability of 0.9211 was recorded for EL, followed by convergent validity of 0.9879 for DD, and 0.9811 for discriminant validity in EL, respectively.

To assess the convergent validity of the items of the construct, outer loadings and the average variance extracted (AVE) were used. AVE estimates of all constructs exceeded the minimum level to demonstrate convergent validity. According to Henseler et al. (Henseler et al., 2016), in PLS-SEM methodology, all items with loading lower than 0.6 were dropped, whereas items with loading higher than 0.6 were retained (Table 3).

To assess the evidence of common method bias (CMB), we carried out a full multicollinearity test, specifically a variance inflation factor (VIF). In addition, based on the results of this post-hoc evaluation, we found that CMB is not an issue since the values of the calculated VIFs were lower than the threshold of 10. As can be seen in our analysis of CMB, the concerns about CMB are minimal, therefore it is unlikely that CMB could be a concern.

Table 3
The variance inflation factor (VIF) and the item loading

	Optimization	Loadings	VIF
COV-1	Coronavirus (COVID-19) exists.	0.7992	7.3460
COV-2	The COVID-19 pandemic is a dangerous disease that affects the entire world.	0.8361	5.2844
COV-3	As a result of this pandemic, I am nervous about getting close to my colleagues.	0.7845	7.3651
COV-4	The COVID-19 pandemic makes me nervous when approaching my professors.	0.9022	2.7761
COV-5	As I am aware, public gatherings are fraught with fear due to the COVID-19 pandemic.	0.9103	2.4435
COV-6	I have changed my approach to things because of the COVID-19 pandemic.	0.8976	3.0118
EL-1	In light of the COVID-19 pandemic, I am experiencing e-learning for the first time in my academic life.	0.6299	1.9543
EL-2	Electronic delivery of the relevant teaching materials has become a common practice.	0.5443	1.9930
EL-3	The lessons that my professors present online are increasingly popular.	0.8260	2.5789
EL-4	As long as I contact them, I can interact with my professors.	0.8003	2.6001
EL-5	Electronic platforms are used for submitting assignments for evaluation.	0.7704	4.0151
DD-1	My university introduced me to e-learning platforms that I had to learn to use on my smartphone quickly.	0.8022	2.5611
DD-2	A device that can be used for e-learning should be provided to all students at my university.	0.7903	3.6009
DD-3	The right orientation on e-learning platforms is important for each student admitted to my university so that they won't be left behind in pandemic situations.	0.7130	3.2561

Note: EL: E-learning, COV: COVID-19, DD: digital divide

Despite this, the HTMT ratio of correlations approach was used to assess the discriminant validity, as was done by Henseler et al. (Henseler et al., 2016) in their research. The results show that none of the corresponding correlation coefficients exceed the minimum cut-off value of 0.85, demonstrating the discriminant validity of the approach (Table 4).

Table 4
Discriminant validity using HTMT

	Concept	1	2	3
1	EL			
2	COV	0.6505		
3	DD	0.6671	0.6078	

Note: EL: E-learning, COV: COVID-19, DD: digital divide

We performed a structural analysis (hypothetical paths) based on the psychometric assessment of the research constructs, to study the relationship between the upsurge of the COVID-19 pandemic and the adoption of e-learning in HEIs (Figure 1). The statistical data analysis revealed both direct and indirect impacts of the structural model. Based on the empirical findings, all the proposed hypotheses were confirmed by the results (Table 5 and Figure 2).

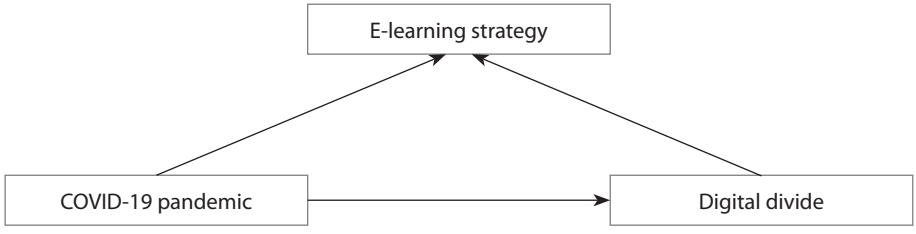

Figure 1. E-learning strategy predictors in higher education institutions: a conceptual model

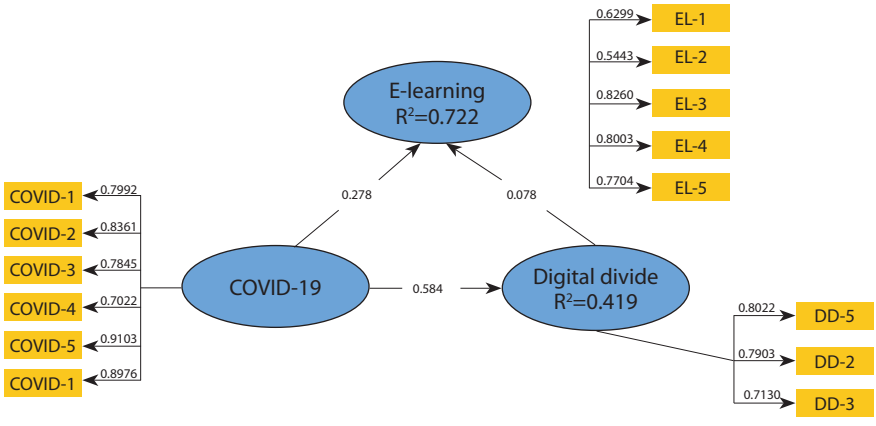

Figure 2. The proposed model analysis

Analysing the proposed hypothesis, we can draw the following conclusions. The first hypothesis ($1H_0$): COV→DD was supported by regression (beta) and significant estimates of $\beta = 0.584$, with statistically significant differences ($p < 0.05$). Th second hypothesis, ($2H_0$): COV→EL, was supported by $\beta = 0.278$, and statistically significant differences ($p < 0.05$). The third hypothesis, ($3H_0$): DD→EL, followed the previous two hypotheses and was supported by $\beta = 0.078$, with statistically significant differences ($p < 0.05$).

Table 5
Hypothetical path—PLS-SEM

Path	Beta (β)	SD	T-value	P-value	Decision
COV - DD	0.584	0.042	9.1121	0.021	Supported
COV - EL	0.278	0.056	7.8732	0.003	Supported
DD - EL	0.078	0.021	8.2843	0.042	Supported
Control variables					
ELS - EL	-0.081	0.018	-3.5561	0.038	Supported
UD - EL	-0.001	0.024	-2.1292	0.041	Supported

Note: EL: E-learning, COV: COVID-19, DD: digital divide, ELS: E-learning source, UD: used device, SD: standard deviation

Additionally, R^2 coefficients for the endogenous and dependent constructs of the proposed model were assessed. The purpose of the assessment was to determine whether the model is capable of predicting the outcome of the test. Based on R^2 values, we can determine what percentage of variable variations (endogenous or dependent constructs) can be explained by the predictive model. The R^2 values above 0.5 are considered good predictors of a particular model (Roy & Roy, 2008). Our estimates in Table 5 indicate a better predictive power of the dependent variable, which renders the model significant ($p<0.05$).

Discussion

E-learning has great potential for enhancing the performance of higher education institutions around the world (Guri-Rosenblit, 2005). In comparison with the traditional system of education, e-learning has a positive effect on educational structures (Al-Adwan et al., 2021; EL-Ariss et al., 2021). As a result of the outbreak and the rapid spread of COVID-19, schools have been closed completely all around the world (Naik et al., 2021). As a result of the prolonged lockdown, the governments tried to reshape education service delivery by enforcing e-learning in tertiary institutions across the globe (Al-Karaki et al., 2021; Edem Adzovie & Jibril, 2022; Mohd Satar et al., 2021; Surendran et al., 2021). It is worthwhile to note, however, that these directives have resulted in the transformation of the education systems of HEIs, according to the findings of the present empirical research. Furthermore, many higher education institutions have provided e-learning platforms as an alternative to lecture delivery during the COVID-19 pandemic (Yatigammana & Wijayarathna, 2021), as our investigation

suggests. To use the current e-learning systems effectively and efficiently, it is necessary to understand both their previous versions and the main challenges associated with adopting these systems during the COVID-19 outbreak.

The present findings also suggest that the pandemic acted both as a challenge and a catalyst for transformation of higher education. Although the transition to online systems was initially enforced by necessity, the data indicate that many students and professors gradually began to recognize the value of digital solutions and to adapt their practices accordingly. This dual effect highlights the paradox of crisis situations: while they expose systemic weaknesses such as gaps in infrastructure, skills, or regulatory frameworks, they also accelerate the search for innovative solutions and encourage institutions to rethink their pedagogical and administrative strategies.

The contrast between public and private institutions further illustrates this complexity. Private universities, due to their earlier investments in distance learning and more flexible structures, were able to respond more rapidly and provide students with functioning platforms and clearer support systems. Public universities, on the other hand, had to reconcile regulatory constraints that emphasized physical attendance with the practical impossibility of continuing traditional teaching under lockdown. This tension underscores the need for systemic changes in higher education governance so that flexibility becomes embedded within institutional policy rather than appearing only as a reaction to crises.

Another important dimension revealed by the study is the technological profile of students and staff. The overwhelming reliance on smartphones rather than laptops reflects a broader trend in digital access and points to a need for mobile-friendly course design. While this trend enhances inclusivity because smartphones are often more affordable and widely available, it also introduces challenges concerning the quality of interaction, the ability to complete complex assignments, and the potential for distraction. Universities that wish to maintain high standards in digital teaching must therefore adapt not only their platforms but also their pedagogical methods to suit a mobile-first environment.

The concept of the digital divide proved to be central in understanding the uneven effects of the pandemic on different groups of students. The study demonstrated that the digital divide is not a single barrier but rather a layered phenomenon that includes access to devices, skills to use them effectively, and the confidence to engage meaningfully with online systems. Addressing this divide requires more than providing equipment; it demands continuous training, support, and the cultivation of a digital culture that empowers students and professors to feel competent and confident in the online space. The evidence from this research reinforces the idea that reducing the digital divide does not only promote equity but also directly strengthens the effectiveness of e-learning initiatives.

These insights also carry long-term implications. The rapid implementation of online solutions during the pandemic has left behind new practices, habits, and expectations

among students and staff. Many now view e-learning not as a temporary substitute but as an integral part of modern education. This perspective opens the door to hybrid models that combine the flexibility of online access with the benefits of face-to-face interaction. For universities, the challenge will be to design sustainable systems that incorporate the strengths of both modalities while minimizing their weaknesses.

Finally, the findings should be viewed as part of a broader discussion about the resilience of education systems. The pandemic has demonstrated that higher education institutions cannot rely solely on traditional models of delivery. Instead, they must be prepared to adapt quickly to disruptions, whether they arise from health crises, technological changes, or social transformations. Building resilience involves not only investment in technology but also developing policies that encourage adaptability, supporting faculty in acquiring new skills, and ensuring that all students, regardless of background, can participate fully in the learning process.

Taken together, the results of this study emphasize that e-learning in the context of the pandemic was not only an emergency measure but also a turning point. It revealed structural weaknesses and also created new opportunities for innovation, inclusivity, and long-term improvement in higher education. The lessons learned during this period should not be treated as temporary adjustments but as foundations for future strategies that will shape the digital university of tomorrow.

Besides its deadly effects (Puvača et al., 2021), the surge of this pandemic has also ignited innovative and creative thinking from the perspective of educational innovation (Kutieshat & Farmanesh, 2022). Academic innovativeness in this study applies only to the new ideas that the higher education institutions have regarding the methods carried out to the overall satisfaction of students. Thus, based on the empirical evidence employed, all of the proposed hypotheses for the research theme were supported (directly and indirectly). Based on this evidence, management and policymakers of HEIs in the country need to reconsider and improve the e-learning system that is currently in place, as well as take this information as a guideline for improving the utilization of e-learning practices by students and professors.

The socio-demographic characteristics of the sample population demonstrate that the younger generation constitutes present and future innovators and users. Therefore, technology developers and service providers could make better and more efficient decisions about product design and the target market if they consider the profile of users. Even so, this does assist in gaining a deeper understanding of behavioural patterns in a particular geographic enclave. Last but not least, knowing how the demographic characteristics of the population are distributed will help determine how well the sample reflects the population.

Conclusions

As part of the study of enabling factors, this paper examines how e-learning systems were used in the course of the outbreak of coronavirus in a less digitalized society. Study findings examined the nexus between the COVID-19 pandemic and the e-learning

policy deployed at the HEIs by using a multiple-mediation analysis. The results of this study provide a valuable contribution for both private and public university management and policymakers to evaluate and employ for certifying the effective implementation of e-learning systems. HEIs adopt e-learning systems primarily as a result of direct and indirect factors. This study was based on the quantitative evidence that identified the direct and indirect factors.

In the end, the application of e-learning systems in higher education institutions during the COVID-19 pandemic has not only mitigated the immediate challenges but has also unveiled a transformative potential for the future of education. The evidence suggests that, when carefully designed and integrated, e-learning can enhance educational quality, access, and inclusivity while fostering a dynamic, technology-enhanced learning environment. However, it is important to continually assess and refine e-learning strategies to maximize its benefits and address potential challenges, ensuring that it remains a powerful tool for higher education.

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References

Abidah, A., Hidaayatullaah, H. N., Simamora, R. M., Fehabutar, D., & Mutakinati, L. (2020). The Impact of Covid-19 to Indonesian Education and Its Relation to the Philosophy of "Merdeka Belajar". *Studies in Philosophy of Science and Education*, *1*(1), 38–49. https://doi.org/10.46627/sipose.v1i1.9

Aboagye, E., Yawson, J. A., & Appiah, K. N. (2020). COVID-19 and E-Learning: The Challenges of Students in Tertiary Institutions. *Social Education Research*, 1–8. https://doi.org/10.37256/ser.212021422

Akaslan, D., & Law, E. L.-C. (2011). Measuring teachers' readiness for e-learning in higher education institutions associated with the subject of electricity in Turkey. *2011 IEEE Global Engineering Education Conference (EDUCON)*, 481–490. https://doi.org/10.1109/EDUCON.2011.5773180

Al-Adwan, A. S., Albelbisi, N. A., Hujran, O., Al-Rahmi, W. M., & Alkhalifah, A. (2021). Developing a Holistic Success Model for Sustainable E-Learning: A Structural Equation Modeling Approach. *Sustainability*, *13*(16), Article 16. https://doi.org/10.3390/su13169453

Al-Karaki, J. N., Ababneh, N., Hamid, Y., & Gawanmeh, A. (2021). Evaluating the Effectiveness of Distance Learning in Higher Education during COVID-19 Global Crisis: UAE Educators' Perspectives. *Contemporary Educational Technology*, *13*(3). https://eric.ed.gov/?id=EJ1306558

Balenović, I., Ignjatijević, S., Stojanović, G., Vapa Tankosić, J., Lekić, N., Milutinović, O., Gajić, A., Ivaniš, M., Bošković, J., Prodanović, R., Puvača, N., & Duđak, L. (2021). Factors Influencing Wine Purchasing by Generation Y and Older Cohorts on the Serbian Wine Market. *Agriculture*, *11*(11), 1054. https://doi.org/10.3390/agriculture11111054

Beason-Abmayr, B., Caprette, D. R., & Gopalan, C. (2021). Flipped teaching eased the transition from face-to-face teaching to online instruction during the COVID-19 pandemic. *Advances in Physiology Education*, *45*(2), 384–389. https://doi.org/10.1152/advan.00248.2020

Camargo, C. P., Tempski, P. Z., Busnardo, F. F., de Arruda Martins, M., & Gemperli, R. (2020). Online learning and COVID-19: A meta-synthesis analysis. *Clinics*, *75*, e2286. https://doi.org/10.6061/clinics/2020/e2286

Çebi, A. (2023). How e-learning readiness and motivation affect student interactions in distance learning? *Education and Information Technologies*, *28*(3), 2941–2960. https://doi.org/10.1007/s10639-022-11312-0

Chen, C., Landa, S., Padilla, A., & Yur-Austin, J. (2021). Learners' experience and needs in online environments: Adopting agility in teaching. *Journal of Research in Innovative Teaching & Learning*, *14*(1), 18–31. https://doi.org/10.1108/JRIT-11-2020-0073

Chen, T., Peng, L., Jing, B., Wu, C., Yang, J., & Cong, G. (2020). The Impact of the COVID-19 Pandemic on User Experience with Online Education Platforms in China. *Sustainability*, *12*(18), Article 18. https://doi.org/10.3390/su12187329

Chick, R. C., Clifton, G. T., Peace, K. M., Propper, B. W., Hale, D. F., Alseidi, A. A., & Vreeland, T. J. (2020). Using Technology to Maintain the Education of Residents During the COVID-19 Pandemic. *Journal of Surgical Education*, *77*(4), 729–732. https://doi.org/10.1016/j.jsurg.2020.03.018

Coman, C., Ţîru, L. G., Meseşan-Schmitz, L., Stanciu, C., & Bularca, M. C. (2020). Online Teaching and Learning in Higher Education during the Coronavirus Pandemic: Students' Perspective. *Sustainability*, *12*(24), Article 24. https://doi.org/10.3390/su122410367

Cullen, R. (2001). Addressing the digital divide. *Online Information Review*, *25*(5), 311–320. https://doi.org/10.1108/14684520110410517

Hermawan, D. (2021). The Rise of E-Learning in COVID-19 Pandemic in Private University: Challenges and Opportunities. *IJORER : International Journal of Recent Educational Research*, *2*(1), 86–95. https://doi.org/10.46245/ijorer.v2i1.77

Dedeilia, A., Sotiropoulos, M. G., Hanrahan, J. G., Janga, D., Dedeilias, P., & Sideris, M. (2020). Medical and Surgical Education Challenges and Innovations in the COVID-19 Era: A Systematic Review. *In Vivo*, *34*(3 suppl), 1603–1611. https://doi.org/10.21873/invivo.11950

Dhawan, S. (2020). Online Learning: A Panacea in the Time of COVID-19 Crisis. *Journal of Educational Technology Systems*, *49*(1), 5–22. https://doi.org/10.1177/0047239520934018

Dijkstra, T. K., & Henseler, J. (2015). Consistent Partial Least Squares Path Modeling. *MIS Quarterly*, *39*(2), 297–316. https://doi.org/10.25300/MISQ/2015/39.2.02

Dobransky, K., & Hargittai, E. (2006). The disability divide in internet access and use. *Information, Communication & Society*, *9*(3), 313–334. https://doi.org/10.1080/13691180600751298

Đurić, K., Tomaš Simin, M., & Glavaš-Trbić, D. (2023). Strategies for Reducing Rural Poverty in Developing Countries. *Journal of Agronomy, Technology and Engineering Management (JATEM)*, *6*(2), 885–892. https://doi.org/10.55817/SBYY1758

Ebner, M., Schön, S., Braun, C., Ebner, M., Grigoriadis, Y., Haas, M., Leitner, P., & Taraghi, B. (2020). COVID-19 Epidemic as E-Learning Boost? Chronological Development and Effects at an Austrian University against the Background of the Concept of "E-Learning Readiness". *Future Internet*, *12*(6), Article 6. https://doi.org/10.3390/fi12060094

Edem Adzovie, D., & Jibril, A. B. (2022). Assessment of the effects of Covid-19 pandemic on the prospects of e-learning in higher learning institutions: The mediating role of academic

innovativeness and technological growth. *Cogent Education*, *9*(1), 2041222. https://doi.org/10.1080/2331186X.2022.2041222

EL-Ariss, B., Zaneldin, E., & Ahmed, W. (2021). Using Videos in Blended E-Learning for a Structural Steel Design Course. *Education Sciences*, *11*(6), Article 6. https://doi.org/10.3390/educsci11060290

Eze, S. C., Chinedu-Eze, V. C. A., Okike, C. K., & Bello, A. O. (2020). Factors influencing the use of e-learning facilities by students in a private Higher Education Institution (HEI) in a developing economy. *Humanities and Social Sciences Communications*, *7*(1), 133. https://doi.org/10.1057/s41599-020-00624-6

Filippetti, A., & Archibugi, D. (2011). Innovation in times of crisis: National Systems of Innovation, structure, and demand. *Research Policy*, *40*(2), 179–192. https://doi.org/10.1016/j.respol.2010.09.001

Furuholt, B., & Kristiansen, S. (2007). A Rural-Urban Digital Divide?: Regional Aspects of Internet Use in Tanzania. *The Electronic Journal of Information Systems in Developing Countries*, *31*(1), 1–15. https://doi.org/10.1002/j.1681-4835.2007.tb00215.x

Gaskell, A., & Mills, R. (2014). The quality and reputation of open, distance and e-learning: What are the challenges? *Open Learning: The Journal of Open, Distance and e-Learning*, *29*(3), 190–205. https://doi.org/10.1080/02680513.2014.993603

Gedro, J., Allain, N. M., De-Souza, D., Dodson, L., & Mawn, M. V. (2020). Flattening the learning curve of leadership development: Reflections of five women higher education leaders during the Coronavirus pandemic of 2020. *Human Resource Development International*, *23*(4), 395–405. https://doi.org/10.1080/13678868.2020.1779911

Guri-Rosenblit, S. (2005). 'Distance education' and 'e-learning': Not the same thing. *Higher Education*, *49*(4), 467–493. https://doi.org/10.1007/s10734-004-0040-0

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, *31*(1), 2–24. https://doi.org/10.1108/EBR-11-2018-0203

Henseler, J., Hubona, G., & Ray, P. A. (2016). Using PLS path modeling in new technology research: Updated guidelines. *Industrial Management & Data Systems*, *116*(1), 2–20. https://doi.org/10.1108/IMDS-09-2015-0382

Hilbert, M. (2011). Digital gender divide or technologically empowered women in developing countries? A typical case of lies, damned lies, and statistics. *Women's Studies International Forum*, *34*(6), 479–489. https://doi.org/10.1016/j.wsif.2011.07.001

Huang, J. (2020). Successes and Challenges: Online Teaching and Learning of Chemistry in Higher Education in China in the Time of COVID-19. *Journal of Chemical Education*, *97*(9), 2810–2814. https://doi.org/10.1021/acs.jchemed.0c00671

Ignjatijević, S., Tankosić, J. V., Lekić, N., Petrović, D., Brkanlić, S., Vapa, B., Tomašević, V., Puvača, N., Prodanović, R., & Milojević, I. (2022). Agro-Environmental Practices and Business Performance in the Wine Sector. *Agriculture*, *12*(2), 239. https://doi.org/10.3390/agriculture12020239

Jin, Y. Q., Lin, C.-L., Zhao, Q., Yu, S.-W., & Su, Y.-S. (2021). A Study on Traditional Teaching Method Transferring to E-Learning under the Covid-19 Pandemic: From Chinese Students' Perspectives. *Frontiers in Psychology*, *12*, 632787. https://doi.org/10.3389/fpsyg.2021.632787

Jokiaho, A., May, B., Specht, M., & Stoyanov, S. (2018). Barriers to Using E Learning in an Advanced Way. *International Journal of Advanced Corporate Learning (iJAC)*, *11*(1), 17. https://doi.org/10.3991/ijac.v11i1.9235

Joshi, S., & P.J., P. (2023). A Collaborative Metaverse Based A-La-Carte Framework for Tertiary Education (CO-MATE). *Heliyon*, *9*(2), e13424. https://doi.org/10.1016/j.heliyon.2023.e13424

Karalis, T., & Raikou, N. (2020). Teaching at the Times of COVID-19: Inferences and Implications for Higher Education Pedagogy. *International Journal of Academic Research in Business and Social Sciences*, *10*(5), Pages 479-493. https://doi.org/10.6007/IJARBSS/v10-i5/7219

Kireev, B., Zhundibayeva, A., & Aktanova, A. (2019). Distance Learning in Higher Education Institutions: Results of an Experiment. *Journal of Social Studies Education Research*, *10*(3), 387–403.

Klein, D., & Ware, M. (2003). E-learning: New opportunities in continuing professional development. *Learned Publishing*, *16*(1), 34–46. https://doi.org/10.1087/095315103320995078

Kumar Basak, S., Wotto, M., & Bélanger, P. (2018). E-learning, M-learning and D-learning: Conceptual definition and comparative analysis. *E-Learning and Digital Media*, *15*(4), 191–216. https://doi.org/10.1177/2042753018785180

Kutieshat, R., & Farmanesh, P. (2022). The Impact of New Human Resource Management Practices on Innovation Performance during the COVID 19 Crisis: A New Perception on Enhancing the Educational Sector. *Sustainability*, *14*(5), Article 5. https://doi.org/10.3390/su14052872

Lin, C.-L., Jin, Y. Q., Zhao, Q., Yu, S.-W., & Su, Y.-S. (2021). Factors Influence Students' Switching Behavior to Online Learning under COVID-19 Pandemic: A Push–Pull–Mooring Model Perspective. *The Asia-Pacific Education Researcher*, *30*(3), 229–245. https://doi.org/10.1007/s40299-021-00570-0

Liu, M., & Yu, D. (2023). Towards intelligent E-learning systems. *Education and Information Technologies*, *28*(7), 7845–7876. https://doi.org/10.1007/s10639-022-11479-6

Makokha, G. L., & Mutisya, D. N. (2016). Status of E-Learning in Public Universities in Kenya. *The International Review of Research in Open and Distributed Learning*, *17*(3). https://doi.org/10.19173/irrodl.v17i3.2235

Marek, M. W., Chew, C. S., & Wu, W. V. (2021). Teacher Experiences in Converting Classes to Distance Learning in the COVID-19 Pandemic: *International Journal of Distance Education Technologies*, *19*(1), 89–109. https://doi.org/10.4018/IJDET.20210101.oa3

Marshall, D. T., Shannon, D. M., & Love, S. M. (2020). How teachers experienced the COVID-19 transition to remote instruction. *Phi Delta Kappan*, *102*(3), 46–50. https://doi.org/10.1177/0031721720970702

Masonta, M. T., Ramoroka, T. M., & Lysko, A. A. (2015). Using TV White Spaces and e-Learning in South African rural schools. *2015 IST-Africa Conference*, 1–12. https://doi.org/10.1109/ISTAFRICA.2015.7190564

Mihhailova, G. (2006). E-learning as internationalization strategy in higher education: Lecturer's and student's perspective. *Baltic Journal of Management*, *1*(3), 270–284. https://doi.org/10.1108/17465260610690926

Mohd Satar, N. S., Dastane, O., & Morshidi, A. H. (2021). *E-learning Satisfaction during COVID-19 Pandemic Lockdown: Analyzing Key Mediators* (SSRN Scholarly Paper ID 3972907). Social Science Research Network. https://papers.ssrn.com/abstract=3972907

Moorhouse, B. L. (2020). Adaptations to a face-to-face initial teacher education course 'forced' online due to the COVID-19 pandemic. *Journal of Education for Teaching*, *46*(4), 609–611. https://doi.org/10.1080/02607476.2020.1755205

Mpungose, C. B. (2020). Emergent transition from face-to-face to online learning in a South African University in the context of the Coronavirus pandemic. *Humanities and Social Sciences Communications*, *7*(1), 113. https://doi.org/10.1057/s41599-020-00603-x

Naidoo, V. (2010). Firm survival through a crisis: The influence of market orientation, marketing innovation and business strategy. *Industrial Marketing Management*, *39*(8), 1311–1320. https://doi.org/10.1016/j.indmarman.2010.02.005

Naik, G. L., Deshpande, M., Shivananda, D. C., Ajey, C. P., & Manjunath Patel, G. C. (2021). Online Teaching and Learning of Higher Education in India during COVID-19 Emergency Lockdown. *Pedagogical Research*, *6*(1). https://eric.ed.gov/?id=EJ1287167

O'Connor, S., Wang, Y., Cooke, S., Ali, A., Kennedy, S., Lee, J. J., & Booth, R. G. (2023). Designing and delivering digital learning (e-Learning) interventions in nursing and midwifery education: A systematic review of theories. *Nurse Education in Practice*, *69*, 103635. https://doi.org/10.1016/j.nepr.2023.103635

Özer, M. (2020). Vocational Education and Training as "A Friend in Need" During Coronavirus Pandemic in Turkey. *Bartın University Journal of Faculty of Education*, *9*(2), Article 2. https://doi.org/10.14686/buefad.713574

Papapanou, M., Routsi, E., Tsamakis, K., Fotis, L., Marinos, G., Lidoriki, I., Karamanou, M., Papaioannou, T. G., Tsiptsios, D., Smyrnis, N., Rizos, E., & Schizas, D. (2021). Medical education challenges and innovations during COVID-19 pandemic. *Postgraduate Medical Journal*, postgradmedj-2021-140032. https://doi.org/10.1136/postgradmedj-2021-140032

Pavlović, A., Nestić, S., & Bošković, G. (2021). Circular economy management in business organizations using digital technologies. *Serbian Journal of Engineering Management*, *6*(1), 22–29. https://doi.org/10.5937/SJEM2101022P

Pokhrel, S., & Chhetri, R. (2021). A Literature Review on Impact of COVID-19 Pandemic on Teaching and Learning. *Higher Education for the Future*, *8*(1), 133–141. https://doi.org/10.1177/2347631120983481

Pratama, H., Azman, M. N. A., Kassymova, G. K., & Duisenbayeva, S. S. (2020). The Trend in Using Online Meeting Applications for Learning During the Period of Pandemic COVID-19: A Literature Review. *Journal of Innovation in Educational and Cultural Research*, *1*(2), 58–68. https://doi.org/10.46843/jiecr.v1i2.15

Puvača, N., Lika, E., Brkanlić, S., Esteve, E. B., Ilić, D., Kika, S., & Brkić, I. (2021). The Pandemic of SARS-CoV-2 as a Worldwide Health Safety Risk. *Journal of Agronomy, Technology and Engineering Management*, *4*(1), 523–532.

Ramos-Morcillo, A. J., Leal-Costa, C., Moral-García, J. E., & Ruzafa-Martínez, M. (2020). Experiences of Nursing Students during the Abrupt Change from Face-to-Face to e-Learning Education during the First Month of Confinement Due to COVID-19 in Spain. *International Journal of Environmental Research and Public Health*, *17*(15), Article 15. https://doi.org/10.3390/ijerph17155519

Rashid, S., & Yadav, S. S. (2020). Impact of Covid-19 Pandemic on Higher Education and Research. *Indian Journal of Human Development*, *14*(2), 340–343. https://doi.org/10.1177/0973703020946700

Roy, P. P., & Roy, K. (2008). On Some Aspects of Variable Selection for Partial Least Squares Regression Models. *QSAR & Combinatorial Science*, *27*(3), 302–313. https://doi.org/10.1002/qsar.200710043

Sims, J., Vidgen, R., & Powell, P. (2008). E-learning and the digital divide: Perpetuating cultural and socio-economic elitism in higher education. *Communications of the Association for Information Systems*, *22*(1), Article 1.

Sterling, S. (2004). Higher Education, Sustainability, and the Role of Systemic Learning. In P. B. Corcoran & A. E. J. Wals (Eds.), *Higher Education and the Challenge of Sustainability* (pp. 49–70). Kluwer Academic Publishers. https://doi.org/10.1007/0-306-48515-X_5

Surendran, S., Hopkins, S., Aji, A. S., Abubakar, S., Clayton, T., Dunuwila, T., Goss, L., Hatch, R., Horst, M. A., Rathnayake, K. M., Rosenberg, S., & Shatwan, I. M. (2021). Perspectives of teaching during the COVID-19 lockdown: A comparison of teaching in university bioscience programmes from around the world. *Research in Science & Technological Education*, 1–22. https://doi.org/10.1080/02635143.2021.1993178

Tossy, T. (Ed.). (2017). *Information Technology Integration for Socio-Economic Development:* IGI Global. https://doi.org/10.4018/978-1-5225-0539-6

Ukoha, C. (2022). As simple as pressing a button? A review of the literature on BigBlueButton. *Procedia Computer Science*, *197*, 503–511. https://doi.org/10.1016/j.procs.2021.12.167

Yatigammana, K., & Wijayarathna, G. (2021). Students' Perceptions of Online Lecture Delivery Modes: Higher Education During Covid-19 Pandemic and Beyond. *International Journal of Emerging Technologies in Learning (iJET)*, *16*(21), 58. https://doi.org/10.3991/ijet.v16i21.25305

Yu, B., Ndumu, A., Mon, L. M., & Fan, Z. (2018). E-inclusion or digital divide: An integrated model of digital inequality. *Journal of Documentation*, *74*(3), 552–574. https://doi.org/10.1108/JD-10-2017-0148

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Upravljanje e-učenjem u visokoobrazovnim institucijama tijekom pandemije COVID-19

Sažetak

Svrha ovog rada je procijeniti iskustva usmjerena na provedbu strategija e-učenja u javnim i privatnim visokoobrazovnim institucijama (VOI) tijekom pandemije COVID-19. U studiji se istražuju čimbenici koji omogućuju korištenje sustava e-učenja tijekom pandemije COVID-19 u društvu koje je manje digitalno osviješteno. Naglasak je stavljen na modeliranje strukturnih jednadžbi (SEM) kako bi se proučavale kvantitativne istraživačke paradigme. Šest stotina trideset i sedam valjanih odgovora sugerira da je izbijanje COVID-19 pozitivno i značajno utjecalo na VOI-e da usvoje strategije e-učenja. Dodatno je utvrđeno da akademska inovativnost i usvajanje e-učenja imaju značajan medijacijski učinak ($p > 0,05$) na vezu između pandemije COVID-19 i provedbe e-učenja. Studija daje korisne smjernice menadžmentu i kreatorima politika sveučilišta i VOI-a u razumijevanju ključnih čimbenika koji studentima i nastavnicima osiguravaju učinkovitu uporabu sustava e-učenja. Zaključno, rezultati ovoga istraživanja predstavljaju novi doprinos menadžmentu i kreatorima politika na javnim i privatnim sveučilištima kako bi mogli vrednovati i primijeniti nalaze radi osiguranja učinkovite primjene praksi e-učenja tijekom pandemijskih kriza.

Ključne riječi: *digitalizacija; obrazovanje; održivi razvoj; poučavanje*

Uvod

Elektroničko učenje je, može se tvrditi, dobilo dodatno značenje zbog pandemije COVID-19 (Abidah i sur., 2020). Kako je internet stekao popularnost, otvorile su se mnoge mogućnosti, a jedna od njih je e-učenje (Mihhailova, 2006). Proces kojim se tehnologije računalnih mreža koriste za distribuiranje informacija i instrukcija ljudima preko intraneta ili interneta naziva se e-učenje (Klein i Ware, 2003). Danas se općenito prihvaća da je e-učenje učinkovita alternativa ili zamjena za nastavu licem u lice u većem dijelu svijeta (Mpungose, 2020).

E-učenje je obrazovni pristup koji koristi elektroničke sustave, koji mogu uključivati računala, internet, multimedijske aplikacije i digitalne sadržaje, kako bi se olakšalo stjecanje znanja i vještina (Joshi i P.J., 2023). Obično obuhvaća razne nastavne strategije, poput *online* kolegija, virtualnih učionica, videopredavanja, interaktivnih

simulacija i digitalnih procjena (O'Connor i sur., 2023). E-učenje nudi prednosti poput fleksibilnosti, skalabilnosti i mogućnosti prilagodbe individualnim potrebama učenja, što ga čini vrijednim alatom suvremenoga obrazovanja (Liu i Yu, 2023). Utemeljeno je na principima instrukcijskoga dizajna, kognitivne psihologije i informacijskih tehnologija, s ciljem pružanja učinkovitih iskustava učenja u različitim obrazovnim okružjima, od formalnih institucija do korporativne edukacije (Çebi, 2023).

Nakon što je Svjetska zdravstvena organizacija (WHO) proglasila COVID-19 globalnom pandemijom, mnoge su obrazovne institucije morale usvojiti e-učenje kao zamjenu za nastavu uživo (Puvača i sur., 2021). Isprva se moglo pretpostaviti da je ovaj fenomen ograničen na zemlje u razvoju (Đurić i sur., 2023). Unatoč tome, primjena rješenja e-učenja u visokom obrazovanju ostaje globalni izazov.

Pandemija je preoblikovala tradicionalne načine rada, posebice u području poučavanja i učenja (Coman i sur., 2020; Gedro i sur., 2020; Özer, 2020). Iako je koncept e-učenja već dugo prisutan, glavni izazovi za učinkovitu primjenu u VOI-u uključuju pristup internetu u određenim dijelovima zemlje, visoke troškove internetskih podataka i nedovoljnu dostupnost elektroničkih uređaja poput pametnih telefona i računala (Aboagye i sur., 2020; Akaslan i Law, 2011; Gaskell i Mills, 2014). Jedna od glavnih prepreka potpunoj implementaciji e-učenja u javnim sveučilištima jest kultura koja zahtijeva fizičko pohađanje predavanja kako bi studenti stekli potrebne bodove (Jokiaho i sur., 2018; Sims i sur., 2008).

Pregled literature

E-učenje se konkretno može definirati kao uključivanje svih oblika učenja i poučavanja koji se odvijaju putem interneta koristeći prijenosno računalo ili pametni telefon (Kumar Basak i sur., 2018) za distribuciju audio ili videozapisa predavanja umjesto izravne fizičke interakcije (Hermawan, 2021). Zbog izbijanja pandemije COVID-19, sve obrazovne institucije u Srbiji i širom svijeta bile su prisiljene prebaciti se s jednoga načina poučavanja na drugi.

Opstanak VOI-a tijekom kriza može ovisiti o njihovoj inovativnosti u kombinaciji s dostupnošću potrebne infrastrukture za pravilno funkcioniranje e-učenja (Filippetti i Archibugi, 2011; Naidoo, 2010; Sterling, 2004). Na primjer, privatna sveučilišta u Srbiji, posebice Poslovna akademija u Novom Sadu, uvijek su imala e-učenje na dnevnome redu, akreditirajući Sustav za obrazovanje na daljinu (DLS) kao prvi u Srbiji, 2011. godine, preko Ministarstva prosvete i tehnološkog razvoja.

Unatoč postojanju opsežne literature o e-učenju, malo je studija u kojima su se procijenile perspektive uvođenja i provedbe rješenja e-učenja u srpskim VOI-ima. Nadalje, malo ili nimalo znanstvenih istraživanja ispitalo je olakšavajuću ulogu noviteta koje su ove institucije koristile tijekom razdoblja pandemije COVID-19.

Kako bi nastavile akademski rad, VOI-i morale su prihvatiti inovacije nakon što je COVID-19 učinio gotovo svaki standardni način rada neupotrebljivim (Dhawan, 2020; Pokhrel i Chhetri, 2021). Zbog toga je došlo do potpunoga prijelaza s nastave

uživo na druge oblike poučavanja (Beason-Abmayr i sur., 2021; Karalis i Raikou, 2020; Marshall i sur., 2020; Ramos-Morcillo i sur., 2020).

COVID-19 je uveo brojne inovacije, osobito u akademskim institucijama, uključujući i medicinsko obrazovanje (Chick i sur., 2020). U medicinskim školama razvijali su se novi pristupi nastavi i testiranju kako bi se ubrzalo školovanje studenata medicine i omogućilo im pridruživanje praktičnim liječnicima u pružanju zdravstvene skrbi tijekom pandemije (Papapanou i sur., 2021).

Inovativno, mnoge medicinske škole uvele su kliničku medicinu kako bi nadomjestile neizvjesno razdoblje pandemije za razliku od poučavanja temeljnih znanosti (Dedeilia i sur., 2020). Neka sveučilišta su zaostajala u implementaciji novih načina poučavanja dok su druga proaktivno reagirala. Utvrđeno je da je broj studenata koji upisuju izborni kolegij povećan kada su ti kolegiji prevedeni u *online* oblik u usporedbi s kolegijima vođenima uživo (Moorhouse, 2020; Rashid i Yadav, 2020).

Obrazovne institucije i sama profesija poučavanja iskazale su brojne oblike inovativnoga razmišljanja tijekom izbijanja pandemije kao što je bila pandemija COVID-19 (Marek i sur., 2021). Zbog fenomena digitalnoga jaza, sudionici odgojno-obrazovnog procesa mogu imati poteškoća s pristupom rješenjima e-učenja. Digitalni jaz podrazumijeva razliku u socioekonomskom položaju između ljudi, skupina i geografskih područja u (smislu) dostupnosti informacijsko-komunikacijskih tehnologija i mogućnostima korištenja interneta (Furuholt i Kristiansen, 2007; Pavlović i sur., 2021).

Oni koji imaju pristup i mogu se koristiti informacijsko-komunikacijskom tehnologijom imaju prednost u odnosu na one koji to ne mogu. Digitalni jaz također se može objasniti kao jaz između onih koji imaju pristup IKT-u i onih koji ga nemaju (Cullen, 2001). Možemo razlikovati tri vrste jaza: 1) ekonomski jaz – nemogućnost kupnje računalnoga uređaja (Yu i sur., 2018); 2) jaz u upotrebljivosti – nemogućnost korištenja računala ili modernih tehnologija (Dobransky i Hargittai, 2006) te 3) jaz osnaživanja – kada ljudi ne mogu u potpunosti iskoristiti tehnologiju i internet iako im je dostupan (Hilbert, 2011).

Pratama i sur. (2020) istaknuli su da je pandemija COVID-19 imala dubok utjecaj na procese učenja i poučavanja u gotovo svim obrazovnim institucijama u svijetu. Ebner i sur. (2020) prikazali su primjer kako je pandemija utjecala na metode poučavanja u Austriji, čija je praksa prije pojave pandemije bila pretežno uživo.

Od izbijanja pandemije COVID-19, *online* poučavanje i učenje objavljeno je u Kini (Chen i sur., 2020; Huang, 2020), pri čemu su dva faktora bila odlučujuća: 1) *push*-faktori – percepcija rizika za sigurnost, praktičnost učenja i kvalitetu usluge (Jin i sur., 2021); 2) *pull*-faktori – upotrebljivost, jednostavnost korištenja, stavovi nastavnika i usklađenost tehnologije i zadatka, koji su važni za spremnost nastavnika da prijeđu s izravnoga na e-učenje (Lin i sur., 2021).

Međutim, još uvijek postoje prepreke uspješnoj implementaciji e-učenja u nekim zemljama u razvoju, uključujući visoke troškove, loš pristup internetu i nestabilna napajanja električnom energijom (Eze i sur., 2020).

S druge strane, komercijalni dobavljači i obrazovne institucije usvojili su različite pristupe e-učenju (Tossy, 2017), pri čemu su pružatelji usluga kao hitnu mjeru nudili besplatne platforme (Makokha i Mutisya, 2016). Izazovi pandemije COVID-19 trebaju se promatrati kao prilika za tehnološke i obrazovne inovacije u institucijama. Globalno gledano, profesori, studenti i istraživači koriste tehnološke inovacije kako bi se nosili s pandemijom COVID-19. Kada je riječ o pristupu internetu, otkriveno je da studenti preferiraju korištenje pametnih telefona za pristup platformama e-učenja. Tijekom pandemije, Zoom je bio najčešće korištena virtualna platforma, slijede Google Meet i Teams (Camargo i sur., 2020; C. Chen i sur., 2021). Također su popularni paketi poput Moodlea i BigBlueButtona (Ukoha, 2022). E-učenje je u nekim slučajevima prenošeno putem televizije za srednje škole, a putem društvenih mreža prvenstveno u sveučilištima (Kireev i sur., 2019; Masonta i sur., 2015).

Cilj ovoga istraživanja jest analizirati i prikazati kako je pandemija COVID-19 utjecala na sustav obrazovanja u javnim i privatnim VOI-ima u zemljama u razvoju poput Srbije. Studija nudi vrijedne uvide za upravu sveučilišta i donositelje obrazovnih politika identificirajući ključne čimbenike koji osiguravaju učinkovitu uporabu sustava e-učenja među studenatima i nastavnicima. Nalazi predstavljaju jedinstven doprinos omogućujući čelnicima VOI-a da primijene zaključke u svrhu osiguranja učinkovitoga korištenja metoda e-učenja tijekom pandemijskih kriza.

Metodologija

Hipoteze

Sljedeće hipoteze su razvijene kako bi se izmjerio utjecaj pandemije COVID-19 na e-učenje u VOI-u.

Prva hipoteza ($1H_0$): Pandemija COVID-19 nije pokrenula ni otkrila digitalni jaz između nastavnika i studenata u visokom obrazovanju.

Prva alternativna hipoteza ($1H_1$): Pandemija COVID-19 je pozitivno pokrenula i otkrila digitalni jaz između nastavnika i studenata u visokom obrazovanju.

Druga hipoteza ($2H_0$): Visokoobrazovne institucije nisu imale koristi od pandemije COVID-19 primjenom strategija e-učenja.

Druga alternativna hipoteza ($2H_1$): Visokoobrazovne institucije su imale koristi od pandemije COVID-19 primjenom strategija e-učenja.

Treća hipoteza ($3H_0$): Digitalni jaz među studentima i nastavnim osobljem u VOI-u nije doveo do integracije strategija e-učenja.

Treća alternativna hipoteza ($3H_1$): Digitalni jaz među studentima i nastavnim osobljem u VOI-u pozitivno je doveo do uključivanja strategija e-učenja.

Uzorak i prikupljanje podataka

U ovom istraživanju korišten je presječni pristup i kvantitativni istraživački dizajn. VOI u Vojvodini, Srbija, sudjelovale su u istraživanju, a uzorak je obuhvatio dva najveća sveučilišta: jedno privatno – Poslovna akademija u Novom Sadu (UBA) –

i jedno javno – Univerzitet u Novom Sadu (UNS). Uzorci su odabrani metodom namjernog uzorka. Zbog ograničenja pandemije COVID-19, podatci su prikupljeni putem *online* upitnika. Privatna i javna sveučilišta bila su proporcionalno zastupljena. Od jedanaest pitanja u upitniku, šest je bilo namijenjeno prikupljanju demografskih podataka (spol, dobna skupina itd.), dok je pet pitanja mjerilo hipoteze razvijene za procjenu utjecaja COVID-19 na e-učenje u visokoobrazovnim institucijama. Percepcije o pandemiji COVID-19 procijenjene su na Likertovoj skali od 1 do 5, od potpuno se ne slažem do slažem se.

Statistička analiza

Strukturni model obrađen je koristeći ADANCO softver budući da je studija koristila SEM, točnije PLS-SEM (*partial least squares structural equation modeling*). Deskriptivna analiza profila ispitanika provedena je u SPSS-u.

Rezultati

U istraživanju je sudjelovalo ukupno 637 sudionika koji su bili uključeni u VOI-i. Upitnik je poslan ukupno 734 osobe, od kojih je 637 odgovorilo, što znači da 97 osoba nisu popunile upitnik.

Raspodjela ispitanika prema spolu bila je gotovo izjednačena, s malom prednošću muškaraca (363) u odnosu na žene (274). Najveći broj ispitanika nalazi se u dobnoj skupini 19 – 29 godina, dok je najmanje ispitanika starije od 50 godina. Rezultati pokazuju da je oko 78 % ispitanika (SD = 255,27) bili studenti, dok su ostali bili nastavnici ili znanstvenici zaposleni u VOI-ima, i to iz privatnih i javnih institucija. Temeljem dobivenih rezultata, 45 % ispitanika bilo je angažirano u privatnim VOI-ima, dok je 55 % ispitanika bilo angažirano u javnim VOI-ima.

Profil sudionika pokazuje da većina koristi svoje pametne telefone (400) kao glavni uređaj za e-učenje, zatim prijenosna računala (226), a najmanje stolna računala (11). Također, podatci su pokazali da ispitanici u VOI-ima preferiraju korištenje osobnih uređaja (582) za e-učenje, dok je korištenje fakultetskih prostora najmanje zastupljeno (14). Cilj studije je ispitati spremnost i namjeru sudionika da prihvate e-učenje kao zamjenu ili nadopunu postojećim tradicionalnim metodama poučavanja.

Tablica 1

Tablica 2

Rezultati su pokazali najvišu pouzdanost od 0,9211 za EL, zatim konvergentnu valjanost od 0,9879 za DD i 0,9811 za diskriminantnu valjanost u EL.

Za procjenu konvergentne valjanosti korišteni su vanjski loadinzi i AVE. Vrijednosti AVE svih konstrukata premašile su minimalnu razinu za dokazivanje konvergentne valjanosti. Prema Henseleru i sur. (2016) u PLS-SEM metodologiji, stavke s loadinzima manjim od 0,6 su izbačene, dok su stavke s loadinzima većim od 0,6 zadržane.

Kako bismo procijenili prisutnost pristranosti metodom (CMB), izvršili smo test potpune multikolinearnosti, konkretno faktor inflacije varijance (VIF). Temeljna

evaluacija pokazala je da CMB nije problem jer su izračunati VIF-ovi manji od praga od 10. Nakon ove procjene, zaključeno je da je zabrinutost zbog CMB-a minimalna.

Tablica 3

Faktor inflacije varijance (VIF) i loadinzi stavki

Optimizacija (stavka)	Loadinzi	VIF
COV-1: Coronavirus (COVID-19) postoji.	0,7992	7,3460
COV-2: Pandemija COVID-19 je opasna bolest koja utječe na cijeli svijet.	0,8361	5,2844
COV-3: Zbog ove pandemije nervozan/ na sam kad se približavam kolegama.	0,7845	7,3651
COV-4: Pandemija COVID-19 me čini nervoznim/om pri približavanju profesorima.	0,9022	2,7761
COV-5: Javna okupljanja su obavijena strahom zbog pandemije COVID-19.	0,9103	2,4435
COV-6: Promijenio/la sam pristup stvarima zbog pandemije COVID-19.	0,8976	3,0118
EL-1: Zbog pandemije COVID-19 prvi put se koristim e-učenjem u svojem akademskom životu.	0,6299	1,9543
EL-2: Elektronička dostava relevantnih nastavnih materijala je uobičajena.	0,5443	1,9930
EL-3: Predavanja koja moji profesori drže *online* sve su popularnija.	0,8260	2,5789
EL-4: Dok god ih kontaktiram, mogu komunicirati s profesorima.	0,8003	2,6001
EL-5: Elektroničke platforme koriste se za predaju zadataka na evaluaciju.	0,7704	4,0151
DD-1: Moje sveučilište mi je uvelo platforme za e-učenje koje sam morao/ la brzo naučiti koristiti na svojem pametnom telefonu.	0,8022	2,5611
DD-2: Uređaj za e-učenje trebao bi biti osiguran svim studentima na mojem sveučilištu.	0,7903	3,6009
DD-3: Pravilna orijentacija na platforme za e-učenje važna je za svakog novoupisanoga studenta na mojem sveučilištu kako ne bi zaostao/la u pandemijskim situacijama.	0,7130	3,2561

Za dodatnu provjeru diskriminantne valjanosti korišten je HTMT pristup (Henseler i sur., 2016). Rezultati pokazuju da nijedan od koeficijenata korelacije ne prelazi prag od 0,85, što potvrđuje diskriminantnu valjanost pristupa.

Tablica 4

Proveli smo strukturnu analizu (hipotetski putevi) na temelju psihometrijske procjene konstrukata istraživanja kako bismo ispitali odnos između pojave pandemije

COVID-19 i usvajanja e-učenja među VOI (Slika 1). Statistička analiza podataka otkrila je i izravne i neizravne utjecaje u strukturnom modelu. Na temelju empirijskih nalaza, sve predložene hipoteze potvrđene su (Tablica 5 i Slika 2).

Slika 1

Slika 2

Promatrajući hipoteze: Prva hipoteza ($1H_0$): COV→DD dobila je potporu regresijom (beta) i značajnom procjenom $\beta = 0,584$ sa statistički značajnim razlikama ($p < 0,05$). Druga hipoteza ($2H_0$): COV→EL potvrdila se s $\beta = 0,278$ i statistički značajnim razlikama ($p < 0,05$). Treća hipoteza ($3H_0$): DD→EL podržana je vrijednošću $\beta = 0,078$ uz statistički značajne razlike ($p < 0,05$).

Tablica 5

Procijenjene vrijednosti koeficijenata R2 za endogene i ovisne konstrukte predloženoga modela analizirane su kako bi se utvrdilo može li model predvidjeti ishod. R2 vrijednosti iznad 0,5 smatraju se dobrim pokazateljem prediktivne moći modela (Roy i Roy, 2008). Naše procjene u Tablici 5 upućuju na dobru prediktivnu snagu ovisne varijable, što čini model značajnim ($p < 0,05$).

Rasprava

E-učenje ima veliki potencijal za poboljšanje visokih učilišta širom svijeta (Guri-Rosenblit, 2005). U usporedbi s tradicionalnim sustavom obrazovanja, e-učenje pozitivno utječe na obrazovne strukture (Al-Adwan i sur., 2021; EL-Ariss i sur., 2021). Zbog izbijanja i brzoga širenja COVID-19, neke škole su na svim razinama bile zatvorene diljem svijeta (Naik i sur., 2021). Dugotrajna zatvaranja natjerala su vlade da preoblikuju pružanje obrazovnih usluga primjenom e-učenja u tercijarnim institucijama (Al-Karaki i sur., 2021; Edem Adzovie i Jibril, 2022; Mohd Satar i sur., 2021; Surendran i sur., 2021).

Važno je napomenuti da su ove smjernice potaknule preobrazbu obrazovnoga sustava VOI-a prema nalazima ovoga empirijskog istraživanja. Mnoge tercijarne institucije osigurale su platforme za e-učenje kao alternativu predavanjima licem u lice tijekom pandemije (Yatigammana i Wijayarathna, 2021).

Za učinkovitu i efikasnu uporabu postojećih sustava e-učenja potrebno je razumjeti i prethodne inačice i glavne izazove povezane s njihovim usvajanjem tijekom izbijanja pandemije COVID-19.

Nalazi ukazuju da je pandemija djelovala i kao izazov i kao katalizator transformacije u visokom obrazovanju. Iako je prijelaz na *online* sustave u početku bio nametnut nužnošću, podatci pokazuju da su se mnogi studenti i profesori postupno počeli prilagođavati i uviđati vrijednost digitalnih rješenja. Ovaj dvostruki učinak ističe paradoks kriznih situacija: one otkrivaju sustavne slabosti, ali i ubrzavaju potragu za inovativnim rješenjima te potiču institucije da preispitaju svoje pedagoške i upravne strategije.

Kontrast između javnih i privatnih institucija dodatno ilustrira ovu kompleksnost. Privatna sveučilišta, zbog ranijih ulaganja u obrazovanje na daljinu i fleksibilnije strukture, mogla su brže odgovoriti i osigurati funkcionalne platforme i jasnije sustave podrške. Javna sveučilišta su, s druge strane, morala uskladiti regulatorne zahtjeve koji su isticali fizičku prisutnost s praktičnom nemogućnošću nastave tijekom zatvaranja.

Tehnološki profil studenata i osoblja otkriva da se u velikoj mjeri oslanjaju na pametne telefone, što ukazuje na potrebu za dizajnom sadržaja prilagođenim mobilnim uređajima.

Pojam digitalnoga jaza pokazao se ključnim za razumijevanje neravnomjernih učinaka pandemije na različite skupine studenata. Studija je pokazala da digitalni jaz nije jedinstvena prepreka, već slojeviti fenomen koji uključuje pristup uređajima, vještine njihove uporabe i povjerenje za aktivno sudjelovanje u *online* sustavima.

Rješavanje ovoga jaza zahtijeva više od same podjele opreme; potrebno je kontinuirano osposobljavanje, podrška i razvoj digitalne kulture koja osnažuje studente i nastavnike da se osjećaju kompetentnima u *online* prostoru. Dokazi iz ovoga istraživanja podupiru ideju da smanjenje digitalnoga jaza ne promovira samo jednakost, već i izravno jača učinkovitost e-učenja.

Ovi uvidi imaju i dugoročne implikacije. Brza implementacija *online* rješenja tijekom pandemije ostavila je nove prakse i očekivanja među studentima i osobljem, a mnogi sada e-učenje vide kao sastavni dio suvremenoga obrazovanja. To otvara mogućnost hibridnih modela koji kombiniraju fleksibilnost *online* pristupa s prednostima osobne interakcije.

Za sveučilišta izazov će biti dizajnirati održive sustave koji integriraju snage obaju modaliteta uz minimiziranje njihovih slabosti. Na kraju, nalazi trebaju biti dio šire rasprave o otpornosti obrazovnih sustava – VOI se ne smiju oslanjati isključivo na tradicionalne modele pružanja nastave.

Temeljem empirijskih dokaza, sve predložene hipoteze u ovom su istraživanju podržane. Na temelju ovih nalaza, menadžment i kreatori politika VOI-a u zemlji trebaju preispitati i unaprijediti postojeće sustave e-učenja i koristiti ove informacije kao smjernice za poboljšanje korištenja praksi e-učenja studenata i nastavnika.

Sociodemografske karakteristike uzorka pokazuju da mlađa generacija predstavlja sadašnje i buduće inovatore i korisnike. Stoga bi razvojni timovi i pružatelji usluga trebali uzeti u obzir profil korisnika pri dizajnu proizvoda i ciljanja tržišta.

Zaključak

U ovom radu analizirani su čimbenici koji omogućuju uporabu sustava e-učenja tijekom izbijanja pandemije koronavirusa u manje digitaliziranom društvu. Korištenjem višestruke medijacijske analize, u studiji je ispitana veza između pandemije COVID-19 i politike e-učenja primijenjene u VOI-ima. Rezultati daju vrijedan doprinos upravama privatnih i javnih sveučilišta i kreatorima politika radi evaluacije i primjene u svrhu osiguranja učinkovite provedbe sustava e-učenja. VOI-i usvajaju sustave e-učenja zbog izravnih i neizravnih čimbenika identificiranih kvantitativnim dokazima.

Primjena sustava e-učenja u VOI-ima tijekom pandemije COVID-19 ne samo da je ublažila neposredne probleme već je i otkrila transformacijski potencijal za budućnost obrazovanja. Kada su pomno dizajnirani i integrirani, sustavi e-učenja mogu poboljšati kvalitetu, pristup i inkluzivnost u obrazovanju, ali je važno kontinuirano procjenjivati i unaprjeđivati strategije e-učenja kako bi se maksimalizirale njihove koristi.

Napomena

Ovo istraživanje financiralo je Ministarstvo prosvjete, nauke i tehnološkog razvoja Republike Srbije.