INTERNATIONAL JOURNAL OF EDUCATION AND INFORMATION TECHNOLOGIES
DOI: 10.46300/9109.2024.18.10 Volume 18, 2024

E-Learning Impact on Higher Education Institutions during COVID-19 Pandemic: A Bibliometric Analysis

Thamer Al-Rousan[1,2], Hassan Abualese[1,2]
[1]Faculty of Information Technology,
Isra University,
Amman,
Jordan

[2]The World Islamic Sciences and Education University,
Amman,
Jordan

Received: April 14, 2023. Revised: August 12, 2024. Accepted: September 16, 2024. Published: October 11, 2024.

Abstract— The COVID-19 pandemic forced a rapid shift to online learning in higher education. To understand this evolving field better, this study employed a powerful technique called bibliometrics. Researchers analyzed scholarly publications between 2020 and 2023 in Web of Science, focusing on keywords related to e-learning, universities, and the pandemic's impact. This data-driven approach provided a more comprehensive picture than traditional reviews, revealing connections between research topics, researchers, and specific studies. Furthermore, the VOSviewer tool was employed to identify frequently co-occurring keywords, thus uncovering the major themes within the research. This analysis of keyword co-occurrence allowed the study to pinpoint key trends and areas of focus in e-learning for higher education institutions. Ultimately, this research offers valuable insights for researchers, educators, and policymakers navigating the changing educational landscape and the future of e-learning in higher education.

Keywords—COVID-19; Higher Education Institutions; Bibliometric analysis; Web of Science; Pandemic Impacts; E-Learning

I. INTRODUCTION

The world was rocked by the COVID-19 pandemic, and education was no exception. All of a sudden, e-learning took center stage and sparked intense debates, [1]. This unanticipated incident thrust e-learning into the public eye and made it an indispensable resource for academic institutions around the globe. It turned traditional classroom learning on its head by substituting online interactions for in-person ones, but more significantly, it kept education going during a worldwide crisis, keeping students from falling behind, [2].

E-learning is fundamentally dependent on computers and internet access. Although there are several names for this type of learning—distance learning, virtual learning, online learning, etc.—they all refer to the same idea: learning from home without the guidance of teachers. Students and teachers can connect remotely with this easily accessible web-based learning program using computers and cell phones, [3]. However, the specific design of these learning environments varies depending on the needs of each institution. Factors like learning objectives, accessibility, content, and target audience all play a crucial role in shaping these virtual spaces, [3].

Driven by the explosive growth of e-learning studies since COVID-19, this study bridges two critical gaps: First, Lack of quantitative analysis. While qualitative reviews abound, the field's intellectual structure and future trends remain unclear. This study employs a pioneering bibliometric approach using the Web of Science database to offer a data-driven, objective perspective. Second, identifying emerging trends and best practices. The vast COVID-19 study presents a unique opportunity to analyze trending topics in e-learning for higher education institutions (HEIs). This can inform institutions on how to best adapt and develop mitigation and intervention plans based on best practices.

Overall, this study provides a comprehensive and data-rich analysis of e-learning implementation in higher education institutions during COVID-19, offering valuable insights for researchers, educators, and institutions to navigate the future of this transformative educational trend.

II. LITERATURE REVIEW

COVID-19 drastically changed education, forcing universities worldwide to pivot to online learning. The studies have primarily focused on two areas: how universities adapted technologically and the impact on students. Studies show that successful adaptation relies on strong educational development, leadership, and innovation, [4]. Student attitudes are complex, and influenced by factors like technology access, platform quality, and institutional support. Researchers have explored student perceptions of online learning across numerous countries, [5].

The pandemic forced unprecedented technology use by educators. Platform quality improved naturally due to their crucial role during the pandemic, potentially leading to increased use by faculty and students together, [6]. Online platforms moved from being supplemental resources to being the main means of distribution, necessitating quick changes to interface design to satisfy user demands, [7]. Funding increases accelerated the development of learning system architecture and implementation, [8]. The pressure to maintain education during lockdowns spurred institutions to fix long-standing technical issues, fostering better online learning environments. Technical issues have also decreased as a result of platform inspection, diagnosis, and improvement, [9].

Different pedagogical content knowledge is needed for teaching online than for traditional teaching. Several variables affect successful implementation, such as organizational culture, policy, technological dependability, accessibility, usability, and content quality, in addition to the knowledge, abilities, and disposition of human resources, [10].

The COVID-19 pandemic dramatically accelerated the usage of technology in higher education, pushing online platforms to the forefront of teaching and learning. This shift has several key implications:

1) **Enhanced Online Platforms:** The pandemic's demand for online platforms led to significant improvements in their quality, making them more appealing to both students and faculty, [10]. These platforms have transitioned from supplementary resources to the primary delivery method, requiring rapid interface design adaptations. Funding increases and rapid technological developments helped to keep up this rise even more, [11].
2) **Sustainability Challenges:** To capitalize on the growing demand for online learning and prepare students for the digital future, universities should invest in mobile applications, online course delivery, and assessment technologies, creating a more accessible, engaging, and future-proof learning experience, [12], [13].
3) **Flexible Learning:** Students may access learning materials from anywhere at any time with the flexibility that comes with online learning. Commonly used tools like education management systems and video conferencing platforms improve communication and the delivery of information, [14].
4) **Factors Affecting E-Learning Adoption:** Studies have determined four main variables that affect the adoption of e-learning systems, [15], [16], [17]:
   - Technological factors. Reliable hardware, easy-to-use software, and professional IT support are required to ensure smooth operation.
   - Quality Content & Platforms: User-friendly platforms with attractive content offer 24/7 access to information, empowering students to learn whenever inspiration strikes.
   - Confidence & Culture: Students should feel comfortable and confident using technology, with access to resources that empower their teachers' preferred teaching methods.
   - Trust & Security: Privacy, reliability, and security are the trifecta of trust and engagement in learning.
5) Blended Learning: Compared with online learning, blended learning combines the flexibility of online learning with the social benefits of in-person classes. This flexible approach has become a major trend since the pandemic, [16], [18].

A growing number of research are concentrating on various aspects of virtual learning, such as blended learning settings and intelligent learning tools, [7], [8]. The primary goal of these studies was to determine which e-learning tools and techniques are most often utilized and significant. Numerous studies have used meta-analyses to examine the findings of articles on e-learning.

This study tries to close the gap left by previous research, which analyzed previous studies to identify key tools and methodologies. Specifically, it compares several methods to determine which best identify the most significant research areas in e-learning, especially in light of the recent effect of COVID-19. This will be helpful as we investigate future directions and the general framework of e-learning research, especially in light of the pandemic.

III. METHODOLOGY

This research makes use of bibliometrics, a method that examines large scientific datasets. In contrast to conventional evaluations, bibliometrics offers a thorough overview of e-learning research conducted during COVID-19. We can show complex relationships between study subjects, the academics who are conducting them, and specific studies, which gives us a deeper and more comprehensive understanding of the study field, [1].

The material included in this analysis was published in Web of Science between 2020 and 2023. Web of Science is an extremely large database with over 80 million academic resources on a variety of topics, [19]. We looked specifically at papers that examined the impact of the pandemic on university and higher education institutions (HEI) online learning.

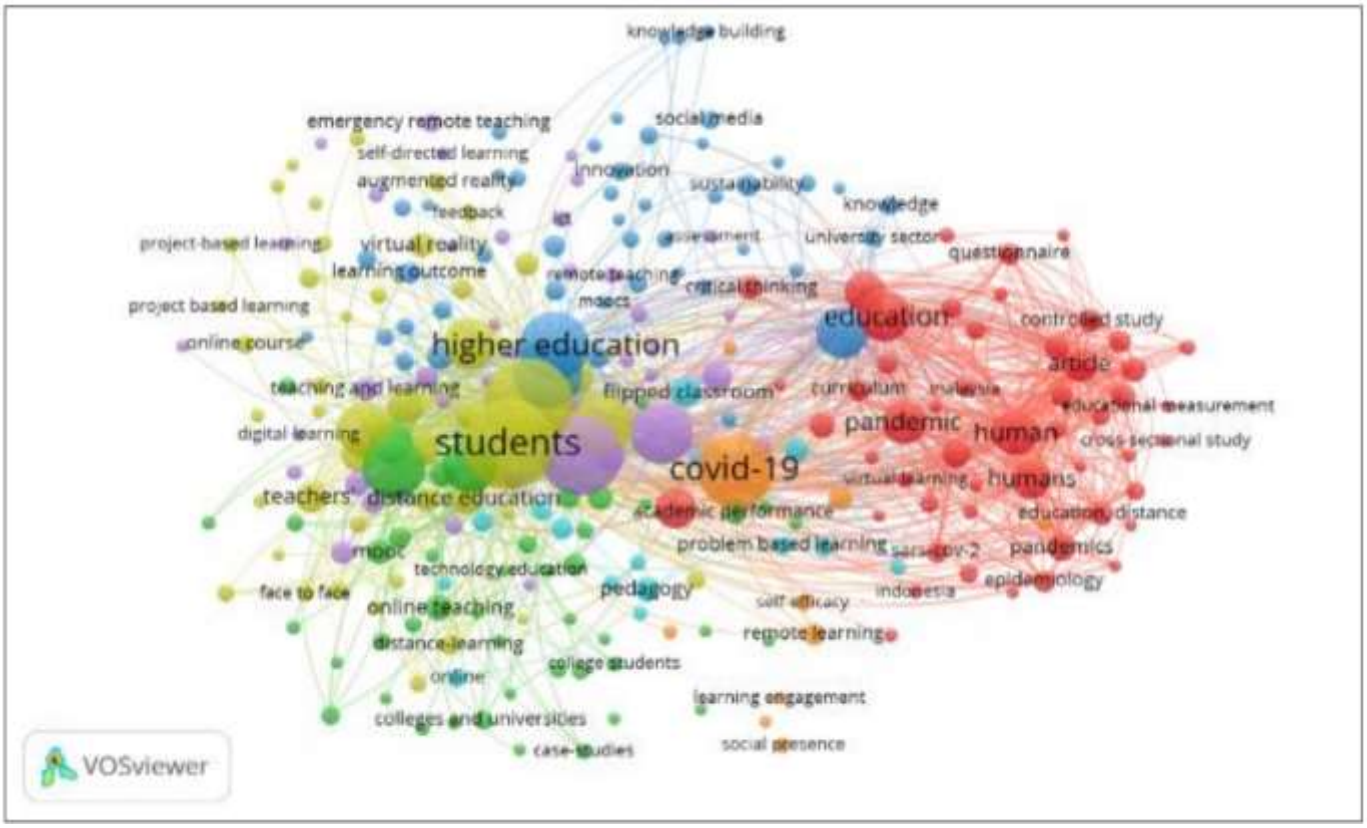

Fig. 1 The output of co-occurrence analysis

To find significant research trends and areas of interest, we searched for keywords associated with universities, online learning, higher education institutions, and COVID-19. The wide scope of the Web of Science allowed us to compile the most relevant studies. The specified collection of 1,507 articles remained after removing duplicates and non-journal publications. Next, we looked at the frequency with which specific words appeared together using the software program VOSviewer. The main topics covered in the chosen research were made clear by this analysis.

VOSviewer generated a network where each node represents a frequently used term, with size indicating its frequency and links showing connections between related terms, [20], [21]. Fig. 1 presents the results of the term co-occurrence analysis using VOSviewer. To interpret these connections, we combined the network analysis with reading study papers containing key terms, ensuring a nuanced understanding of the identified themes.

IV. RESULT

Our initial search identified a whopping 2,048 articles, but after focusing on journal-based empirical studies, we landed at 1,507 relevant ones. These studies have already garnered impressive citation counts: over 8,354 citations overall, and 6,367 excluding self-citations. On average, each article received 5.54 citations, indicating strong scholarly interest. The h-index of 42 further underscores this impact. The publication trend reveals a remarkable surge: from 147 articles in 2020 to 513 in 2023. This nearly fourfold increase highlights the growing importance of this field. Even after the pandemic subsides, e-learning in HEIs is expected to continue thriving. Its ability to overcome physical barriers and enhance educational practices ensures its sustained relevance and potential.

Many studies use **keyword co-occurrence analysis**, a technique that reveals hidden connections between terms that often appear together in research papers, [1], [22], [23]. Think of it like mapping out a conversation: First, important keywords are picked out from each paper, usually from the author's list, title, or abstract. These keywords are then visualized as bubbles, with their size indicating how often they show up. The bigger the bubble, the more frequently the term is discussed. Lines connect the bubbles, and their thickness reveals how often specific keywords appear together within the same text. Thicker lines indicate stronger connections between ideas. By analyzing these bubbles and lines, researchers can:

- **Identify key topics:** Larger bubbles represent the most talked-about topics in the research.
- **Understand how concepts are connected:** thicker lines show strong connections between different ideas.
- **Recognize emerging trends:** New clusters of keywords could point to exciting new research areas.

This technique helps us understand the current state of a research field and where it might be heading next.

TABLE I. TOP 7 KEYWORDS IN THE CO-OCCURRENCE

Ranking	Keyword	Occurrences	Total link strength
1.	Covide-19	230	1467
2.	E-Learning	227	1395
3.	Distance Learning	165	1013
4.	Mobile Learning	126	621
5.	Education	98	407
6.	Student	83	1336
7.	Blended learning	72	508

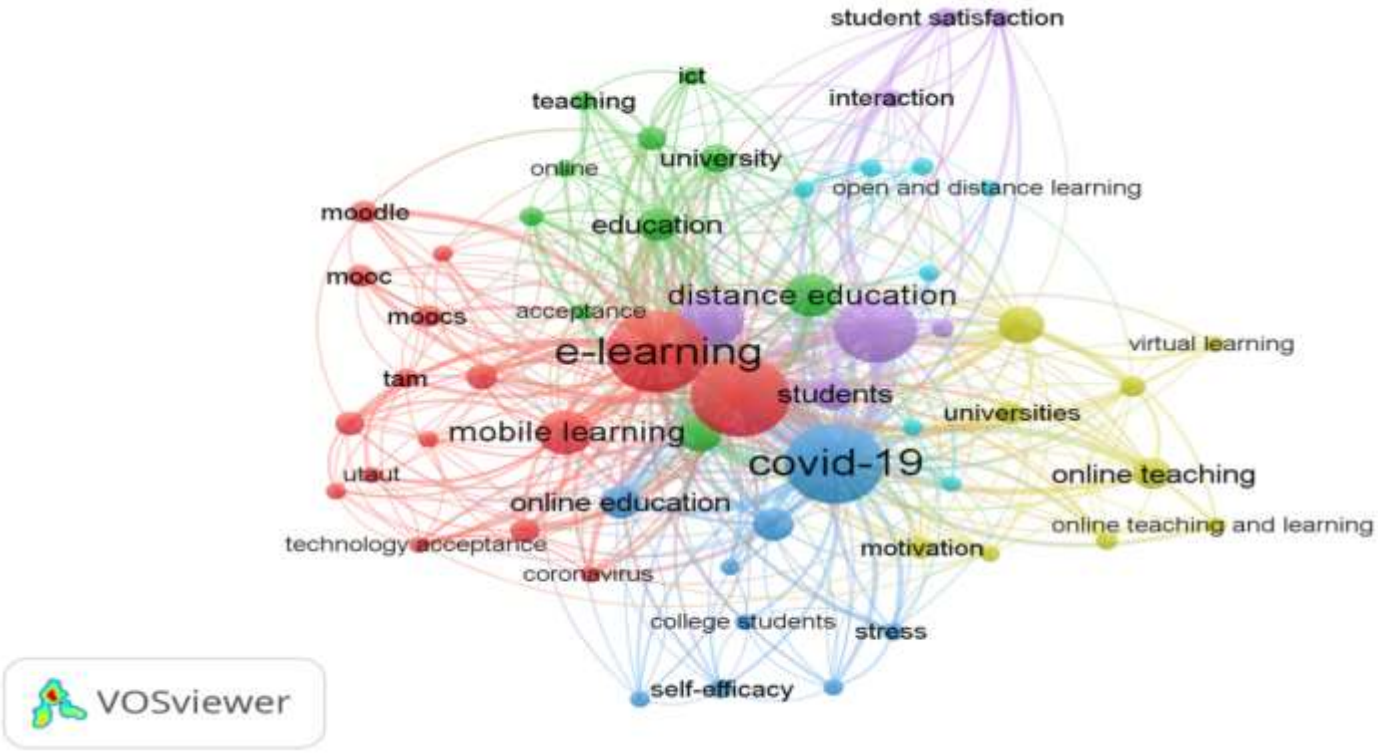

Fig. 2 Keyword analysis that co-occurs graphically

The study used author keywords for co-occurrence analysis. Only keywords mentioned at least 15 times were considered, resulting in 63 keywords out of 2,173. These keywords, with their frequency indicating relative popularity, offer insights into trends in HEI during the pandemic. The most common keyword was "COVID-19," followed by "e-learning" and "distance education." Table I displays the top six most frequent keywords.

Fig. 2 shows how keyword analysis co-occurs graphically. Five primary groupings are identified by the graphing as being related to e-learning in HEIs. Naturally, the most common term on the list was "COVID-19" (230 occurrences), which was followed by "online learning" (227) and "distance learning" (196). This emphasizes how much the pandemic affected HEIs' embrace of e-learning. The 5 groups in the co-occurrence of keyword analysis are then explained:

1) E-learning and Pandemic (red): This group (19 keywords) highlights the shift from pre-pandemic to "emergency remote teaching" characterized by distance learning and e-learning adoption under urgent circumstances. The main keywords are E-Learning, Mobile Learning, and Moodle.

2) Mental Health (blue): This group (17 keywords) acknowledges the increased prevalence of mental health issues like anxiety and depression among students due to the limitations of online learning compared to in-person classes. Scholars suggest various strategies to address these concerns. The main keywords are Mental Health, Stress, College Students, and Medical Education.

3) Distance learning (green): This group (16 keywords) focuses on challenges faced by online learning and health education, as well as the use of technology to modify higher education courses in light of COVID-19's restricted chances for practical training. It emphasizes the need for innovative online teaching methods, including those for practical skills. The main keywords are Distance learning, Teaching, University, Online, and Education.

4) Technology Flexibility and Student Satisfaction (purple): This group (14 keywords) emphasizes the role of technology in facilitating flexible, independent learning

and student satisfaction. The main keywords are Student Satisfaction, Web-Based Learning, Interaction, and Distance Learning.

5) Implementing E-learning (yellow): This group (13 keywords) focuses on practical implementation strategies adopted by HEIs and faculty during the pandemic. It delves into topics like the effectiveness of e-learning programs, ensuring learner engagement, measuring learning outcomes, and online assessment systems. The main keywords are Online Teaching, Teaching and learning, Motivation, and University.

There are five research groups that the study found. Tightly woven groups 1, 2, 3, and 5 come together to form the figure's center group. These groups center on how educators and learners adjust to online instruction in the event of a pandemic. The fifth group is rather isolated. With fewer links to the other groups, it focuses on practical implementation strategies adopted by HEIs and faculty during the pandemic. These primary groups gave rise to several important topics. First, during a pandemic, experts are curious about how teachers and students adjust to online learning. Second, modifying courses that need practical instruction, like those in the health sciences and medicine, is a significant issue. Third, the study investigates how e-learning affects students' isolation and mental health. Fourth, the role of technology in facilitating flexible, independent learning and student satisfaction. Additionally, the operational problem with the adoption of e-learning relates to mixed learning, online evaluations, and flipped classrooms.

V. DISCUSSION

The pandemic undeniably forced a dramatic transformation in higher education, leaving behind the pre-pandemic "business as usual" and ushering in an era of significant change. This analysis focuses on the immediate impacts, excluding long-term post-pandemic trends. One of the most critical areas affected was faculty-student interaction. The rapid shift to online learning demanded new skills and resources from faculty, who often lacked experience in this medium. Universities made significant investments in faculty training and technology infrastructure, but challenges including unequal access, instructional limits in online models, and technical hiccups continued, [23].

Teachers, staff, and students all experienced financial, psychological, and emotional hardship as a result of the pandemic. Anxiety was exacerbated by financial hardships, doubts about the upcoming school year, and worries about the future. Universities had to adjust, but several were in danger of closing because of erratic enrollment, [24].

Notwithstanding the challenges, certain favorable results surfaced. Teachers developed closer ties by facing similar obstacles together and working together to resolve problems such as administrative worries and troubles with online instruction. Notably, in certain situations, teacher-student contact did increase with online learning. Unquestionably, universities improved their IT infrastructure, and instructors now need to be proficient in ICT, [25]. However, learning was originally impeded by device constraints, connectivity concerns, and technological issues. The success of the shift to an online learning environment differed throughout universities, primarily due to the flexibility of the faculty and the state of the infrastructure, [26].

This study analyzed the adoption of e-learning in higher education institutions during the COVID-19 pandemic using bibliometric analysis. The authors analyzed over 1,507 papers over a four-year, demonstrating a spike in e-learning research since 2020. They believe that even after the epidemic, this trend will continue. The analysis highlighted several areas of interest for COVID-19 e-learning research, such as:

- **Student mental health**, which calls for mitigation initiatives. Many perspectives are now being investigated on the subject, along with a plan for mitigation and treatment. Through linked keywords (COVID-19, e-learning, mental health, anxiety, sadness, and stress), group 2 displays the mental health group based on the co-occurrence of keywords analysis. Since many students and teachers are at a greater risk of having mental health issues, the problem emerges. Students confront several challenges, including late graduation owing to postponed exams and the stress of entering the workforce amid the global crisis.
- **Adapting educational approaches for a post-pandemic environment**. To improve student engagement, instructors might use interactive approaches to teaching. They may also modify their lectures to attract students' interest. Additionally, every learning approach used at HEIs, including lectures, digital open books, and exams, should be changed to make sure students can keep up academically without sacrificing the standard of education.
- **Students' and instructors' Satisfaction.** Both students and instructors showed a preference for going back to traditional in-person classes, even though there was an increase in contact in some areas, [27]. Notably, training focused mostly on professors, ignoring the requirements of students. A small number of universities prioritized student instruction. Considering the difficulties students encounter when adjusting to online learning, this discrepancy calls for additional research, [28].
- **Employing e-learning in certain disciplines.** E-learning implementation in disciplines such as medicine, where face-to-face instruction is essential. In this unique time, many majors and courses suffer greatly, especially medical education which depends on in-person instruction and contact. It is necessary to embrace and get familiar with fresh perspectives and innovative approaches for medical education, such as the one Imperial College London used for its online final-year medical test, [4]. Due to the pandemic, medical education has advanced thanks to innovative and revolutionary active curricula across a wide range of medical fields.

The usage of e-learning in higher education institutions during the COVID-19 epidemic is analyzed in this study. It provides a comprehensive and data-rich analysis of e-learning implementation in higher education institutions during COVID-19, offering valuable insights for researchers, educators, and institutions to navigate the future of this transformative educational trend. Ultimately, our findings suggest that e-learning will remain a popular area of study even after the pandemic is over.

VI. CONCLUSION

This study examines how the COVID-19 epidemic affected higher education institutions (HEIs) around the world by analyzing 1,507 e-learning studies that were conducted during this chaotic time. The analysis shows a significant increase in e-learning research over the last four years, underscoring the importance of sustaining students' learning. To survive in this rapidly changing environment, higher education institutions have to adapt their strategies to the new online environment and increase their investments in online education.

Although the epidemic presented many difficulties, it also acted as a strong impetus for the advancement of online learning and evaluation strategies. Beyond the COVID-19 era, these developments and the growth of improved digital proficiency have the potential to greatly increase student and faculty happiness.

The influence of the pandemic on HEIs is the special subject of this study, which highlights the exponential expansion of e-learning research. It explores the ongoing relevance of e-learning in a post-pandemic environment and identifies the major topics and areas of concentration in this study. Researchers, educators, and policymakers navigating the constantly changing educational landscape, both during and after the COVID-19 crisis, will find this research to be a significant resource as it offers a thorough grasp of the current condition of e-learning and its hopeful future in higher education.

ACKNOWLEDGMENTS

Our heartfelt thanks go to Isra University, Amman, Jordan, for supporting this research. We also extend our sincere appreciation to our colleagues whose expertise and guidance greatly influenced this research**.**

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used Grammarly for language editing. After using this service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

References

[1] N. Kaur, D. Dwivedi, J. Arora, and A. Gandhi, “Study of the Effectiveness of E-Learning to Conventional Teaching in Medical Undergraduates Amid Covid-19 Pandemic,” Natl J Physiol Pharm Pharmacol, vol. 10, no. 7, pp. 563–7, 2020.

[2] E. K. Elberkawi, A. Maatuk, S. F. Elharish, and W. M. Eltajoury, “A Comparative Study of the Challenges and Obstacles Facing E-Learning During the COVID-19 Pandemic from the Perspectives of University Instructors and Students,” in Australasian Computer Science Week 2022, Brisbane Australia: ACM, Feb. 2022, pp. 186–192.

[3] E. M. Onyema, R. Khan, N. C. Eucheria, and T. Kumar, “Impact of Mobile Technology and Use of Big Data in Physics Education During Coronavirus Lockdown,” Big Data Min. Anal., vol. 6, no. 3, pp. 381–389, Sep. 2023.

[4] Z. Mseleku, “A Literature Review of E-Learning and E-Teaching in the Era of Covid-19 Pandemic.” Sage Los Angeles, CA, USA: 2020. pp. 128–139 Accessed: Feb. 19, 2024.

[5] G. Croucher and W. Locke, “A Post-Coronavirus Pandemic World: Some Possible Trends and Their Implications for Australian Higher Education,” Front. Psychol., vol. 10, no. 3, pp. 81–88, 2020.

[6] K. Stecu\la and R. Wolniak, “Advantages and Disadvantages of E-Learning Innovations during Covid-19 Pandemic in Higher Education in Poland,” J. Open Innov. Technol. Mark. Complex. vol. 8, no. 3, pp. 159, 2022.

[7] M. Mahyoob, “Challenges of E-Learning During the Covid-19 Pandemic Experienced by Efl Learners,” Arab World Engl. J. AWEJ, vol. 11, no. 4, pp. 38–49,2020, Accessed: Feb. 19, 2024.

[8] I. A. Adeoye, A. F. Adanikin, and A. Adanikin, “Covid-19 and E-Learning: Nigeria Tertiary Education System Experience,” J. Research and Innovation in Applied Science, vol.5, no. 5, pp. 28–39, 2020, Accessed: Feb. 19, 2024.

[9] T. Rousan, and B. Al-Shargabi, “A New Maturity Model for the Implementation of Software Process Improvement in Web-Based Projects,” J. Digital Information Management, vol. 12, no. 2, pp. 51–59, 2017.

[10] M. Z. Hoq, “E-Learning During the Period of Pandemic (covid-19) in the Kingdom of Saudi Arabia: An Empirical Study,” Am. J. Educ. Res., vol. 8, no. 7, pp. 457–464, 2020.

[11] R. Radha, K. Mahalakshmi, V. S. Kumar, and A. R. Saravanakumar, “E-Learning During Lockdown of Covid-19 Pandemic: A Global Perspective,” Int. J. Control Autom., vol. 13, no. 4, pp. 1088–1099, 2020.

[12] S. Subedi, S. Nayaju, S. Subedi, S. K. Shah, and J. M. Shah, “Impact of E-Learning During Covid-19 Pandemic Among Nursing Students and Teachers of Nepal,” Int. J. Sci. Healthc. Res., vol. 5, no. 3, pp. 68–76, 2020.

[13] A. Gumantan, R. A. Nugroho, and R. Yuliandra, "Learning During the Covid-19 Pandemic: Analysis of E-Learning on Sports Education Students," J. Sport Area, vol. 6, no. 1, pp. 51–58, 2021.

[14] S. Dhawan, S. "Online learning: a panacea in the time of COVID-19 crisis," J. Educ.Technol. Syst. vol. 49 no. 1, pp.5–22, 2020.

[15] A. R. Alsoud and A. A. Harasis, "The Impact of Covid-19 Pandemic on Student's E-Learning Experience in Jordan," J. Theor. Appl. Electron. Commer. Res., vol. 16, no. 5, pp. 1404–1414, 2021.

[16] T. Rousan, S. Sulaiman, and S. Salam, "Project management using Risk Identification Architecture Pattern (RIAP) model: A case study on a web-based application," in 16th Asia-Pacific Software Engineering Conference, Malaysia, Penang: IEEE, 2009, pp. 449-456.

[17] N. S. Mohd Satar, A. H. Morshidi, and D. O. Dastane, "Success Factors for E-Learning Satisfaction during Covid-19 Pandemic Lockdown," Int. J. Adv. Trends Comput. Sci. Eng. ISSN, pp. 2278–3091, 2020.

[18] R. Lestiyanawati, "The Strategies and Problems Faced by Indonesian Teachers in Conducting E-Learning During Covid-19 Outbreak," CLLiENT Cult. Lit. Linguist. Engl. Teach., vol. 2, no. 1, pp. 71–82, 2020.

[19] D. Hermawan, "The Rise of E-Learning in Covid-19 Pandemic in Private University: Challenges and Opportunities," IJORER Int. J. Recent Educ. Res., vol. 2, no. 1, pp. 86–95, 2021.

[20] M. Relics, "E-Learning in Nursing and Midwifery during the COV.pdf." Technol. Mark. Complex. vol.7, no. 2, pp. 159-167, 2021.

[21] A. Almanthari, S. Maulina, and S. Bruce, "Secondary School Mathematics Teachers' Views on E-Learning Implementation Barriers during the Covid-19 Pandemic: The Case of Indonesia." Eurasia J. Math. Sci. Technol. Educ., vol. 16, no. 7, pp. 272–283, 2020, Accessed: Feb. 19, 2024.

[22] M. A. Khan, M. K. Nabi, M. Khojah, and M. Tahir, "Students' Perception towards E-Learning during Covid-19 Pandemic in India: An Empirical Study," Sustainability, vol. 13, no. 1, pp. 57-68, 2020.

[23] R. Masa'deh, D. Almajali, A. Alrowwad, R. Alkhawaldeh, S. Khwaldeh, and B. Obeidat, "Evaluation of factors affecting university students' satisfaction with e-learning systems used dur-ing Covid-19 crisis: A field study in Jordanian higher education institutions," Int. J. Data Netw. Sci., vol. 7, no. 1, pp. 199–214, 2023.

[24] A. Y. Alqahtani and A. A. Rajkhan, "E-Learning Critical Success Factors During the Covid-19 Pandemic: A Comprehensive Analysis of E-Learning Managerial Perspectives," Educ. Sci., vol. 10, no. 9, pp. 216, 2020.

[25] P. Gohiya and A. Gohiya, "E-Learning during Covid-19 Pandemic," Research Square., vol. 16, no. 2, pp. 311–319, 2020,

[26] N. Mlinar Reljić, M. Drešček Dolinar, G. Štiglic, S. Kmetec, Z. Fekonja, and B. Donik, "E-Learning in Nursing and Midwifery during the COVID-19 Pandemic," Healthcare, vol. 11, no. 23, pp. 3094-3099, Dec. 2023.

[27] S. K. M. Brika, K. Chergui, A. Algamdi, A. A. Musa, and R. Zouaghi, "E-Learning Research Trends in Higher Education in Light of Covid-19: A Bibliometric Analysis," Front. Psychol., vol. 12, pp. 762819- 762828, Mar. 2022.

[28] Q. A. Qurotul Aini, M. B. Mukti Budiarto, P. O. H. POH Putra, and U. R. Untung Rahardja, "Exploring E-Learning Challenges during the Global Covid-19 Pandemic: A Review," J. Sist. Inf. J. Inf. Syst., vol. 16, no. 2, pp. 47–65, 2020.

Contribution of individual authors to the creation of a scientific article (ghostwriting policy)

The authors equally contributed to the present research, at all stages from the formulation of the problem to the final findings and solution.

Sources of funding for research presented in a scientific article or scientific article itself

No funding was received for conducting this study.

Conflict of Interest

The authors have no conflicts of interest to declare that are relevant to the content of this article.