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## **Experience of Implementing E-Learning to Support the Educational Process in EU Countries during the COVID-19 Pandemic: A Bibliometric Review**

***Oleksandr Hruzevskiy***

*D. Sci., MD, PhD (Medicine), Professor of the Department with course of Microbiology and Immunology, Odessa National Medical University Epidemiology and biosafety, Odessa, Ukraine, <https://orcid.org/0000-0003-1953-8380>*

**\*Correspondence email:** [gruzevskiy@ua.fm](mailto:gruzevskiy@ua.fm).

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**Abstract:** Due to the rapid development of technology, the educational sector is trying to adapt to the requirements of the modern world, especially in the context of the COVID-19 pandemic. The purpose of the article is to review the experience of implementing e-learning in the pandemic crisis, aimed at creating a flexible, inclusive and high-quality learning environment that combines technology and human skills in the crisis. The paper is based on a systematic literature review using scientometric databases and inclusion and exclusion criteria. The databases used were Web of Science, Scopus, and PubMed. The results of the study showed that open e-platforms have become an innovative approach to learning during the pandemic, based on the use of digital technologies to create accessible online learning tools. These platforms not only provided access to knowledge in an interactive way, but also facilitated interaction between students, teachers and parents in time, creating a flexible environment for learning in different time zones and conditions. A key aspect during the pandemic was the transition from traditional teaching methods to digital technologies, with a focus on individualising learning and taking into account the needs of each participant in education. This meant preserving the human aspects of



education, such as interaction, empathy and motivation, with the help of the latest digital tools. The introduction of open digital school models was intended to ensure that education was accessible to all, regardless of geographic location, physical ability or personal circumstances. The key goal of the digital transformation was to ensure quality learning that not only imparts knowledge but also develops critical thinking, communication skills, and the ability to work collaboratively in a new, electronic format. The integration of technology and support of the pedagogical process contributed to the creation of a learning environment that met the requirements of the modern world and the crisis situation. Conclusions - Future research on the human-centred digital transformation of education through e-learning models promises to explore new opportunities to strengthen the quality and accessibility of education. It is expected that such research will contribute to the development of innovative approaches to learning, in particular through digital technologies that contribute to the creation of an inclusive and stimulating learning environment in both physical and virtual spaces.

**Keywords:** digital divide, digital skills, strategies for overcoming the crisis, transformation of education.

## Introduction

The dramatic transformations in learning due to the COVID-19 pandemic have exposed the weaknesses and lack of preparedness of current global education systems. Following the closure of schools and universities, several million students were suddenly excluded from education due to a glaring digital divide (Adem & Berkessa, 2022). Connectivity has thus become a key element in guaranteeing the right to education.

Around half of the world's population (around 3.6 billion people) still do not have an internet connection (Da, 2019). At least 463 million learners, almost one-third of the world's school population, did not have access to distance learning at the time of the pandemic, mainly due to a lack of e-learning policies or the equipment needed to connect from home (Brinkman & Grudin, 2023). Most learners lacked the connectivity, devices, and digital skills necessary to find and use educational content that is only available through technology (Holomb et al., 2022).

At the global level, at the height of the pandemic and the lockdown, governments and the international community identified five priority areas for urgent action, including supporting teachers as the link that would save the education process, investing in skills development, and bridging the digital divide (Hamouche, 2023). Expanding digital skills and learning will increase the reach and relevance of education systems and improve the career prospects of young people in our rapidly changing digital economies.

The introduction of e-learning to support the learning process in EU countries during the COVID-19 pandemic was a global initiative aimed at bridging the digital divide and driving rapid transformation of education systems (Kim & Maloney, 2020). The initiative was based on partnerships between EU countries to enable them to collaborate and accelerate progress in digital learning and skills (Maraieva, 2022). The initiative was also supported by UNESCO, UNICEF, the Global Education Coalition and Generation Unlimited (Mortazavi et al., 2021).

Joint initiatives and timely responses by EU countries have strengthened political will and collective efforts to ensure quality education and accelerate progress in a critical pandemic situation (Rose, 2020).



Analysis The experience of implementing e-learning to support the learning process in EU countries during the COVID-19 pandemic requires a focused approach to study. This paper aims to provide such an analysis, looking at progress in digital learning and skills in the short term, as well as progress in the implementation of new e-learning initiatives in the long term. This is due to globalisation and geopolitical developments in the world, which show that digital learning is a lifesaver in various critical situations.

### **Research Problem**

The timely provision of an enabling ecosystem during the pandemic and lockdowns, involving governments, private sectors, and other key partners, committed to a renewed social contract for e-learning, skills development, and livelihoods (Parmar, 2023).

In the realities of the pandemic, the majority of education participants in EU countries faced full or partial interruption of their education, and 11.3 million of them were at risk of not returning to education (Reem, 2022). How these countries have managed the transition to resume education, build resilience and rethink education is vital for global progress and critical situations (Sapiński & Stanisław 2021).

Thanks to the position of the concepts of global education and international cooperation, as well as the alignment between this initiative and priorities, through national action plans, e-learning has made it possible to create a global coalition (Skakun, 2021), whose initiative focused on the following aspects:

**Table 1**

*Actions to Overcome the Education Crisis during the COVID-19 Pandemic*

<b>Action</b>	<b>Overcoming the problem</b>
Expanding access to digital learning solutions	Developing a range of skills for all education stakeholders, and ensuring that teachers, parents and educators can provide the foundation needed for learning in a crisis situation.
Providing participants with devices (mobile phones, laptops and computers)	Opportunity to access training.
Data and content availability	Investing in teacher training expands innovative practices to support digital learning.
Removing barriers	Addressing barriers that prevent girls and young women in certain countries from accessing digital technologies, including social norms, online safety and privacy, skills and leadership, to close the gender digital divide.
Investing in youth reorientation and development	Ensure a better transition from education to work.
Involving young people in achieving the goal of e-learning	Ensure e-learning is relevant, privacy is protected and security is promoted.

Source: Kleinert et al. (2021).



Thus, a bibliometric review to analyse the experience of implementing e-learning during the COVID-19 pandemic will help to reveal strategies for bridging the digital divide in EU countries.

### **Research Focus**

The focus of the study is to examine the implementation of e-learning as a means of ensuring the educational process during the COVID-19 pandemic in the EU. The bibliometric review helped to identify key trends, popular topics and research methods in this area. This analysis allowed us to understand which aspects of e-learning were most relevant and effective during the pandemic, which may be useful for the future development of educational strategies and technologies.

### **Research Aim and Research Questions**

The purpose of the study is to conduct a literature review to highlight the problem of implementing e-learning to support the educational process in the EU during the COVID-19 pandemic. The following issues are highlighted in the context of the objective:

What is the role of open online courses for digital literacy?

How has artificial intelligence helped with educational transformation and gender inequality?

Why is technology so important in times of crisis like COVID-19?

### **Literature Review**

Digital technologies have become a social necessity to ensure education as a fundamental human right, especially in a world facing an increasing frequency of crises and conflicts (Sengupta et al., 2018). During the COVID-19 pandemic, some EU countries lacked sufficient ICT infrastructure and adequate resources for digital learning systems (Soroya et al., 2021). They experienced the most severe disruption and loss of learning, resulting in almost a third of students in these countries missing school during the lockdown (Veikkolainen et al., 2023). The disruptions in education caused by COVID-19 have revealed an urgent need to combine technology and human resources to transform educational models and create inclusive, open and sustainable learning systems (Onishchuk et al., 2020). Each EU country responded both in a joint struggle and separately. For educators in France, for example, it has been important to use digital innovations to expand access to educational opportunities and promote inclusion, increase the relevance and quality of learning, build lifelong learning pathways, strengthen ICT, strengthen education and learning management systems, and monitor learning processes (Caron, 2021).

To achieve these goals of preserving the educational process during the pandemic, Polish education has worked to develop digital literacy and digital skills with a focus on teachers and students (Kucharczyk & Wojakowska, 2023).

UK strategies have focused on combining online and face-to-face learning systems, especially for medical education (Tsopra et al., 2023). Other countries were affected by the crisis in terms of more traditional topics related to technology for learning. Educators have been looking for tools to facilitate the integration of formal and non-formal mechanisms, which are now giving new meaning to the hybridisation of education (Van Heerden & Bas, 2021).

During the pandemic, formal eLearning training followed a specific methodology, including course models and monitoring and evaluation procedures (Stanczak et al., 2022). In addition, e-



learning facilitated anytime, anywhere user engagement with high levels of engagement (Suter, 2019).

From this perspective, Pelau et al. (2021) note that usability and perceived usefulness are also issues that influence the adoption of any technological innovation. Both of these aspects are recognised as quite complex and important topics for evaluation in digital learning systems (Bustamante et al., 2022). Furthermore, e-learning - whether formal or often informal through devices such as social media - stores, classifies and processes big data on user behaviour and traces (Paragae, 2023). This information can be used to tailor learning and teaching experiences to individual expectations and group goals.

Using the experience of implementing e-learning to support the learning process in EU countries during the COVID-19 pandemic, the education system can provide individual recommendations for progress in various indicators: interaction, initial production, support, content production, etc. Thus, the combined e-learning model can work with both formal and non-formal learning (Alhasani, 2022). Overall, this experience has been useful at the global level (Borowczyk et al., 2023). It has allowed for the integration of methods to engage learners in an interconnected environment. Oliveira et al. (2023) note that the integration of e-learning has largely depended on the educational model, which must be tied to the market so that the learner acquires skills for a purpose, not just for fun. These models provide the basis for linking learning outcomes to market-relevant skills and knowledge. Educational technology is a driving force for innovative education that can contribute to better learning and teaching (Nikolenko, 2022). Particular attention is paid to technologies used in education and assessment, with a particular focus on big data, artificial intelligence and data analytics. However, adapting teaching to the needs of learners in online assessment remains challenging due to the communication breakdown that typically occurs in such an educational environment.

## **Methods**

The paper uses the methodology of a bibliometric review of the experience of implementing e-learning in the EU countries during the COVID-19 pandemic.

The research methods included a search for scientific articles, conferences, reports and other relevant literature on the implementation of e-learning in the EU during the COVID-19 pandemic.

The paper uses a systematic literature review with the use of specific databases and inclusion/exclusion criteria. Databases such as Web of Science, Scopus, PubMed were used. The search strategy consisted of using keywords and operators to identify relevant studies and date restrictions. Studies published in the specified period and relevant to the topic of e-learning during COVID-19 in the EU countries were included. Accordingly, studies that are not relevant or do not have the full text available are excluded.

Data were collected by manual extraction from the selected studies. The risk assessment criteria for the impact of benefits and other tools were used to assess the quality of the included studies. The bibliometric analysis used bibliometric analysis methods such as citation analysis, co-citation and bibliographic linking. We used indicators such as the number of citations, publication trends, and networks of co-authors. The bibliometric data were interpreted to provide insights into the implementation of e-learning during the pandemic in EU countries.



## Results

The experience of implementing e-learning to support the learning process in the EU during the COVID-19 pandemic has been extensive and varied. In particular, many countries have taken temporary measures to switch to distance learning due to the closure of schools and educational institutions. Educational institutions quickly adapted to the new conditions and introduced various forms of e-learning, including webinars, video tutorials, and interactive platforms for remote access to learning material.

According to Deja et al. (2021), an important aspect was to support teachers and students in mastering new technologies and methods of teaching and learning in an online format. At the time of the crisis, governments and educational institutions actively collaborated with technology companies and platforms to provide the necessary infrastructure and support for effective distance learning.

Thanks to e-learning, pupils and students were able to continue their studies even during restrictions and quarantine measures, which allowed them to maintain the continuity of the educational process (de Oliveira et al., 2023). However, challenges were also identified related to internet access and technical support for all participants in the educational process.

The lessons learnt during the pandemic have proved valuable for the future development of education, highlighting the importance of flexible and innovative approaches to learning that can be useful even after the crisis is over.

An important innovative approach to e-learning, according to Davenport (2018), is open educational resources - teaching or research materials that are freely available to all. EU countries support their development and use, and are still working on the development of indicators to monitor and evaluate their use and impact, thus contributing to the creation of new e-learning opportunities. In this regard, the experience of France is illustrative. The country has developed and adopted international consensus and instruments, including the 2012 Paris Declaration on OER and the UNESCO Recommendation on OER, and has provided guidelines for the development of OER policies and technical support to member states in developing strategies for the adoption of OER (Durmishi & Durmishi, 2022).

Artificial intelligence is a separate topic for scientific debate in the context of the presented topic. Artificial intelligence offers the potential to solve many major problems in education and make teaching and learning practices more innovative (Alqahtani & Rajkhan, 2020). At the same time, its use should be consistent with the principles of inclusiveness and equity (Fenves, 2019). EU member states support the potential to use artificial intelligence to achieve educational goals through a humanistic approach (Glikson & Woolley, 2020). The main actions of educators during the crisis have focused on the role of AI in addressing inequalities in access to knowledge, research and diversity of cultural expressions to prevent widening technological gaps within and between EU countries.

Gender inequality in access to new technologies has also been highlighted by researchers who have studied the impact of the pandemic on the education system (Pera, 2021). Gender inequality affects the skills and future professional development of women and girls in digital disciplines, which also leads to gender bias in the development of artificial intelligence and technological tools (Gervais, 2021). Indeed, women and girls are underrepresented in ICT



disciplines, the ICT sector, and AI development, with 80% of software development being done exclusively by male teams (Alotumi, 2022).

Education systems in EU countries are still working to mitigate the impact of education disruptions and school closures in the post-pandemic period. Effective distance learning solutions have allowed teachers and policy makers to continue to follow national lesson plans, building on available digital and technological resources (Bajohr, 2020). In this regard, a number of tools have been developed in Spain, for example, offering best practices, innovative ideas and guidelines for e-learning (Assunção et al., 2022).

In addition to responding to the COVID-19 pandemic crisis, efforts to expand e-learning at all levels of education have been underway (Borowczyk et al., 2023). This has provided valuable lessons and the potential to lay the groundwork for long-term goals to build more open, inclusive and flexible education systems in the post-pandemic period.

The COVID-19 pandemic has significantly changed the learning environment around the world, including in the European Union (EU). In this article, we will look at how different EU countries have adapted to the new conditions by implementing e-learning and what results have been achieved.

**Table 2**

*Experience of E-Learning Implementation in EU Countries*

Country	Implementation/Results
Germany	Implementation of online platforms for educational institutions. Increased use of webinars and interactive tools, preserving the continuity of the educational process. Increased competence in the use of digital tools.
France	Organising video conferences and online lessons. Increasing access to education for all students. Reducing the learning gap through individual support for students via video conferencing.
Italy	Expansion of electronic platforms for distance learning. Increased resources for teachers and students, which helped to maintain the quality of education. Positive response to the use of interactive tools.
Spain	Learning through interactive platforms. Increasing the incentive for students to actively participate in the learning process, in particular through the use of group assignments and online collective classes.

Source: Author's development.

The experience of implementing e-learning in EU countries during the pandemic has shown a significant increase in the use of technology to support the educational process (Jacques et al., 2021). The introduction of online learning formats has helped to maintain the continuity of learning and keep students and teachers connected in difficult conditions (Cofini et al., 2022). Each country has identified its own peculiarities and achievements, but the general trend has been to increase access to education and adapt to new technologies.

Thus, the EU's experience in implementing e-learning during the COVID-19 pandemic can serve as an important example for the future development of education, emphasising the need for flexible and innovative approaches to learning.



## Discussion

Thus, a literature review has shown that e-learning has the potential to increase access to education, improve learning outcomes, and equip learners with the knowledge and skills needed to meet the challenges of the 21st century (Favale et al., 2020). However, the digital divide has remained a persistent obstacle for millions of people around the world during the pandemic and now, preventing them from taking advantage of the opportunities offered by digital technologies.

We are increasingly living in a digital age, which has led to significant changes in various aspects of life, including education systems (Bambuliak et al., 2023). Digital innovations can expand access to educational opportunities. Open digital schools can make education systems more inclusive of the diverse needs of learners and more resilient to crises (Barron, 2023).

In this context, a related study suggests that as digital technologies become increasingly complex and ubiquitous, digital skills and information literacy are becoming a key part of fundamental learning, without which people cannot participate effectively and responsibly in social, civic and economic life (Chiu et al., 2023).

However, despite the promising opportunities of the pandemic and post-pandemic period, such as improved accessibility for marginalised learners through advances such as connectivity, portability, open educational resources and artificial intelligence, significant inequalities persist, especially in connectivity, capacity and access to quality digital learning content (Chun & Elkins, 2022).

The COVID-19 pandemic has further highlighted the importance of digital technologies in education, revealing wide disparities in access and learning outcomes (Abdur Rehman et al., 2021). Recognising the importance of this shift, scholars are emphasising e-learning as a priority (Grassini, 2023). In addition, the rapid proliferation of AI applications in education, often without clear rules, has led to a growing demand for technical support and guidance. In response to this demand, EU educators have worked to establish regulatory frameworks, equip teachers and students with digital skills, and collect data for policy-making in an effort to navigate this transition (Gündüzalp, 2021).

In his study, Hammarberg (2022) advocates the use of digital innovations to expand access to educational opportunities, improve the quality of learning, and create inclusive and sustainable learning systems. However, they emphasise that no screen will ever replace a qualified teacher and a well-equipped classroom (Harris et al., 2020). When used properly, technology can complement and enhance the work of teachers (Baber, 2021). For technology to improve learning outcomes and reduce inequalities, we must actively manage the digital revolution in education on our own terms.

Heflin (2020) argues for a humanistic approach to ensure that technology is designed to serve people in accordance with international human rights frameworks, and that digital technologies are used as a common good to support the achievement of education goals (Jalilbayli, 2022).

Mussa and Niyazovab (2017) support EU countries' attempts to develop, integrate and implement effective national e-learning policies and master plans, ensuring that activities on the





ground are tailored to the needs of each country and community, with a particular focus on disadvantaged groups.

Latifi and Kasumi (2022) describe UNESCO's work during the pandemic to lead international efforts to help countries understand the role that technology can play in accelerating progress towards education goals (Kozak et al., 2021).

The use of ICT in education, as well as artificial intelligence, has the potential to transform education (Kampen et al., 2022).

In this context, Jones (2022) publishes recommendations for policymakers, teachers, and students for teaching artificial intelligence in primary and secondary schools: mapping government-approved curricula and ensuring effective distance learning during the COVID-19 crisis.

Kaliuta (2023) describes international dialogues during the pandemic, providing a knowledge-sharing platform to guide the digital transformation of education by addressing emerging challenges related to generative AI.

In summary, e-learning has proven its potential and addressed many of the biggest challenges in education during the crisis. E-learning continues to make teaching and learning practices more innovative, helping to reduce barriers to access, automate management processes, analyse learning patterns and optimise learning processes to improve learning outcomes. At the same time, its use must be consistent with the principles of inclusiveness and equity.

## **Conclusions and Implications**

Thus, the bibliometric review has shown that in order to support EU education systems in developing strategies and policies for e-learning in education, education policy makers have developed a series of detailed guidelines aimed at preparing decision makers to sustain education in times of crisis.

Open educational resources have become freely available to everyone. They have made it possible to access them, reuse them, use them for other purposes, adapt them and distribute them to others free of charge. EU education policymakers have supported their development and use, and have worked to develop indicators to monitor and evaluate their use and impact, thus contributing to the creation of national policies to overcome the crisis caused by the global pandemic.

France has developed and adopted international consensus and instruments, and has provided guidelines for the development of OER policies and technical support to Member States in developing strategies for the adoption of OER.

Germany and Italy aimed to organise and collaborate with partners to provide education stakeholders with high quality, freely accessible e-learning resources. Spain has developed the concept of a "World Digital Library" for learning initiatives.



Pathways to public e-learning are well developed in England through global multi-partner initiatives. These actions have been aimed at supporting countries to ensure equal access to free and open e-learning content.

During the pandemic, Poland has responded sharply to gender inequality in access to new technologies, which affects the skills and future professional development of women and girls in digital disciplines, and also leads to gender bias in the development of artificial intelligence and technological tools.

All EU countries have supported local initiatives by providing training and mentoring for STEM ambassadors and promoting e-learning awareness campaigns.

However, even in the post-COVID era, there will be an urgent need for more crisis-resilient, inclusive and forward-looking education, and education transformation is a critical part of this effort.

### **Suggestions for Future Research**

Prospects for future research in the field of e-learning in the European Union during the COVID-19 pandemic may include studies aimed at assessing the real results of e-learning implementation in school, higher education and vocational training institutions. Assessment of the ability of this technology to provide quality education in the context of the pandemic and after it. Exploring new technologies and platforms to ensure the effectiveness of the learning process, including adaptation to the specific requirements of pandemic restrictions and the needs of different groups of students, also shows promise. Social inclusion and accessibility are relevant topics for further research. Such research could investigate how e-learning affects the accessibility of education for different social groups and local communities in EU countries, in particular in remote or vulnerable regions. In addition, research on the development of new learning models that combine e-learning with traditional methods to improve the quality of education and student engagement can contribute to understanding the impact of e-learning on educational processes in EU countries, help improve practice and prepare the ground for further innovation in this area.

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