

**DIGITAL EDUCATION AT EUROPEAN HIGHER
EDUCATION INSTITUTIONS DURING COVID-19
PANDEMIC – EXAMPLE OF THE LIBRARY AND
INFORMATION SCIENCE FIELD**

**DIGITALNO OBRAZOVANJE U EUROPSKIM
VISOKOŠKOLSKIM USTANOVAMA TIJEKOM PANDEMIJE
BOLESTI COVID-19 – PRIMJER U PODRUČJU KNJIŽNIČNE I
INFORMACIJSKE ZNANOSTI**

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Abstract

Objective. The objective of this study was to identify and interpret the current state-of-play of the implementation of digital education (DE) in higher education institutions (HEIs) in the field of library and information science (LIS) during COVID-19 pandemic.

Approach/Methodology/Design. In order to collect data, a questionnaire-based survey was conducted. A survey for the study's target audience - the heads/directors of LIS schools/departments in Europe - was created and disseminated. The collected data were analysed using the method of descriptive statistics.

Results. The survey was completed by the heads/directors of 56 LIS schools/departments in 23 European countries. The results indicate that DE presents a positive disruptive force that transforms the teaching and learning process and widens access to education, especially in crisis situations. It also indicates that despite the need for emergency response, almost all aspects of DE were deliberately and successfully implemented in most of the LIS higher education institutions. Further analysis of core topic areas (through interviews and focus groups) will provide a deeper insight into teachers' and students' practices and their overall appraisal of DE during the pandemic.

Limitations. Limitations include the methods used to collect data and the lack of clarity and understanding of certain terms and concepts by a small number of participants.

Originality/value. This paper offers an in-depth understanding of the role of DE in crisis situations within the field of LIS. It underlines the necessity for consistent monitoring and evaluation of DE to guarantee its quality. Consequently, this paper may contribute to more effective policy and decision-making processes concerning DE. Moreover, it aims to help create frameworks and guidelines that facilitate simpler, more sustainable, and broader implementation of DE in LIS HEIs.

Keywords: COVID-19 pandemic; digital education; higher education institutions; library and information science

Sažetak

Cilj. Cilj je istraživanja utvrditi i interpretirati situaciju s implementacijom digitalnog obrazovanja u visokoškolskim ustanovama u području knjižnične i informacijske znanosti (KIZ) tijekom pandemije bolesti COVID-19.

Pristup/Methodologija/Dizajn. S ciljem prikupljanja podataka provedeno je anketiranje. Za potrebe ovog istraživanja pripremljen je i distribuiran upitnik namijenjen čelnicima visokoškolskih ustanova u Europi. Prikupljeni podaci analizirani su metodom deskriptivne statistike.

Rezultati. Anketu su ispunili voditelji/ravnatelji 56 KIZ-škola/odjela iz 23 europske države. Rezultati pokazuju da digitalno obrazovanje predstavlja pozitivnu disruptivnu snagu koja transformira proces poučavanja i učenja te proširuje pristup obrazovanju, posebice u kriznim situacijama. Također ukazuje da su unatoč potrebi za hitnim odgovorom, gotovo svi aspekti digitalnog obrazovanja bili namjerno i uspješno implementirani u većini KIZ-a visokoškolskih ustanova. Daljnja analiza ključnih tematskih područja

(kroz intervjuje i fokusne grupe) pružit će dublji uvid u prakse nastavnika i učenika i njihovu ukupnu procjenu digitalnog obrazovanja tijekom pandemije.

Ograničenja. Ograničenja su vezana za metode koje su korištene za prikupljanje podataka te nedostatak jasnoće i razumijevanja određenih pojmova i koncepata od strane manjeg broja sudionika.

Originalnost/vrijednost. Ovaj rad pruža dublji uvid u ulogu digitalnog obrazovanja u kriznim situacijama u područja knjižnične i informacijske znanosti. Također naglašava nužnost dosljednog praćenja i vrednovanja digitalnog obrazovanja u svrhu poboljšanja njegove kvalitete. Nadalje, rad pridonosi učinkovitijem oblikovanju politika i procesa donošenja odluka u vezi digitalnog obrazovanja. U konačnici cilj je podržati proces stvaranja okvira i smjernica koje omogućuju jednostavniju, održiviju i širu implementaciju digitalnog obrazovanja u visokoškolskim ustanovama u području knjižnične i informacijske znanosti.

Ključne riječi: digitalno obrazovanje; knjižnična i informacijska znanost; pandemija bolesti COVID-19; visokoškolske ustanove

1. Introduction

In the age of the recent technological revolution, (digital) education has become a key component in the acquisition of key competences for lifelong learning and teaching (Council of the European Union, 2006). New competencies include flexible learning, digital competencies, problem solving, active and collaborative learning (Chaka, 2011; Zhao, Pinto Llorente & Sánchez Gómez, 2021). Education has a key role in supporting the digital transformation and the economic growth (World Economic Forum, 2020) and with the emergence of COVID-19 crisis digital education and transformation of educational processes became a priority across higher education institutions (HEIs) around the world (Castro Benavides et al., 2020).

Digital education (DE) refers to the innovative use of digital tools and technologies for teaching, learning and training and it can take either fully online or blended form¹ (Gaebel et al., 2014). In recent years, it has become a widely accepted term for describing the interface between digital tools and technology and higher education, to a large extent taking the place of other recently popular terminologies such as „e-Learning“, „Digitally Enhanced Learning and Teaching (DELT)“, „Technology Enhanced Learning (TEL)“, „Computer-based Learning“, etc.

¹ A pedagogical model combining face-to-face classroom teaching and the innovative use of ICT. Experts often associate blended learning with the redesign of the educational environment and learning experience, thus contributing to the creation of a “community of inquiry”. A blended learning approach, by which digitally enhanced learning materials enable students to learn asynchronously and use face-to-face time for meaningful interaction with peers and teachers.

Historically, first approaches in teaching with the help of technology started between the 1960s and 1970s with projects like PLATO and TICCIT², that were a kind of pioneers of the digital environment. This continued in the 1980s and 1990s with arrival of personal computers and the Internet (Harasim, 2006). Eventually, Massive Open Online Learning (MOOC)³ systems were further developed and emerged in 2012/13 (Gaebel et al., 2021). In 2014 almost all European universities were using some kind of DE and about one third of them provided online degree courses and more than half are principally ready to embrace MOOCs (Gaebel et al., 2014). Other reports like Trends 2015 (Sursock, 2015) and Trends 2018 (Gaebel & Zhang, 2018) confirm that over recent years the overall acceptance of digitally enhanced learning and teaching in higher education had grown, but also that many institutions were still planning to develop a more systematic and strategic employment of digitally enhanced provision. The latest EUA's study revealed that both strategies and the actual use of digitally enhanced learning and teaching have increased at HEIs across Europe and that blended learning continues to be the most popular delivery mode. The number of HEIs that offer MOOCs has also increased since 2014 and HEIs seem to place more attention on widening access and lifelong learning in their digital provision (Gaebel et al., 2021).

In March 2020 due to COVID-19 crisis, the vast majority of European universities closed their campuses. In addition to the obvious impacts on student learning, the crisis also had an impact on internationalisation and mobility, as well as the effects on research, resulting in obstacles for research collaboration and the shift to remote collaboration (European University Association, 2020).

Some of the outcomes of the COVID-19 pandemic at HEIs were the increase in the use of digital tools, open educational resources (OERs), and modification of both didactics and methodology which were now more oriented towards open education. COVID crisis marked a turning point for how digital technology is used in education and training and new Digital Education Action Plan 2021-2027

² PLATO (Programmed Logic for Automatic Teaching Operation) and TICCIT (Time-shared, Interactive, Computer-Controlled Information Television) were pioneering educational projects funded by the U.S. National Science Foundation in the 1960s and 1970s. PLATO, initiated by Professor Donald L. Bitzer, utilized mainframe computers and offered a broad range of instructional materials to users across the U.S. and Canada through specialized terminals. TICCIT, led by the Mitre Corporation, employed minicomputers for localized learning environments and utilized a structured team approach to curriculum development. Both projects aimed to integrate computers into education but faced challenges in scalability and instructional design methodologies (Cerri, 2012).

³ MOOCs stands for massive open online courses. Massive, as there is generally no participation limit, thousands can enrol for the same course. Open, as they are accessible to a large public of learners: institutions usually do not require any formal entry requirement for registration, and they are free of charge. The whole course is delivered online, including assessment and additional services (even though personal contact with other participants or tutors is a possibility).

now offers a long-term strategic vision for high-quality, inclusive and accessible European digital education (European Commission, 2020).

The objective of this study was to identify and interpret the state-of-play of the implementation of digital education (DE) in higher education institutions (HEIs) in the LIS field during COVID-19 pandemic.

2. Theoretical background

In this chapter, we proceed with a brief overview of the body of research on the topic of DE in general with specific emphasis on issues related to DE during COVID-19 pandemic. This literature review was instrumental in establishing a theoretical framework around DE issues, providing a robust theoretical foundation for broadening knowledge on DE in the context of crisis situations, such as the COVID-19 pandemic. It was essential to lay this solid theoretical groundwork to construct a comprehensive questionnaire covering all pertinent questions related to DE, OERs, and institutional support. Following the review of literature and documentation, we developed a questionnaire. Thus, the layout of theoretical background follows the structure of the questionnaire.

2.1. Digital education skills and competencies

During the COVID-19 pandemic, DE relied primarily on the adoption and integration of ICTs and the development of digital competencies and skills. Studies on digital competencies and skills at HEIs during times of the pandemic show positive and significant relationship between the integration of ICT and digital skills and students' digital competence and their digital learning and academic engagement (Manco-Chavez et al., 2020; Heidari et al., 2021; Bergdahl, Nouri & Fors, 2020). Students were confident about their digital skills and competences, but in some cases they felt that teachers did not have appropriate skills to manage digital teaching (Tejedor et al., 2020).

2.2. Evaluation and monitoring of digital education

Evaluation and monitoring of DE during the COVID-19 pandemic was difficult because no baseline data was available. A large number of documents have been published in the form of guidelines and recommendations primarily for monitoring the learning and teaching process and ways how to take account of learning through meaningful formative and summative assessment practices (UNICEF, 2020; García-Peñalvo et al., 2021). Several studies focused on monitoring and evaluating teacher's performance (Ramírez-Hurtado et al., 2021), students' engagement (Khlaf, Salha & Kouraichi, 2021) and workload (Beena & Sony, 2022),

learning outcomes (Guangul et al., 2020), and academic integrity (Gamage, Silva & Gunawardhana, 2020).

2.3. Digital education and support provided by academic libraries

To support users' learning and research during the pandemic, many academic libraries launched a series of free resources like multimedia academic resources, online education platforms, e-books, e-journals, etc. Also, many database providers, publishers and internet companies launched free academic resources (Rafiq et al., 2021; Connell, Wallis & Comeaux, 2021; Huffman, 2020; Guo et al., 2021). Studies suggested that there was an increase in applying virtual communication methods with users, such as chat, email, WhatsApp and online meetings. Some extended services were provided like flexibility in extending the borrowing privilege of physical items, as well as new services like Zoom-with-a-Librarian, securing laptops for students who had been negatively impacted by COVID-19, etc. (Guo et al., 2021; Ma, 2020; Decker, 2021). Library staff helped course instructors transition to the online teaching environment and were also involved in equipping users with digital and media literacy skills and competencies (Martzoukou, 2021; Ma, 2020).

2.4. Digital education and challenges faced by students

The sudden shift from classrooms to distance learning during COVID-19 pandemic had certain effects on both students' perspective of DE and their experience of DE. Some of the studies (Almendingen et al., 2021; Chakraborty et al. 2021; Kaisara & Bwalya, 2021) confirmed that, despite their overall successful adaptation to new learning circumstances, students faced different challenges, from fully online classes hindering the achievement of learning outcomes, hardware and software problems, issues with accessibility of e-learning resources, maintaining the level of engagement and collaboration in online environment, recreating classroom atmosphere and conditions in the home environment, all the way to lack of social interaction, lower motivation and, for some, more stress. Another study (Raskova Octaberlina & Muslimin, 2020) putting into focus student's perspective towards online learning, revealed that students experienced dominant three barriers during online learning: unfamiliarity of e-learning, slow internet connection, and physical condition, e.g. eye strain.

Despite these challenges, most students had positive attitudes toward the use of digital technology and digital learning materials and felt less stress, pressure and loneliness, especially when it comes to their expectations regarding the upcoming term and especially when they were prepared for the shift to online learning (Händel et al., 2020). A global perspective on online learning during COVID-19

pandemic showed that online learning has become dominant way of learning at educational institutions (Radha et al., 2020; Ali, 2020). Students who participated in the study (Radha et al., 2020) expressed willingness to learn online and noticed the positive improvement in their self-study skills during lockdown. Short-term e-learning courses during pandemic have been assessed and positive students' opinion about online learning has been detected (Pokrovskaia et al., 2021). Students highly appreciated communication digital tools such as messengers (Viber, WhatsApp, Telegram, etc.), tools for short option surveying (e.g. Mentimeter), social media, video conferences, etc. On the other hand, students expressed low satisfaction with the pedagogical platform. Finally, a study done by Ionescu et al. (2020) found that students recognized different advantages of online learning and DE – flexible working time, possibility (and freedom) to attend classes from home and wider selection of documentation and information sources.

Of course, a special concern should be given to students with disabilities and their need for digital tools (especially assistive technology) and educational resources that are fully accessible as well as appropriate hardware and software that can provide engaging and supportive online learning experience (Ali, 2021; European Commission, 2020).

2.5. Digital education, pedagogical approaches and curriculum innovations

The issue that may be overlooked in times of crisis and need for rapid change and adjustment is pedagogy and curriculum development, which is why there is still little body of research on the pedagogical approaches and principles adopted during the pandemic. Online learning and DE have not come with the pandemic. Conversations and research on benefits and limitations of asynchronous and synchronous e-learning (Hrastinski, 2008), the need to develop constructivist, learner-centred cooperative pedagogy (Hiltz & Turoff, 2005) and modify traditional pedagogical approach has been a part of the debate on digital transformation of education for some years now. It should be noted that HEIs' response to COVID-19 pandemic varies across the countries and while some changed almost nothing except opting for distancing and reduced social gatherings, others moved fully to DE (i.e. online learning) while rapidly redeveloping their curricula for fully online classes (Crawford, et al., 2020; Sabharwal, Ficke & LaPorte, 2020). The effectiveness of flipped classroom has been examined as well (Tang et al., 2020). Students stated their dissatisfaction with online learning in general, but this study also revealed that the combined model of online teaching with the flipped learning improved students' learning, attention, and evaluation of courses.

Regardless of their previous DE and online learning experience, many HEIs reported they started using new teaching methods during COVID-19 pandemic

in order to maintain quality education and high levels of engagement of and with students. Besides adopting new flexible and innovative teaching methods like using pre-recorded or live webinars and discussion forums, some HEIs, i.e. faculty started modifying assignments and exams (e.g. adopting pass-fail model or open-book examination) or even dropping them, providing more time for students to do their work, providing more (online) resources, lowering expectations regarding students' work or even expectations of the faculty teaching (Johnson, Veletsianos & Seaman, 2020; Ray, 2020; Sabharwal, Ficke & LaPorte, 2020; Sandhu & Wolf, 2020). Of course, certain academic disciplines faced specific challenges. For instance, the field of medicine, where practical training ensures the quality of education, needs to supplement institutional training with technology and pedagogical approaches that will create an environment where trainees can actively participate in a specific area of medical training (Roy & Cecchini, 2020).

Along with challenges, different opportunities for improvement were emphasized by research so far. They refer to employing techniques like gamification, flipped classroom and case studies, increasing flexibility and communication, relaxing attendance rules and expectations from students, delivering course content in a clear and simple way, positioning learners as knowledge producers (e.g. through peer-reviewed projects), adopting sophisticated pedagogical approaches and principles in a loose blended learning environment, connecting values and pedagogy, providing assistance to students, and raising awareness about the nature of sociality in digital spaces and the issues of inequalities of access and outcomes (Chakraborty et al., 2021; Peters, et al., 2020; Ray, 2020).

2.6. Digital education tools and systems

During COVID-19 lockdown educational institutions needed to react rapidly, but at the same time they had to have in mind all educational and organizational aspects. The Organisation for Economic Co-operation and Development (OECD) prepared a framework to guide an education response to the COVID-19 pandemic based on survey results representing 98 different countries (OECD, 2020). In response to the crisis critical priorities have been identified: ensuring continuity of academic learning for students, providing professional support to teachers, ensuring well-being of teachers and students, and supporting students who lack skills. Regarding implementation, the most challenging was to provide technological infrastructure and to address student's emotional health. European Commission expressed the need for cooperation between universities during time of crisis, especially emphasizing the need to collect and share online courses, data, digital and research infrastructure among European universities (European Commission, 2020).

It is certain that COVID-19 pandemic and DE facilitated the wide use of digital technology that has been used to improve the quality of the teaching and learning process. Even in the times of great educational disruption various types of learning were implemented – active learning, individualised and personalised learning, and online social learning (Getto, 2020). Different devices, tools, applications, platforms and software were used to continue and extend education and training. The research done over the past two years pointed to some crucial factors regarding HEIs' adoption of digital technology during the pandemic; e.g. the quality of the platforms and tools used, previous experience with the use of educational technology, performance and effort expectancy, as well as social influence and even social isolation (Ionescu et al., 2020; Kaqinari et al., 2021; Raza et al., 2021).

During the pandemic, especially in the periods of lockdown, technological infrastructure and internet were main facilitators of online learning. Poor or no internet connection may pose a huge problem for students making it difficult for them to engage and follow classes and instructions (Doyumğaç, Tanhan & Kiymaz, 2021; Kaisara, & Bwalya, 2021). Besides connectivity, having appropriate digital equipment, being able to afford the equipment, organisational capacity, digital and organisational skills are main factors of successful DE (Arora et al., 2020; European Commission, 2020). Information systems play an important role in educational processes. The effectiveness of integrating information system during the pandemic has been evaluated in the study done by Ibrahim et al. (2020). The findings demonstrate that there was a lack of positive impact on end-users. This study also emphasized the importance of library systems providing a future generation of learning tools.

Different studies (Adedoyin and Soykan, 2020; Al-Marroof et al., 2020; Chakraborty et al., 2021; Doyumğaç, Tanhan and Kiymaz, 2021; Ionescu et al., 2020; Johnson, Veletsianos and Seaman, 2020; Kaqinari et al., 2021; Ray, 2020; Sasere, and Makhasane, 2020) identified specific tools being used to support DE during COVID-19 pandemic, for both synchronous and asynchronous lectures. Regarding devices, both lecturers and students used mobile phones, smartphones, laptops, desktops, and tablets. As for platforms and e-learning environments the most used were Moodle, Zoom, Google Meet, Panopto and virtual laboratories. Additionally, a number of applications, programmes and services were utilized, such as different presentation programmes and note-taking programmes, different video technologies for synchronous video and asynchronous (pre-recorded) lectures, different tools for technology enhanced assessment like Turnitin, communication tools like WhatsApp, Messenger, E-mail, social media like Facebook, Instagram and YouTube, etc.

There were also studies done in different countries that disclosed specific DE approaches and tools implemented. The impact on COVID-19 on digital higher education in Germany has been explored by Zawacki-Richter (2020). The term

“emergency remote teaching” has been used to represent sudden and rapid change in teaching (and learning) practice induced by some crisis like pandemic. Using synchronous video conferencing and recording presentation or lectures has been observed as the most common practice during pandemic. The study at Romanian universities (Edelhauser & Lupu-Dima, 2020) revealed that students used laptops and tablets for accessing online courses, and that dominant tool for communication with teachers was e-mail. The study conducted among school teachers in Sweden (Bergdahl & Nouri, 2021) showed that the school preparations were mostly related to technical aspects lacking pedagogical strategies to empower teachers during pandemic.

Besides harnessing the benefits of digital technology, DE ecosystems need to effectively manage challenges and risks they are facing. Most of the problems in DE during the pandemic stem from technological and internet problems, i.e. infrastructure and connectivity problems. Many of the e-learning platforms and used multimedia require high bandwidths which can be an issue since broadband internet varies across the EU and world countries. Another issue refers to the dependency on technological equipment, which usually refers to outdated devices, i.e. the need to provide students and lecturers with up-to-date laptops, desktops, smartphones and tablets (Adedoyin and Soykan, 2020; Doyumğaç, Tanhan & Kiyamaz, 2021; European Commission, 2020; Sasere, & Makhasane, 2020). However, what is certain is that rapid digital transformation and digital shift facilitated and hindered access to education, learning outcomes, and collaboration (Laufer et al., 2021).

And last, assessment in DE has also been a largely discussed research topic. The review of assessment in a digital age is given in the study done by Oldfield et al. (2012) providing a good starting point for emergency assessment strategies during COVID-19 pandemic. Whether a formative assessment (assessment for learning) or summative assessment (assessment of learning), the role of digital technology in different types of assessment has benefits for learning and students’ achievement. For instance, despite some criticism of using digital technology in assessment, there are also many benefits, like providing immediate feedback, improving assessment validity and reliability, reducing teachers’ workloads, increasing flexibility in approach, timing and format of assessment, improving students’ performance, etc.

3. Methodology

This research serves as an example of an investigation into the use of DE in the field of LIS, while considering the general aspects of DE as analysed in the theoretical background. COVID-19 caused widespread disruption in education, necessitating the adoption of all institutional components, including LIS.

The research questions guiding DE part of the study are the following:

1. What is the state-of-play regarding the implementation of DE at HEIs in the context of COVID-19 pandemic, specifically in the field of LIS?
2. Which learning and teaching aspects of DE were implemented successfully and which aspects need to be developed further and improved?
3. What is the impact of DE on higher education in the field of LIS?

The answers to the questions above were intended to be obtained through an integrative literature review, document analysis and conducting an extensive survey at the European universities. It is important to acknowledge the interchangeable nature of the three research questions and how this interchangeability later influenced the interpretation of the study's findings.

An online survey method was used to analyse the current state of the implementation and use of DE in HEIs with the example of the LIS field during the COVID-19 pandemic. This research was done as part of the Erasmus+ project *Digital Education for Crisis Situations: Times when there is no alternative* (DECriS; <https://decris.ffos.hr/>) whose aim is to create a framework for proper adoption of OERs in general, and in crisis situations in particular (Mičunović, Rako & Feldvari, 2022). This study is part of the research completed within the first intellectual output (IO1) of the DECriS project with five more IOs following (IO2- Appraisal of digital education and quality perception by students, teachers, and trainers at the partner HEIs during the COVID-19 crisis; IO3- A list of critical success factors and their typological classification for the evaluation of OERs; IO4- Case study on how the critical success factors work in practice; IO5- Optimization of OERs; and IO6- Apprenticeship framework for crisis situations).

The final questionnaire was comprised of three sets of questions (38 questions in total) referring to the issues of:

- a) the implementation of DE during COVID-19 pandemic (for example, "What DE techniques/strategies does your LIS school/department use during COVID-19 pandemic?", "How do you approach and handle students' problems and issues regarding DE?", etc.
- b) the implementation and modes of use of open educational resources (OERs) during COVID-19 pandemic (for example, "Does your institutional repository have a collection for OERs?", "Are there any incentives at your institution and/or at national level for developing and implementing OERs during COVID-19 pandemic?", etc.,
- c) institutional support provided to LIS schools/departments in regard to both DE and OERs during COVID-19 pandemic, for example, "Which of the documents or procedures frameworks does your LIS school/department have?", "What type of practical support does your universi-

ty/faculty/school/department provide for the teaching staff during COVID-19 pandemic?”, etc.

The participants were informed about the purpose of the survey, the data collection process, and were requested to give consent to participate in the research study before completing the questionnaire. The coordinator of IO1 finalized the survey questionnaire, followed by all project partners conducting a pretest to verify the validity of the instrument. Following the pretesting phase, it was determined that the instrument was accurate and did not require modification for the research purposes. The pretesting was done from May 25th till May 31st 2021. The questionnaire was active via LimeSurvey from June 1st till September 1st 2021. During that period 67 LIS schools/departments representatives accessed and began to complete it. The responses of 56 representatives who fully completed the questionnaire were included in further analysis. The response rate was 54.9%, which may not be sufficient for drawing general conclusions but can indicate trends in how HEIs coped with disruptions caused by the pandemic. It is important to note that the results represent experiences from 23 countries and encompass 305 study programs involving more than 25,000 students.

Convenience (accidental) sampling was used. Statistical analysis was performed with R, a language and environment for statistical computing (R Core Team, 2022). The dataset was described quantitatively using descriptive statistics. The goal was to summarise, organize, and show the data in a clear and concise way, as well as to give fundamental information about the dataset and draw attention to possible relationships.

Table 1: Survey elements related to DE during COVID-19 pandemic

Division	Survey content	Method
General information	Name of LIS school/department	Open-ended question
	Position	Open-ended question
	Country	Open-ended question
	Number of teachers	Numeric value
	Number of students	Numeric value
	Number of study programmes	Numeric value
	Types of study programmes	Selection
	Other study programmes	Open-ended question

Division	Survey content	Method
Digital Education (DE) during COVID 19 pandemic	Aspects of DE implemented during COVID-19	Multiple selection & Open-ended question
	DE techniques/strategies used during COVID-19	Multiple selection & Open-ended question
	Tools used during COVID-19	Multiple selection & Open-ended question
	Resources used during COVID-19	Multiple selection & Open-ended question
	New didactic implementation during COVID-19 (The following are conditional questions:)	Yes/No question
	If yes, ways of implementing new didactics during COVID-19	Multiple selection & Open-ended question
	If not, common reasons for not implementing new didactics	Open-ended question
	Approaches to handle students' problems and issues regarding DE	Multiple selection & Open-ended question
	Developing new or adapting current curricula during COVID-19	Yes/No question
	Teaching staff provided with the option of customization (The following are conditional questions:)	Yes/No question
	If yes, which customization options	Multiple selection & Open-ended question
	Type of software used for DE in general	Multiple selection & Open-ended question
	Ensuring continuity and quality of classes and activities during COVID-19 using the existing system, tools, and practices	Multiple selection & Open-ended question
	Collaboration with academic library during COVID-19	Multiple selection & Open-ended question
Level of DE implementation	Multiple selection & Open-ended question	
Monitoring and evaluation procedures of DE during COVID-19	Yes/No question	
If yes, components, procedures, and aspects of DE monitored and evaluated	Multiple selection & Open-ended question	
If not, Reasons for not monitoring and evaluating DE during COVID-19	Open-ended question	

4. Results

Altogether, answers from 56 LIS schools/departments from 23 countries were collected. As shown in Table 2, 1,839 teachers, 25,978 students and 305 study programmes were included in the results analysis. In a previous study Borego (2015) has identified 220 centres offering LIS education in 26 European countries. The overall number, along with the individual number for each EU member country can serve as a benchmark. By focusing solely on LIS schools/departments in the EU that participated in this study and considering the number of total LIS institutions in each participating EU country, this study included almost a quarter (24%) of LIS institutions in 17 EU countries. It is also important to emphasize that this study includes several LIS schools/departments outside the EU.

Table 2: Number of teachers, students and study programmes at LIS schools/departments

Country	Number of LIS schools/departments	Number of teachers	Number of students	Number of study programmes (undergraduate, graduate and postgraduate combined) ⁴
Austria	1	4	2 000	5
Belarus	1	51	254	3
Bosnia and Herzegovina	2	39	490	6
Bulgaria	3	167	4 950	36
Croatia	2	39	315	8
Estonia	1	9	120	3
Finland	2	10	300	6
France	2	24	820	17
Germany	6	66	2 740	18
Greece	1	31	700	4
Hungary	2	18	80	7
Ireland	1	14	200	8
Italy	1	82	785	2
Poland	3	74	1 131	10
Portugal	3	515	4 214	27
Russia	6	262	2 903	82

⁴ Undergraduate, graduate and postgraduate combined.

Country	Number of LIS schools/departments	Number of teachers	Number of students	Number of study programmes (undergraduate, graduate and postgraduate combined) ⁴
Slovakia	1	9	89	3
Slovenia	1	10	300	6
Spain	10	316	2 704	36
Sweden	1	27	150	3
Turkey	2	19	346	3
Ukraine	3	48	332	10
United Kingdom	1	5	55	2
Total	56	1 839	25 978	305

Regarding aspects, strategies and approaches to DE, as can be seen from Fig. 1., during COVID-19 pandemic live teaching sessions were dominantly implemented at majority of LIS schools/departments (96 %), following by online communication with students (95 %).

Which aspects of DE are being implemented at your LIS school/department during COVID-19 pandemic?

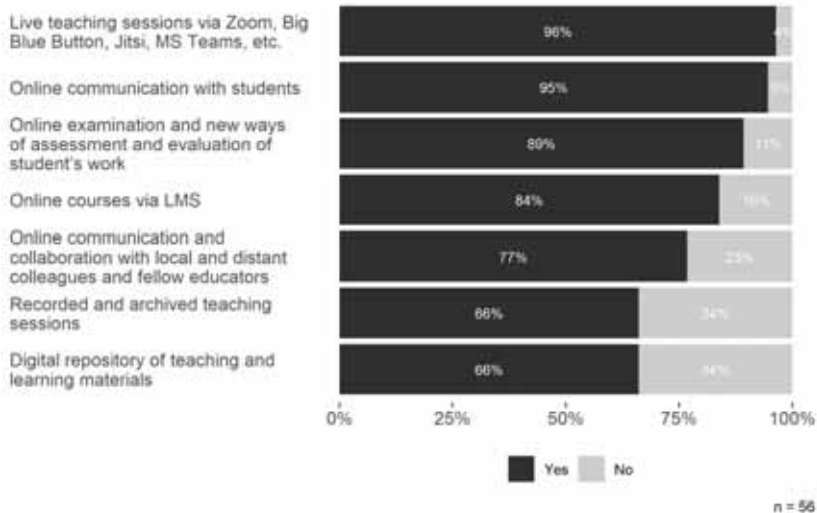


Figure 1: Aspects of DE, implemented in LIS schools/departments during Covid-19 pandemic

Regarding techniques/strategies (Figure 2), blended learning approach was used on 80% of LIS schools/departments participating in this study. It is also noticeable that project-based learning and problem-based learning were also significantly represented (73% and 71%, respectively).

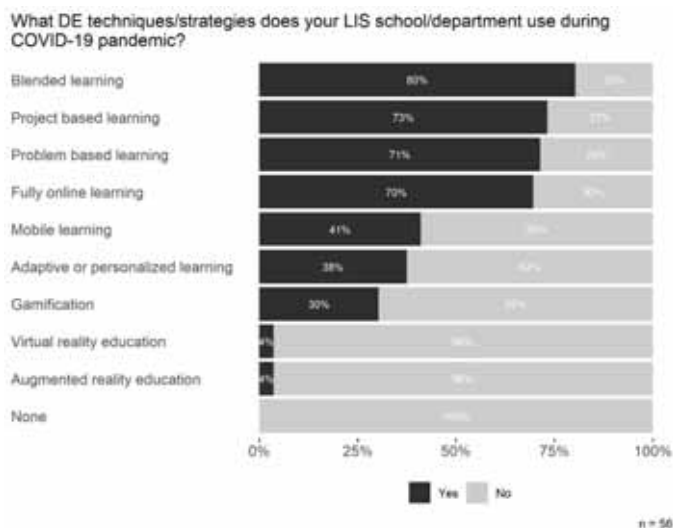


Figure 2: Main DE techniques and strategies used during COVID-19 pandemic

During the pandemic, institutions strongly relied on digital tools. It can be seen that LIS schools/departments mostly used video conferencing tools and learning management systems (LMS). Surprisingly, antiplagiarism software was also used many LIS schools/departments (80%).

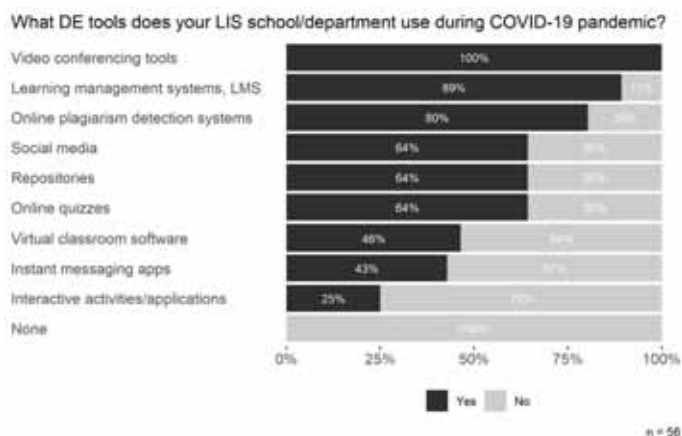


Figure 3: Main DE tools used during COVID-19 pandemic

Digital learning materials were used as a digital education resource by all 56 LIS schools/departments (100%). The least used were wiki books (14%). It is encouraging that 52% of LIS schools/departments used digital OERs.

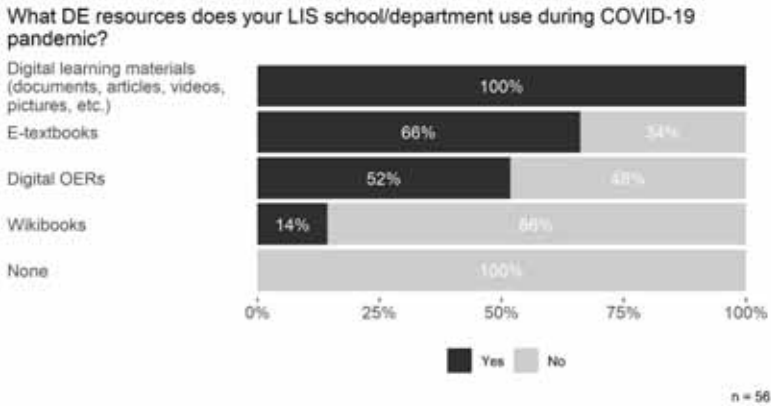


Figure 4: Main DE resources used during COVID-19 pandemic

Implementing new didactics is one of the issues closely related to the use of digital technology and digital resources in education. It usually includes applying new teaching and learning modalities. 53 out of 56 LIS schools/departments implemented new didactics in their teaching. Live online sessions and (79%) and platforms for sharing knowledge (75%) were the most common ways of implementing new didactic approaches.

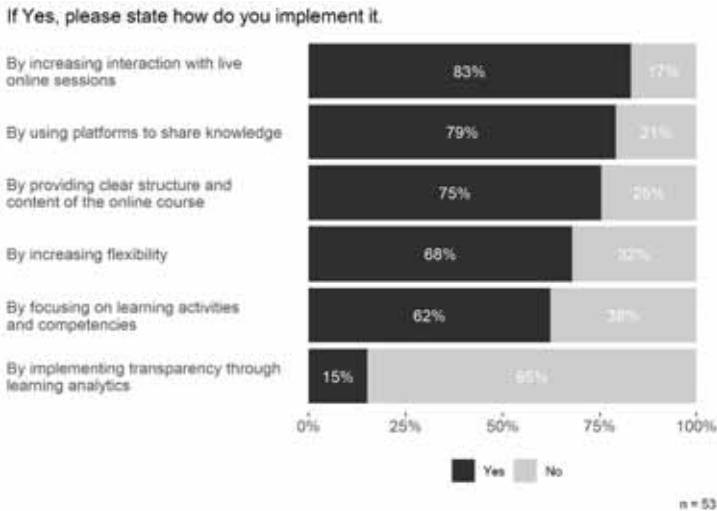


Figure 5: Most common ways of implementing new didactics

During the pandemic students faced different challenges and issues. The most common approaches to addressing those challenges and issues were providing regular consultations and live online Q&A sessions (88%), and providing technical support (73%).

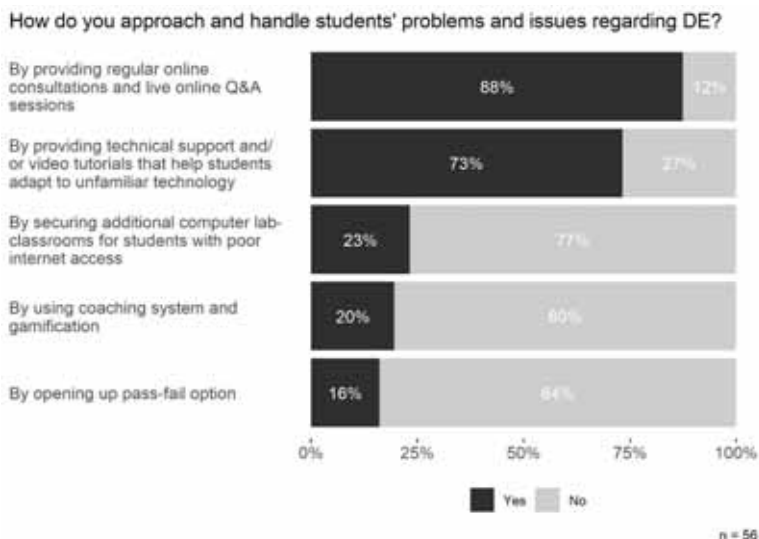


Figure 6: Ways of approaching and handling students' problems and issues

Due to the pandemic and overall rise in the use of digital technology, 36 out of 56 institutions developed new or adapted existing curricula. Yet, 47 institutions provided their teachers and trainers with the possibility to customize their teaching process.

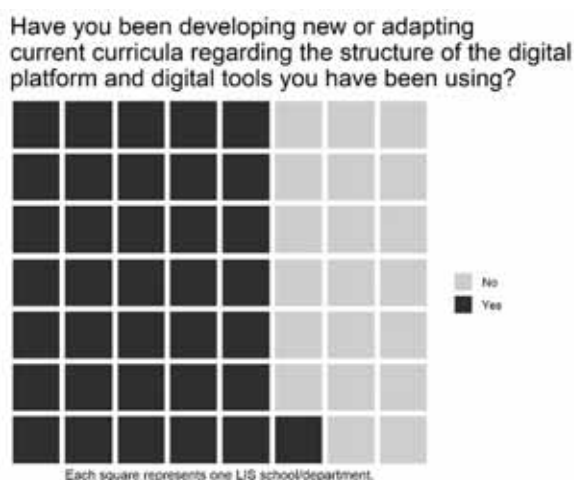


Figure 7: Developing new or adapting current curricula

Many of the teachers and trainers would apply flexibility in the course content (73%), allow students different opportunities to show and demonstrate their knowledge and skills (71%) or flip the instructions (66%).

If Yes, please state which customization options are offered to them.

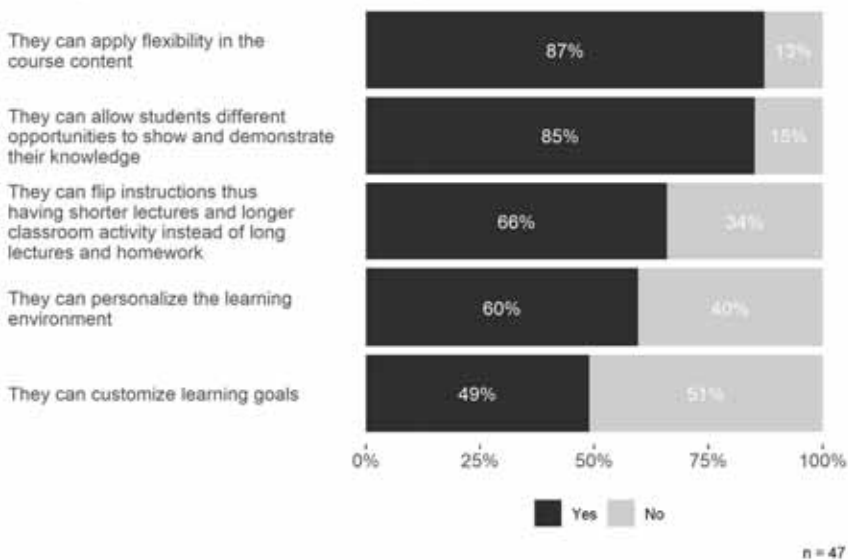


Figure 8: Customization options offered to teachers and trainers

For DE, mostly proprietary software is used (77%), but free and open-source software is also highly represented (70%).

What software does your LIS school/department use for DE in general?

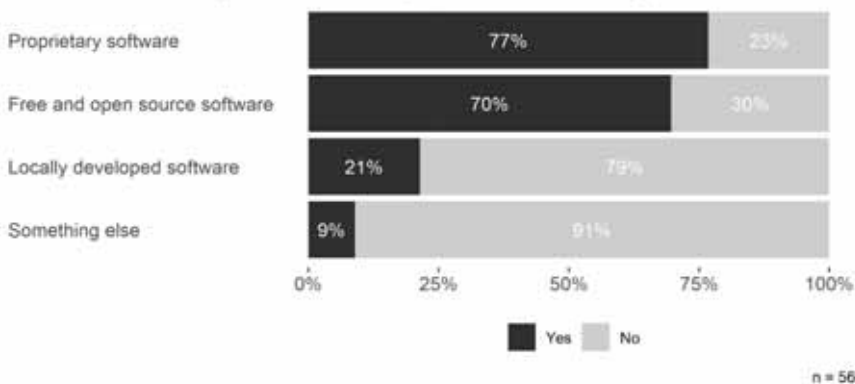


Figure 9: DE software used

Effectiveness of systems, tools and practices is an important aspect to be considered in this context and should be further explored. As can be seen, during COVID-19 pandemic, all the systems, tools and practices used worked as an integrated system at 66% of institutions.

Do existing systems, tools and practices within your LIS school/department provide enough help and support in ensuring the continuity and quality of classes and activities during COVID-19 pandemic?

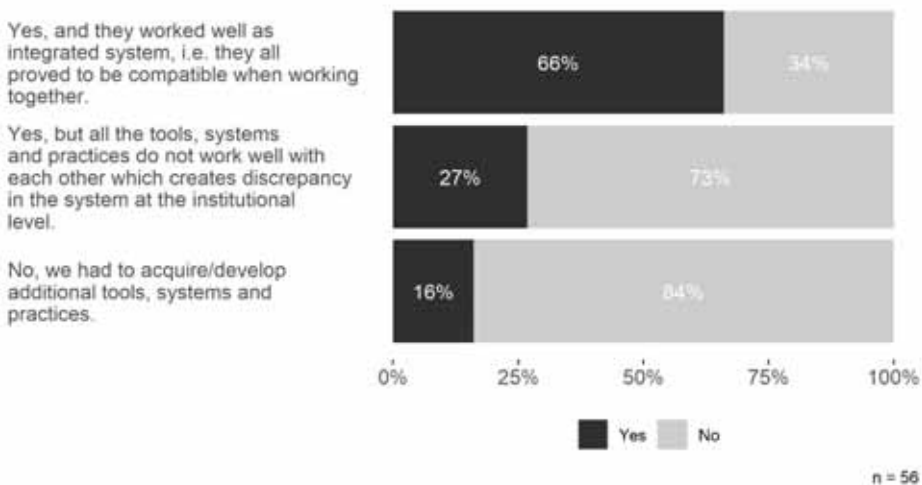


Figure 10: Ensuring continuity and quality of education during COVID-19 pandemic with existing systems, tools and practices

48 institutions (out of 56) carried out monitoring and evaluation procedures of DE. Online teaching and learning was the most monitored and evaluated process (at 62% of institutions), following by student's learning outcomes (57%) and participation (54%). While pedagogy, didactics and methodology were monitored on by 43% and level of communication only by 30% of LIS schools/departments.

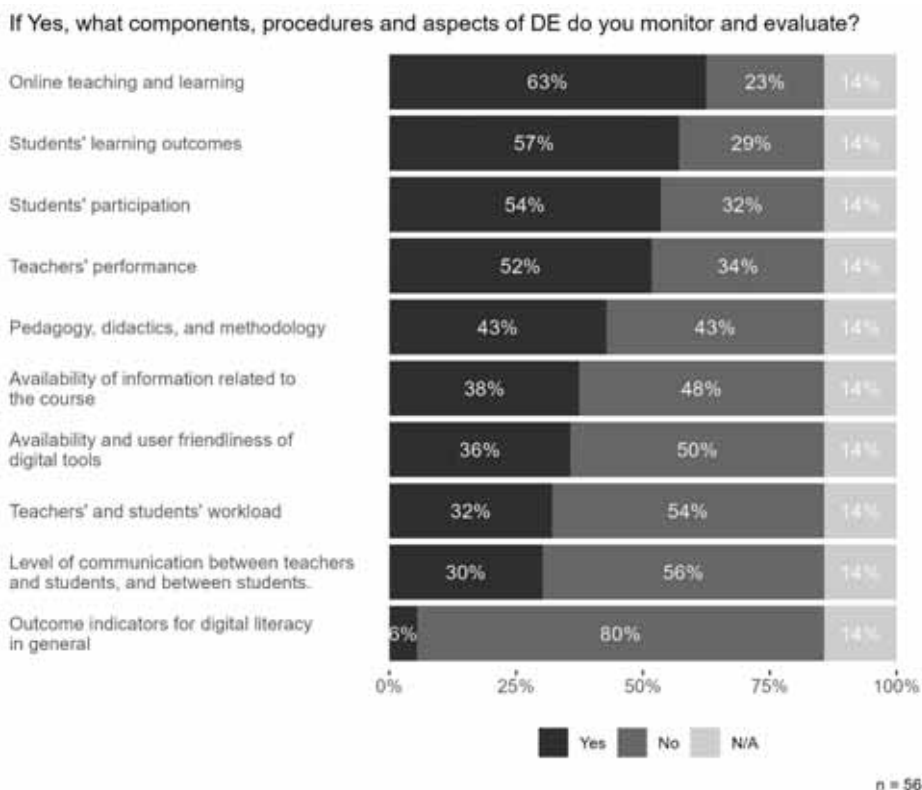


Figure 11: Main components, procedures and aspects of DE monitored and evaluated

COVID-19 pandemic required close collaboration of all stakeholders at HEIs. At 80% of institutions, students were able to obtain necessary library materials, meaning that libraries did not stop to provide core service to the students. At 59% of institutions, students were able to obtain library materials during closures.

In what ways does your LIS school/department collaborate with academic library regarding DE during COVID-19 pandemic?

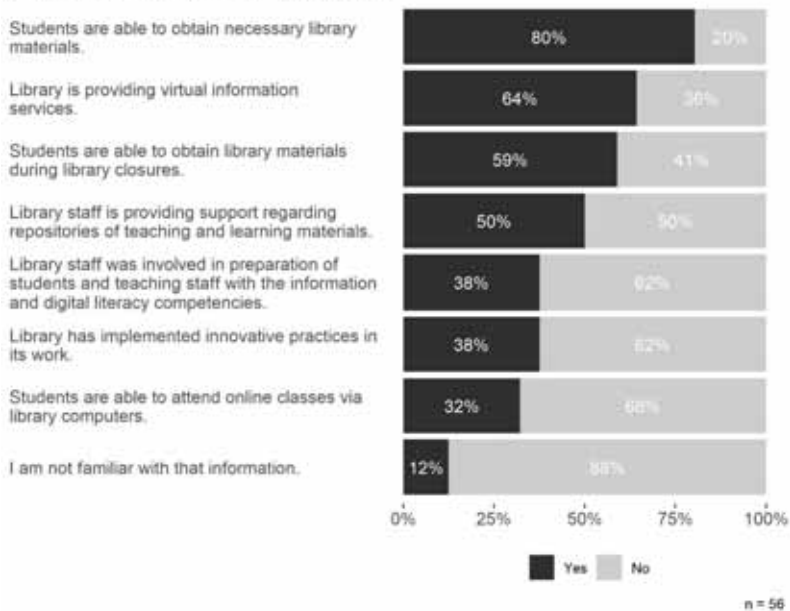


Figure 12: Main ways of collaboration with academic libraries regarding DE during COVID-19 pandemic

Since institutional support in implementation of DE is essential, it is encouraging to notice that 73% of institutions ensured implementation of DE at institutional level.

At what levels is DE implemented at your LIS school/department?

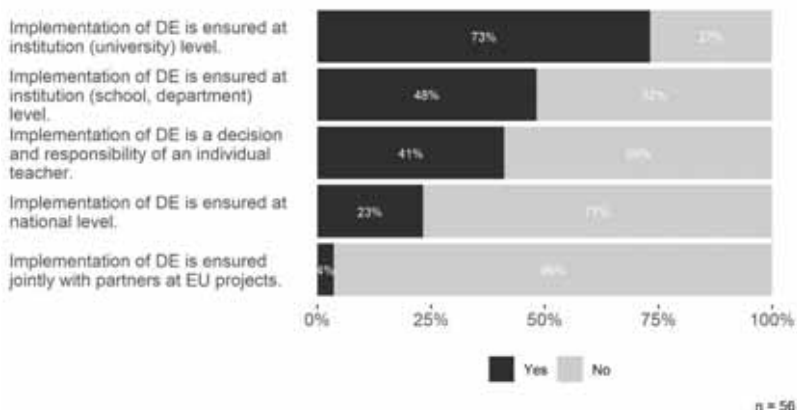


Figure 13: Main levels of DE implementation

5. Discussion

The following interpretation of the results provides insight into practices regarding DE undertaken in European LIS HEIs during COVID-19 pandemic. Since they are interchangeably connected, we will interpret the results in regards to the RQ1 (*What is the state-of-play regarding the implementation of DE in the context of COVID-19 pandemic, specifically in the field of LIS?*), RQ2 (*Which aspects of DE were implemented successfully and which aspects need to be developed further and improved?*), and RQ3 (*What is the impact of DE on higher education in the field of LIS?*) together. As already stated in the methodology section, it was intended to obtain the answers to the three RQ through integrative literature review, document analysis, but mainly by conducting an extensive survey at the European HEIs in the field of LIS.

DE offers many benefits in terms of location, timing, and modes of instruction. Unlike digital credentials, online communication with students and live teaching sessions via video conferencing were the two most popular components of DE during the pandemic, likely because those aspects of DE were used as existing educational methods even before the pandemic. Despite some teachers feeling unease about communicating with students online, various communication means, strategies and techniques can ensure the effectiveness, professionalism, respectfulness, and supportive nature of such communication while having a positive impact on the teacher-student relationship, students' motivation, their understanding of the material and overall productivity. Additionally, they can reduce students' sense of isolation. However, to ensure the continued development of DE, particularly in times of crises, LIS schools and departments should strengthen the application of digital credentials at the policy and programmatic levels. (RQ1, RQ2, RQ3).

Around 50% of LIS departments and schools used OERs while all of them used digital learning materials.

Blended learning, which combines the advantages of traditional and online learning, was the most prominent teaching strategy alongside project-based and problem-based learning, as concluded by previous studies (Chakraborty et al., 2021; Peters, et al., 2020; Ray, 2020). Equal learning opportunities can be created through blended learning, which is especially important during a crisis. It is important to note that various participants had different perceptions of the term "blended learning", such as that it represents a complete shift to online classes (in the case of a lockdown). VR and AR education are the least popular DE techniques, likely due to the fact that they require specialized and expensive technology and skills (Al-Ansi et al., 2023; Sviridova et al. 2023). Often, it is difficult for institutions to acquire the necessary money, time, and resources to integrate VR and AR education during a crisis if they do not already have them as part of their curriculum. Also, there are some concerns that online tools may lead to an infor-

mal educational setting due to the decentralized and nonhierarchical nature of the internet (RQ1, RQ2).

In order to facilitate DE during the COVID-19 pandemic, many HEIs employed existing video conferencing tools, anti-plagiarism software, learning management systems, social media, online tests, and repositories as was also reported in studies mentioned before (Adedoyin and Soykan, 2020; Al-Marroof et al., 2020; Chakraborty et al., 2021; Doyumğaç, Tanhan and Kiyimaz, 2021; Ionescu et al., 2020; Johnson, Veletsianos and Seaman, 2020; Kaqinari et al., 2021; Ray, 2020; Sasere and Makhasane, 2020). These tools allowed for better monitoring of students' attendance and academic achievement and could accommodate all class sizes. Recorded lectures, which are beneficial for self-directed study and test preparation, were also popular, especially among students. In some cases, certain tools and systems were integrated, e.g. the integration of LMS and video conferencing tools. However, during the COVID-19 crisis, many HEIs discovered that existing tools and systems were incompatible or inadequate all together. HEIs and governmental organizations must invest in the infrastructure and up-skilling of the teachers in order to facilitate successful DE implementation in future crises. Open-source products and software may be particularly helpful in that regard. Additionally, AI technologies should be explored as means to assist with the teaching and learning, as well as with reflecting on and evaluating the work of teachers and students.

Although DE technological issues tend to be more practical, as indicated by Adedoyin and Soykan (2020), Doyumğaç, Tanhan and Kiyimaz (2021), European Commission (2020), and Sasere and Makhasane (2020), it is still necessary to account for the effect of well-selected and applied pedagogical and didactic approaches and strategies that incorporate theoretical sides of education. Most LIS schools and departments adopted new didactics or new teaching and learning modes, mainly through the internet, digital tools, and media. They did it by modifying the curriculum (or reordering curriculum objectives) and altering teaching and learning content, sharing knowledge across platforms, and having live online sessions that often involved streaming the traditional classroom. Live, real-time interactions generated a synchronous environment for online learning which, as Hrastinski (2008) concludes, has many benefits and is essential for higher education teaching and learning, especially in the unanticipated pandemic situation. On the other hand, information sharing across platforms created an asynchronous environment, which is the key for creating conditions that favourably influence teaching and learning behaviour and aid the achievement of learning goals. The COVID-19 pandemic and the partial or complete cancelling of all face-to-face academic activity led to new advancements in didactic models and techniques that are changing teaching and learning formats. The mix of several teaching and learning approaches that best promote active, learner-centred teaching and learn-

ing began to appear as a pattern. Their role in maintaining students' engagement and education quality was recognized by previous studies (Hiltz & Turoff, 2005; Johnson, Veletsianos & Seaman, 2020; Ray, 2020; Sabharwal, Ficke & LaPorte, 2020; Sandhu & Wolf, 2020). As suggested by Tang et al. (2020), the modality of flipped classroom is the best example of mixing synchronous and asynchronous learning. Finally, all HEIs realized the importance of innovative pedagogy and didactics during the pandemic (RQ1, RQ3).

Most LIS departments and schools discovered useful strategies for handling students' issues and concerns with DE, such as having regular consultations and online Q&A sessions, and providing technical support to students. The prevalence of online consultations and live online Q&A sessions may indicate their importance, meaning that DE, especially when it is fully online and during crises, will not be successful if there is not any live and real-time interaction between students and teachers outside of a regular class. Although online communication might result in communication ambiguity and reduce motivation for active participation, particularly without a visual component, it can still create a feeling of personal communication, enhance students' drive and help them overcome all the challenges prompted by online setting as shown in studies done by Almendingen et al. (2021), Chakraborty et al. (2021) and Kaisara and Bwalya (2021) (RQ1, RQ3).

More than half of LIS schools/departments used digital platforms and technologies during the COVID-19 pandemic, which led to the adaptation of existing curriculum or the creation of new ones. This enabled greater curriculum customization and increased student inclusion. The pandemic impacted teaching methods for some teachers, to the point of affecting their teaching quality, and also changed learning techniques, posing challenges for students to learn autonomously from home. This prompted various curriculum innovations. The further development of digital skills and associated learning outcomes, such as assessing digital content, may be related to future curriculum modifications and development. Especially considering the positive impact digital skills have on digital proficiency, learning and academic engagement of students, as suggested by Bergdahl, Nouri and Fors (2020), Heidari et al. (2021) and Manco-Chavez et al. (2020). Also, the use of digital tools and technology usually generates more data, like learning analytics, which may be used to improve curriculum planning. Therefore, it is vital for HEIs to have a strategic approach to designing their DE ecosystems to match their general curriculum (RQ2, RQ3).

During the pandemic, DE has helped teachers become more proficient in using digital tools to deliver lessons, connect with other teachers, and monitor and evaluate student progress. Most teachers at LIS schools and departments had the freedom to customize the teaching and learning process. Since crises are often unpredictable, dynamic, and stressful, this adaptability is essential. Giving teachers the ability to devise their own teaching context and adjust to the new teaching and

research environment is critical in such situations as it helps them maintain the quality and consistency of their work. As far as students are concerned, personalized learning is a key element of customization in the domain of DE. Through monitoring and assessing each student's progress and designing courses that fit their needs, preferences, and level of understanding of the material, digital technology can be used to tailor the curriculum to each student's strengths and weaknesses, thereby boosting their academic performance. Assessment in DE has been a widely discussed research topic (Oldfield et al. 2012) (RQ1, RQ3).

Many LIS schools and departments relied on proprietary software like Zoom and MS Teams, but also made use of open-source software, especially Moodle. About 1/4 of respondents (21%) reported using locally (institutionally) created software such as UBYS (Üniversite Bilgi Yönetimi Sistemi), UniTUBE (for live streaming), Sumarum, Infordocente, Inforstudante, SWOP, ARL, UPV and others. To keep teaching and learning going during the COVID-19 pandemic, the integration of educational technology was imperative. To ensure quality of both online and offline activities, a range of tools, applications, platforms, systems, and resources, were employed. Open-source tools and systems can be very helpful to many HEIs in crises, especially those who must take into account the cost-effectiveness of their technical infrastructure. Moreover, they typically have a large user base and offer powerful, diverse, and customizable capabilities, particularly in terms of localization (RQ2).

During the COVID-19 pandemic, most LIS schools and departments used existing methods, tools, and practices, but some of these proved to be incompatible or inadequate all together. It can be costly and challenging (in terms of time and resources) to bring in new tools, systems, and approaches during crisis situations. HEIs and government agencies will have to invest in infrastructure and training of the faculty to make sure DE is implemented effectively in times of crisis, especially if similar events occur in the future. Open-source software and solutions can have a significant impact in this regard (RQ1).

The majority of LIS departments and schools have implemented monitoring and evaluation for DE. This is necessary for determining performance metrics, future planning, and enhancing and/or changing existing educational models and programmes. It is an ongoing activity that takes into consideration the opinions of all stakeholder involved in higher education. As pointed out by UNICEF (2020) and García-Peñalvo et al. (2021), guidelines and recommendations in regards to monitoring and evaluation are of great importance. In a crisis setting, DE can be monitored and evaluated in several ways, such as monitoring and evaluating student engagement, academic performance, and outcomes, as well as access to digital tools and resources, obtaining feedback from teachers and students using online surveys, and using collected data for learning analytics. Special attention

must be given to data protection and data curation since DE systems can generate large amounts of data (RQ1).

During the pandemic, academic libraries have been essential in providing the necessary teaching and learning materials and virtual information services. They have been able to adjust to the changing conditions of the pandemic and successfully support the continuation of teaching and learning activities, whether through traditional or online services. Libraries not only provided virtual information services, but also ensured accessibility to teaching and learning materials for the teaching staff during periods of library closure. Additionally, when required, library staff provided teachers with guidance on specific digital literacy skills thus aiding in their preparation for online teaching where digital literacy is a fundamental component. Digital technology did not only enhance the depth and scope of library services, but, through them, it also confirmed DE in the LIS field and broadened the reach of LIS programmes. Studies (Connell, Wallis and Comeaux, 2021; Holland, 2021; Huffman, 2020; Guo et al., 2021; Ma, 2020; Martzoukou, 2021; Decker, 2021; Rafiq et al., 2021; Quinteiro Goris, 2021) have shown that academic libraries have been able to maintain their services during the pandemic and have been innovative in designing new digital services and adopting new practices in delivering those services. Since they had to undergo a rapid leveraging of services and skills to meet the demand of newly transformed educational environment, they have demonstrated their importance in times of crisis, their adaptability and flexibility, and their significance for their patrons, especially new undergraduates. (RQ1, RQ3).

Finally, the results have shown that HEIs should invest in technological infrastructure, but also provide professional support and development opportunities for both teachers and students for them to become more proficient in using DE strategies and tools. HEIs should also consider emotional and psychological effects of the crisis situation on mental health and provide support to teachers and students in that regard. In most cases, DE implementation is overseen at the institutional level, but in some cases, it is the responsibility of individual teachers. In these cases, teachers need to be motivated and skilled in using digital tools and strategies to successfully address the issues, so investing in up-skilling and re-skilling of teachers is necessary for preparing for changes in education in general and in future crisis circumstances (RQ1).

5.1. Strengths and limitations of the study

This research focuses on the impact of DE on higher education in the field of LIS. The results of this study serve as an evidence-based insight into DE practices and their impact on the LIS HEIs while identifying best practices, i.e. what works and what does not. Also, this study provides better understanding of challenges

and solutions regarding DE especially during crisis situations, and brings a more forward-looking perspective on technological advancements and their impact on the future of the LIS higher education. Lastly, the results point to the need for further monitoring and evaluation of DE to ensure quality, as well as providing deeper insight into the state-of-play of DE in crisis situations which helps LIS HEIs, academic libraries and stakeholders in policy making and decision-making regarding DE, and in creating frameworks and guidelines that would enable easier, more sustainable and more widespread adoption of DE in LIS HEIs. The limitations include the methods used to collect data and the lack of clarity and understanding of certain terms and concepts by a small number of participants. It may be possible the heads of the LIS schools/departments were not familiar with all the practices and processes undertaken by individual teachers and thus omitted to mention or identify certain actions and strategies that are a part of their institution's teaching process. Some participants were mixing certain terms, like blended learning and e-learning or proprietary and open-source software and it is possible that some of them were not familiar with the specific educational tools, applications, approaches, techniques and strategies mentioned in the survey which could have impacted the precision and clarity of their answers.

5.2. Future research and recommendation for practice

This research will be supplemented by interviews with teachers and trainers and focus groups with students to gain a better understanding of the perception, practices, and overall evaluation of DE during the pandemic. To further improve DE in the LIS field, it is important to identify which of the practices used during the pandemic should remain as part of the curriculum and teaching and learning practice to ensure continuity and quality of higher education in future crisis situations. Although some of the practices were upscaled and some new were carried out, the question remains whether they should become a part of standardised curriculum and teaching and learning practice, and in which way can they improve DE in general and in possible future crisis situations. This raises the need for a more comprehensive and planned educational strategy.

In addition, an even more comprehensive picture could be obtained through assessment of knowledge and conclusions gained with this study, and those following it, in comparison to knowledge and conclusions gained in previous circumstances and outside of the scope of the DECriS project.

6. Conclusion

The disruption in higher education caused by the COVID-19 pandemic has been amplified, causing constraints on resources and a decrease in support and

continuity of education. The main contributing factor to the disruption in higher education during the pandemic was fast and wide adoption of digital technology and tools which affected not just the process of ‘mere’ transmission of knowledge, but also all other aspects of higher education – educational resources, pedagogy, methodology, didactics, HEIs and their adjustments to the new and unique set of challenges (including financial hardships), professional collaboration, as well as communication and relationship between and among teachers and students. To respond to the challenges of the pandemic, digital technology and tools have been comprehensively adopted, which led to certain benefits such as the transformation of the teaching and learning methods, widening of access to education and minimization of the impact of crisis situations.

In accordance with most of the previous research, our study pointed out to some challenging trends and advanced some crucial issues regarding DE and disruptive character of crisis situations.

- There is a necessity for DE’s ongoing optimization according to the dynamics and changing character of education in general and in crisis situation in particular.
- Changes in education refer to an array of different issues – ensuring the quality of teaching and learning, innovating curriculum and pedagogy, ensuring necessary infrastructure and services, developing and improving digital skills and competencies of teachers and students, and lastly, ensuring collaboration between teachers and students, amongst HEIs, and between HEIs and business and industry.
- Collaboration and sharing of experience can help identify success factors that could be further tested via case studies and put into practice (e.g. building a platform for cooperation and exchange of ideas and experiences at national and international level).
- Going beyond the storyline of education can help raise awareness of potential social, economic and psychological consequences of DE and distant education.
- Thinking beyond what is going on in the classroom can help build the right framework for apprenticeship, internship, field work and clinical work in the context of DE.

The biggest issue was successfully responding to global social challenges while keeping the teaching and learning quality, especially in regards to local and institutional context and circumstances.

To ensure successful and inclusive implementation of DE during crisis situations, issues such as access to digital infrastructure and tools, access to OERs, pedagogical design, skills, institutional support, and social and cultural challenges and differences must be addressed, as well as finding a balance between regula-

tion and flexibility to respond to changing dynamics. In that regard, all levels and parties involved in DE process should be considered, from students, teachers and trainers, through HEIs (including academic libraries), to local, regional and national institutions and agencies.

DE may be important and valuable alternative in crisis situation when teaching and learning process is disrupted, but in the context of the future of higher education the combination of digital and traditional education should be implemented to meet the diverse needs and goals of students and HEIs. In order to successfully prepare students for the labour market and professional life, higher education should promote social skills, emotional intelligence, critical thinking and psychological flexibility which are sometimes best supported by traditional forms of education.

What we learned from COVID-19 pandemic is that it is important to keep the balance between regulation that refers to well organized and structured educational ecosystem, and flexibility that responds to changing dynamic of crisis situations, and that no matter the format, traditional or online, education should always offer students engaging and informative learning experiences.

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