

# Virtual Learning Environments as a Remedy for Universities Against the COVID-19 Pandemic Crisis

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## Abstract

**Purpose:** The aim of the paper is to assess the level of interest in the Virtual Learning Environment (VLE) during and before the pandemic, as well as to identify and compare solutions implemented at selected Polish universities during the COVID-19 pandemic.

**Research methodology:** The preliminary study was based on bibliometric analysis. The frequency of the VLE notion in the scientific literature was verified. Then a case study was applied. Six universities in Poland were analyzed, which had to make radical organizational changes in a short time, allowing them to conduct classes with students almost exclusively remotely.

**Findings:** The conducted analysis led to the identification of significant similarities in the procedures undertaken and organizational changes of the universities described. Some variation has been observed in terms of the software used that builds the university's VLE.

**Research limitations:** Only cases of universities in Poland have been described. The choice of the university was intentional.

**Value:** The value of the paper is to draw attention to: on the one hand, the versatility of the VLE, and on the other, certain common features that university VLEs should have in order to ensure the work of the university (and other institutions dealing with education) in a crisis situation.

**Keywords:** VLE, Virtual Learning Environment, COVID-19, pandemic.

**JEL:** I230, O320

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## Wirtualne środowiska nauczania jako remedium dla uniwersytetów na kryzys pandemii COVID-19

### Streszczenie

**Cel:** ocena poziomu zainteresowania tematyką VLE w czasie pandemii i przed nią, a także identyfikacja i porównanie rozwiązań wdrożonych na wybranych polskich uczelniach podczas pandemii COVID-19.

**Metodologia badań:** badanie wstępne opiera się na analizie bibliometrycznej. Zweryfikowano częstotliwość wystąpienia tematyki VLE w literaturze o charakterze naukowym. Następnie zastosowano studium przypadku. Przeanalizowano 6 wyższych uczelni w Polsce, które w krótkim czasie musiały dokonać radykalnych zmian organizacyjnych, pozwalających na prowadzenie zajęć ze studentami prawie wyłącznie w formie zdalnej.

**Wyniki:** przeprowadzona analiza doprowadziła do wskazania dużych zbieżności w podjętych procedurach i zmianach organizacyjnych opisanych uczelni. Pewne zróżnicowanie zaobserwowano w zakresie stosowanego oprogramowania, które tworzy VLE uczelni.

**Ograniczenia badawcze:** opisane zostały tylko przypadki uczelni w Polsce. Dobór uczelni miał charakter celowy.

**Wartość:** wartością artykułu jest zwrócenie uwagi na: z jednej strony wszechstronność VLE, a z drugiej pewnych cech wspólnych, które powinny posiadać uczelniane VLE celem zapewnienia pracy uczelni (i innej instytucji zajmującej się edukacją) w sytuacji kryzysowej.

**Słowa kluczowe:** VLE, wirtualne środowisko nauczania, COVID-19, pandemia.

### 1. Introduction

Various sources indicate that the COVID-19 pandemic, resulting from the spread of the SARS-CoV-2 virus, began on November 17, 2019 in the Chinese city of Wuhan, Hubei province (Ma, 2020). The virus turned out to be so contagious that almost every corner of the globe inhabited by people was at risk of the disease. On March 11, 2020, the World Health Organization (WHO) announced a global pandemic (WHO, 2020). In Poland, the first cases of the disease were reported from March 4, 2020 (Ministerstwo Zdrowia, 2020).

The fact of an epidemiological threat forced state authorities to take radical legal steps to protect the life and health of citizens. In almost each country in the world, the way of life underwent such changes that would have been unimaginable a few weeks earlier. Total or partial sanitary restrictions were announced with varying intensity practically all over the world. According to data for April 2020, the lockdown affected more than 3.9 billion people, which was more than half of the Earth's population (Sandford, 2020). The limitations affected many spheres of peoples' life, including education, which was most often replaced by distance learning or the so-called hybrid learning. It is estimated that the governments of as many as 193 countries introduced large-scale programs to shut down entire education systems, involving about 1 billion students, the majority of whom were children (Laboure, 2021).

This paper focuses solely on universities. According to GUS data: in the 2018/19 academic year, 1.23 million people in Poland had the status of a student (GUS, 2019).

Before the pandemic, Polish universities and other educational institutions were characterized by a different level of use of e-learning and virtual learning environments (VLE). As a result, the restrictions that were introduced and the order to teach only in a remote form were not the same organizational and technological challenge for every university and educational institution.

Currently, the number of publications that deal with the issues of changes in education resulting from the pandemic is growing. Many researchers focus on the problems of changes in education from the point of view of employees or students (Rizun & Strzelecki, 2020; Klimowicz, 2020; Almarzooq, Lopes, & Kochar, 2020) or the problems of conducting research during a pandemic (Myers et al., 2020). Nevertheless, there are no studies that would attempt to analyze universities in terms of VLE built by them.

The author of this study made an attempt to fill the identified research gap. The paper compares 6 universities in Poland in terms of organizational and technological changes that these universities had to implement during the COVID-19 pandemic. The aim of this paper was to analyze these cases and find differences and similarities in the use of virtual learning environments (VLE) in the context of counteracting the COVID-19 crisis in the field of education. The main goal has been augmented with a supplementary goal. The author undertook a bibliometric analysis to determine whether the pandemic effect strengthened the interest of researchers in VLE.

## 2. Virtual Learning Environment (VLE)

According to the Cambridge Dictionary, the virtual learning environment is “a system for learning and teaching using the internet and special software” (“VLE,” n.d.). The essence of the virtual learning environment is also reflected in the definition: “*Virtual learning environment (VLE) is a system supporting the administration, organization and conduct of e-learning training with the use of tools for creating educational materials and online communication*” (Wrycza, 2010, p. 529).

Initially, VLE was understood as a synonym for LMS (Learning Management Systems) and was constructed based on the client-server architecture (Britain & Liber, 1999). The understanding of this term has changed over the years (Borawska-Kalbarczyk, 2017). Today, VLE appears to have more functionality than was predicted twenty years ago, and also uses distributed architecture and cloud computing, and sometimes even artificial intelligence technology. VLE can contain software that is one product, or it can be an integrated set of separate tools with additional functionality (Jisc, 2016). An accurate formulation, illustrating the essence

of things, is: “*the virtual learning environment is a designed information space*” (Dillenbourg, 2000).

Undoubtedly, every university in the 21st century has and develops its own VLE. But what was it like before the pandemic? In one of the papers from a dozen or so years ago, there were statements that then the implementation of VLE was only a “disruption” of teaching practices and there was no serious transformation or change in the structure of teaching and learning (Blin & Munro, 2008). This was the case in 2008, but of course, shortly thereafter, universities were ready to propose online paths for their students that took much more advantage of the benefits of VLE extended to e-learning tools.

Polish academic e-learning is subject to certain conditions (Drażek & Komorowski, 2010). And today’s virtual learning environments can be very versatile. Among other things, they can involve students in the educational process through the use of gamification elements through the use of appropriate framework (Swacha et al., 2020).

There is no doubt that the COVID-19 pandemic has triggered long-lasting changes in many sectors, including the education sector (along with higher education). Lockdown forced the adaptation of VLE to new conditions and needs. Virtual learning environments had to become flexible enough to almost completely simulate traditional classroom activities.

### 3. Research Methodology

In this work, in addition to the goals listed in the introduction, the following research question was posed:

Has the development of the COVID-19 coronavirus pandemic forced Polish universities to quickly expand their own virtual learning environments? – with regard to the configuration of at least several complementary information systems, dedicated to the transfer of knowledge and communication.

The purpose of the research is to answer the above question. The study was divided into two stages. The first stage is a bibliometric analysis in which the results of Google Scholar searches were used. The data covered the period from 1990 to 2020. The aim of the first stage of the study was to investigate the degree of interest the authors of scientific papers have in VLE.

The second stage of the research is a case study. Between December 2020 and February 2021, 6 universities were analyzed. The description of the research sample is presented in Table 1. The following universities were surveyed:

- the University of Warsaw (Uniwersytet Warszawski),
- the Cardinal Stefan Wyszyński University (Uniwersytet Kardynała Stefana Wyszyńskiego),

- the University of Economics in Katowice (Uniwersytet Ekonomiczny w Katowicach),
- WSB University in Poznań (Wyższa Szkoła Bankowa w Poznaniu),
- WSB Academy in Dąbrowa Górnicza (Akademia WSB w Dąbrowie Górniczej),
- the Silesian University of Technology in Gliwice (Politechnika Śląska w Gliwicach).

In order to collect the research material, information from the universities' websites was followed and statistical data from the various sources were used. Then, internal legal acts from 2020 were analyzed (rector's, dean's, chancellor's and other regulations, organizational procedures regarding safety during a pandemic and the technologies used). Next, a structured interview with employees of the above-mentioned universities and the participant observation method were used. Finally, attention was paid to the IT systems used in the context of VLE in the universities mentioned. The purpose of the structured interview was to penetrate two leading issues, namely:

- what measures have been taken to successfully continue higher education in the time of the coronavirus pandemic (legal acts, training, reconstruction of IT systems),
- what new technologies have been implemented and what technologies were used before.

In addition, during the interview, the respondents were asked how long it took them to switch to distance learning and what perturbations were related to that fact.

#### 4. Bibliometric Analysis

A preliminary study analyzed the volume of publications and scientific studies on VLE. The analysis concerned the results of searches in Google Scholar. Three search variants were adopted:

- Variant 1. The presence of the words: “virtual,” “learning,” “environment,”
- Variant 2. The use of the phrase in the following order: “virtual learning environment,”
- Variant 3. The use of the words “virtual,” “environment” or “learning environment” in Polish-language studies.

In the first two variants, the frequency of occurrence of words and phrases in the years from 1990 to 2020 was analyzed. This time frame was adopted because most or even all publications from before the 1990s (variant 2) had to be rejected because they were wrongly cataloged by the search tool. This fact was found after a more careful analysis.

In total, the words “virtual,” “learning,” “environment” appeared about 2.6 million times, and the phrase “virtual learning environment” appeared about 65.4 thousand times. The results are shown in Figure 1. The axis on

the left shows the frequency of occurrence of any arrangement of individual words, while the axis on the right shows the frequency of occurrence of a uniform phrase “virtual learning environment.” The entire phrase appeared much less frequently, especially at the beginning of the analyzed period of time. In the last 10 years, the phrase has appeared from about 20 to 45 times less often than these words, but arranged in any order.

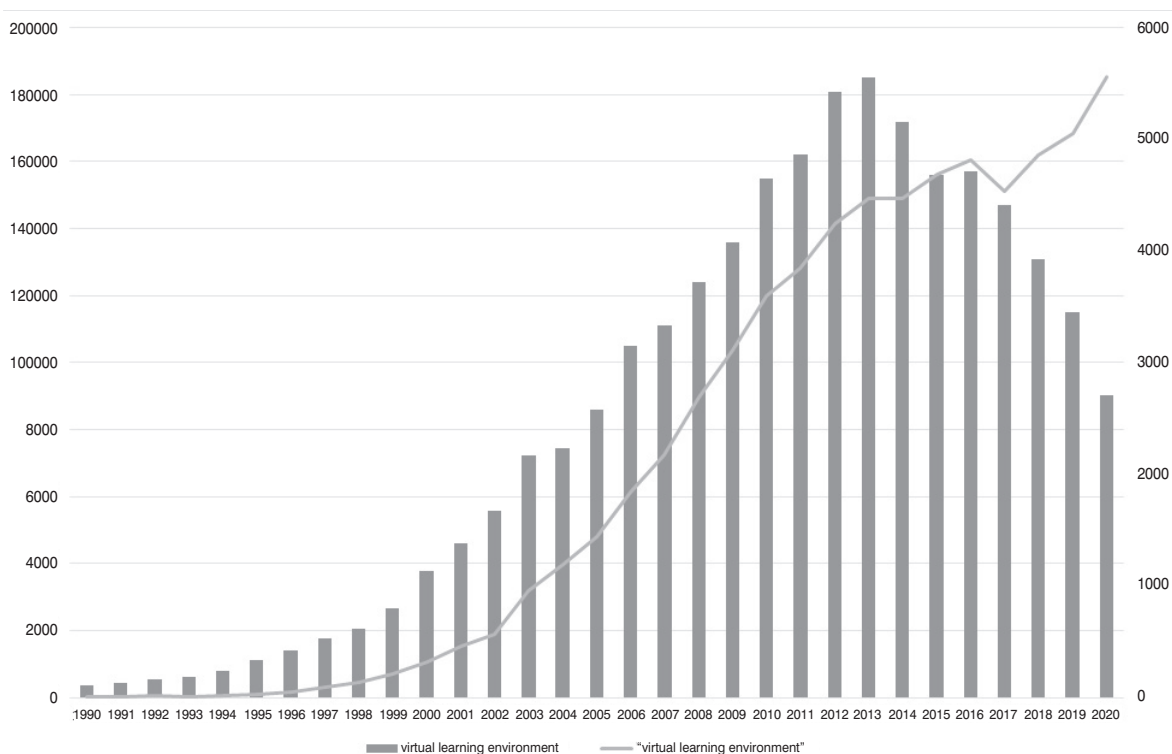


Fig. 1. The frequency of occurrence of the words: *virtual*, *learning*, *environment* and the phrase “*virtual learning environment*” in scientific articles and studies in the years 1990–2020, including citations and patents. Source: Own study based on Google Scholar data, access: 2021-06-12.

The words “*virtual*,” “*learning*,” “*environment*” in any order appeared most often in the years 2012–2013. From then on, a decrease in the number of occurrences was noticeable. However, the analysis of the frequency of the single phrase “*virtual learning environment*” is more reliable. It appeared most often in publications in the year 2020. There is a noticeable increase in the interest in this issue, despite a slight and temporary downward trend after 2016.

A similar analysis was carried out for Polish words in Polish studies (variant 3). Due to the specificity of the grammar of the Polish language, the analysis was more difficult. Ultimately, it was decided to use a query containing the phrase: “wirtualne środowisko OR środowiska nauczania.” The obtained results are presented in Figure 2.

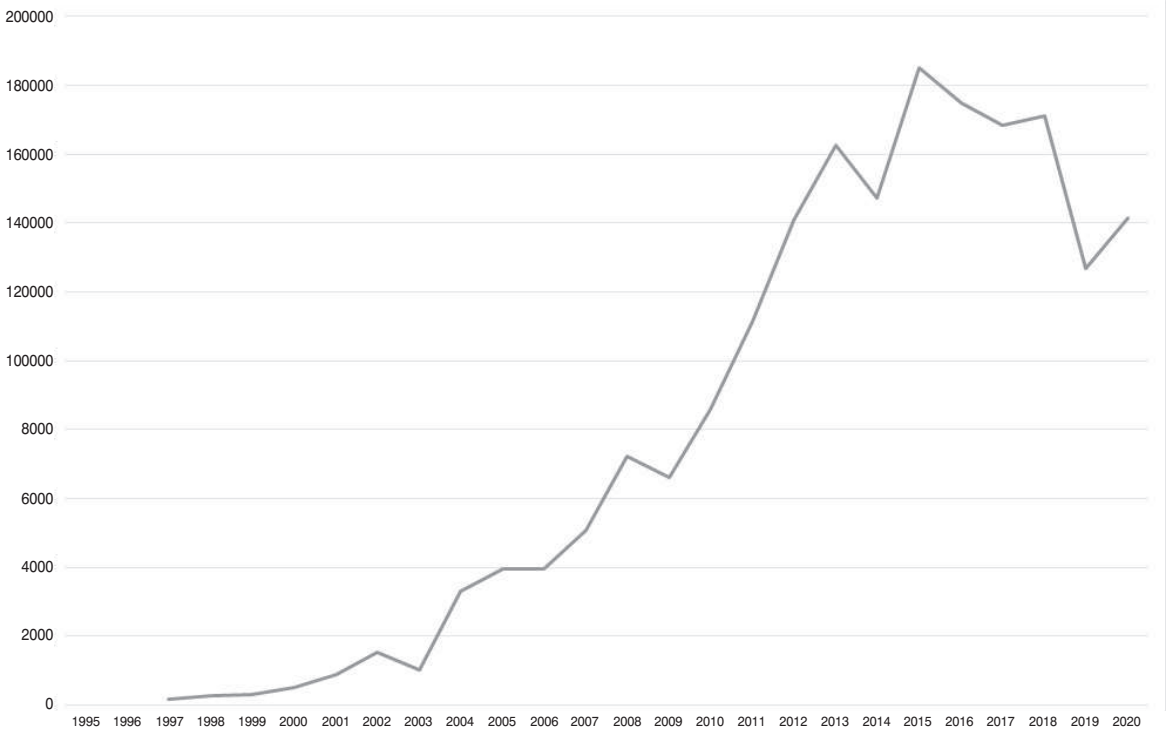


Fig. 2. The frequency of the words: virtual learning environment / learning environments in Polish-language scientific articles and studies in 1997–2020, including citations and patents. Source: Own study based on Google Scholar data, access 2021-06-12.

The number of studies in Polish on VLE is of course dramatically lower. Items from before 1997, as inadequate in content (imperfections of the method), were excluded. Looking at the chart, it is easy to see that the peak of interest was in 2015. Then a downward trend can be observed. Although there is a visible increase in the interest in 2020, this is not a very large percentage leap.

## 5. Case Reports

Table 1 presents descriptions of 6 analyzed cases. The universities were deliberately selected in such a way that each of them had different characteristics from the others (type of university, tradition, location, size in terms of the teaching base and number of faculties, number of students and staff).

	Uniwersytet Warszawski <sup>a</sup>	Uniwersytet Kardynała Stefana Wyszyńskiego <sup>b</sup>	Uniwersytet Ekonomiczny w Katowicach <sup>c</sup>	Wyższa Szkoła Bankowa w Poznaniu <sup>d</sup>	Akademia WSB w Dąbrowie Górniczej <sup>e</sup>	Politechnika Śląska w Gliwicach <sup>f</sup>
Type of university	public	public	public	non-public	non-public	non-public
Location	Masovian Voivodeship	Masovian Voivodeship	Silesian Voivodeship	Greater Poland, Silesia and West Pomeranian Voivodeships	Silesian and Lesser Poland Voivodeships	Silesian Voivodeship
Tradition	Since 1886 (204 years)	Since 1954 (46 years)	Since 1936 (64 years)	Since 1994 (26 years)	Since 1995 (25 years)	Since 1945 (75 years)
Number of campuses, buildings in use of the university	3 campuses, 184 buildings	2 campuses, 23 buildings	2 campuses, 11 buildings	3 campuses, each in a different city	5 campuses, each in a different city	3 campuses
Number of faculties (colleges)	24	12	4	3	5	15 (including 2 institutes)
Number of employees <sup>g</sup>	about 7000	about 1250	about 1450	about 400	about 350	about 3200
Number of students <sup>h,i</sup>	40.6 K	9.3 K	8.1 K	17 K	7.5 K	18.1 K

<sup>a</sup> Based on: <https://www.uw.edu.pl/universytet/fakty-i-liczby/>, access: 2021-01-28.

<sup>b</sup> Based on: <https://uksw.edu.pl/pl/universytet/uczelnia-dzis>, access: 2021-01-28.

<sup>c</sup> Based on: <https://www.ue.katowice.pl/uczelnia/o-uczelni.html>, access: 2021-01-28.

<sup>d</sup> Based on: <https://www.wsb.pl/poznan/poznaj-wsb/o-uczelni>, access: 2021-01-28.

<sup>e</sup> Based on: <https://wsb.edu.pl/o-uczelni-misja-status,m,mg,1>, access: 2021-01-28.

<sup>f</sup> Based on: <https://www.polsl.pl/Informacje/Uczelnia/Strony/witamy.aspx>, access: 2021-01-28.

<sup>g</sup> Based on Bisnode, <https://www.bisnode.pl>, access: 2021-02-14.

<sup>h</sup> Data for 2019, based on (GUS, 2020, pp. 40–45).

<sup>i</sup> Data for 2018/2019, based on (GUS, 2019).

*Tab. 1. Description of the analyzed cases of universities in Poland. Source: Own study based on the given sources and interviews.*



The method of analysis (case study) proposed later in the paper is of a qualitative nature. It does not answer the question whether all universities in Poland coped with the crisis, but indicates how those universities that were selected in the study handled the difficulties in a deliberate manner.

## 6. Cases Comparison

The universities had to implement specific organizational solutions that allowed for the replacement of traditional education with the remote mode. These solutions had to be in line with overriding state legal acts that applied to all universities. This paper only deals with the internal regulations and procedures that have been implemented. It was these regulations that had a significant impact on the way education programs were (and continue to be) conducted and on what software was approved for the use within the university. It is this software that has become the building block of the university VLE.

Each of the universities implemented ordinances at the rector's and dean's level, regulating the principles of conducting classes during the pandemic. Administrative matters were usually regulated by chancellor's regulations. Moreover, procedures adequate to the degree of epidemiological threat were adopted. Another important issue was to initiate training for the staff.

In each university, training courses were conducted that concerned the technical aspects of software use and important aspects of teaching methodology. Each of the universities had implemented e-learning before (usually for several years), so a significant part of the staff did not need to learn from scratch. Hence, many trainings were not only designed to teach the basics of the service, but were advanced in nature, extending the already possessed competences.

In addition, each university formally regulated which IT tools would be allowed for remote classes. Since such elements of VLE as the student service system or e-learning platform had long been used in each of the universities, it was more related to the VLE complementary software. Almost every university had taken the first steps toward the implementation of e-learning, the first installations of the e-learning platform, staff training over a dozen or even about 20 years before the outbreak of the pandemic.

Table 2 compares the described cases in terms of the introduced organizational changes and specific activities, training, and technologies used. Large convergences were observed in the procedures and organizational changes undertaken, as well as in the training sphere of the universities described. Therefore, they were described uniformly for all universities in Table 2, without listing specific internal legal acts. The table also compares selected software packages used during the pandemic.

	Uniwersytet Warszawski	Uniwersytet Kardynała Stefana Wyszyńskiego	Uniwersytet Ekonomiczny w Katowicach	Wyższa Szkoła Bankowa w Poznaniu	Akademia WSB w Dąbrowie Górniczej	Politechnika Śląska w Gliwicach
Regulations and procedures	Regulations at the rector's level, at the dean's and chancellor's levels. Necessary sanitary and safety procedures were implemented as well.					
Training	Methodological, technical and maintenance training – varied levels of advancement					
The tradition of e-learning implementing	> 10 years					
E-learning platform	Moodle (Campus, eNauka)	Moodle (eUKSW)	Moodle	Moodle	Moodle (OnlineWSB)	Moodle
Student service system	USOS <sup>a</sup>	USOS	Simple.Bazus	Intranet/ Extranet (dedicated software)	e-UNI	USOS
The dominant tool for synchronous communication	ZOOM	Microsoft Teams	Google Meet	Microsoft Teams	Clickmeeting – recommended, but also acceptable: Zoom, Microsoft Teams, Google Hangouts and other <sup>b</sup>	Zoom
Virtual desktops	VDI – IBM VMware Horizon	Yes, but mostly used for remote work	VDI – IBM VMware Horizon	Virtual Box – rather locally	Yes, but no specific data is available	VDI – IBM VMware Horizon
Cloud computing services	Microsoft 365					

<sup>a</sup> USOS, <https://www.usos.edu.pl/> access: 2021-02-11.

<sup>b</sup> Based on: <https://wsb.edu.pl/index.php?p=m&idg=KORO,5390>, access: 2021-02-15.

*Tab. 2. Selected aspects of case studies in terms of selected organizational and technological changes of the VLE in connection with the COVID-19 pandemic. Source: Own study.*

Table 2 shows the synthesis of research based on a legal analysis, interviews and participant observation. This table indicates that there were many similarities in the activities of the universities. The university authorities approached internal legislative acts or training of teaching staff in a similar way. Each of the universities has quite a long tradition of implementing e-learning (always longer than 10 years). On the other hand, the differences occur mainly in the field of selecting the elements of the university's VLE.

Some elements of VLE are consistently used by all the universities surveyed. Thus, all universities use the Moodle e-learning platform and Office 365 as a cloud computing solution. There are differences in the selection of the student service system. USOS is popular with, but not all, public universities. Moreover, apart from USOS, dedicated systems are also used. Among the tools for synchronous communication, Microsoft Teams and Zoom are most often employed in teaching. Other systems were also used. The most popular virtual desktop tool is VDI – IBM VMware Horizon. Still, it was also not the only possible option here. The selection of VLE elements could result from a certain consequence of using previously selected solutions or the choice between popular and recommended systems.

As a result of the fact that universities already had extensive VLEs, it was very quickly possible – considering the crisis conditions – to propose an alternative, remote mode of education. It was the fact of having a comprehensive VLE that helped ensure that the transition period to e-learning did not exceed two weeks. Such a time period or less was given in the interviews. At the same time, some universities allowed, in the summer semester of 2020, that classes should be mainly asynchronous, but already in the winter semester of 2020/2021, classes could be held fully synchronously. Existing VLEs were only enriched with instant messaging or cloud services, and virtual desktops became more commonly used outside university walls.

## 7. Research Limitations

The bibliometric analysis concerned the 1st and 2nd variants of the phrases in the English language. Option 3 concerned Polish words. Since the results of Google Scholar searches were used, which process huge amounts of data, all the advantages and disadvantages of such methods should be taken into account. Inaccuracies may result, among others, from incorrect tagging and cataloging of some publications (which has already been mentioned in the context of pre-1990 and Polish works before 1997).

The correction for ambiguity in the interpretation of the term VLE should also be taken into account, especially in the earlier literature. The frequency of the abbreviation VLE was not analyzed as it also has other connotations.

The described case studies concern only Polish universities. The selected sample was purposeful and aimed at presenting good practices. The author's observations show that many Polish universities have followed a similar path.

## 8. Discussion

The bibliometric analysis showed a certain increase in the interest in VLE in 2020. However, it should be noted that this was not a dramatic increase. This means that the subject of VLE turned out to be interesting for many

authors many years before the pandemic. Thus the interest had been around for a long time before and the pandemic effect only strengthened it slightly.

Due to the fact that VLE had already been operated by universities, it was possible to find a solution to the existing difficult situation in a relatively short time. If, however, universities had not been interested in e-learning and building VLE before the pandemic, the need to start distance learning and hybrid learning would have faced powerful barriers of various nature (lack of technology, lack of staff competences, organizational chaos). The analysis of the described cases shows that the previous experiences with remote teaching in the case of each of the universities enabled them to organize substitute education based on the technology and competences of the academic staff relatively quickly.

The described implementations, solutions, and tools are likely to continue to be used, even after the pandemic has ended. On the other hand, various internal laws that have been enacted at these universities are likely to be temporary and will expire or be repealed after the pandemic ends.

Unfortunately, not all educational institutions coped with the crisis as efficiently as the universities described above. The report “Remote education during the pandemic” concerns primary and upper secondary schools (Buchner & Wierzbicka, 2020). The report reveals a long list of problems faced by schools. These included low digital competences of teachers, chaos, disinformation, negligible support from the Ministry of National Education, a mismatched core curriculum, insufficient preparation not only for the first, but even for the second wave of the pandemic. All this had an impact on the psychological well-being of teachers and students. As a result, it could translate into total passivity and exclusion, which results in the so-called “disappearing” teacher and “disappearing” student. The author’s private observations show that some educational institutions only adopted communication platforms for their purposes after the summer holidays and managed to train their teachers. This clearly shows how beneficial it was to create comprehensive virtual learning environments for universities before the pandemic. The availability of virtual learning environments significantly facilitated the adaptation of universities to crisis conditions.

## 9. Conclusions

The analyses made allowed for the formulation of the following conclusions:

1. The results obtained in the bibliometric study show that VLE has been of interest to various types of researchers for many years. The shapes of the curves in Figures 1 and 2 are quite similar to popular product life curves. However, in 2020 the effect of interest in VLE was strengthened. The increase in interest, however, was not dramatic.

2. Universities had been building their own VLE for a long time. The pandemic effect accelerated certain decisions and certain – ongoing – processes. The internal legal acts that came into force in the analyzed universities were quite similar in nature. The main differences concerned the IT tools adapted to the needs of universities.
3. These universities had been implementing e-learning for a good dozen or so years (or more), with the main emphasis being on asynchronous communication and the use of the e-learning platform for this purpose.
4. All of the analyzed universities were equipped with e-learning platforms before the pandemic. In each case, it was the Australian open source e-learning platform Moodle<sup>1</sup>, which is available under an open license. This platform is particularly popular in this part of Europe and readily adopted and used by universities in Poland. Thus, universities, in many cases, were much better technologically prepared for the crisis than secondary and primary schools in Poland.
5. The outbreak of the pandemic and sanitary restrictions forced the use of alternative IT tools for videoconferencing. Each of the universities had to quickly add such a system to the package of its IT systems necessary for efficient teaching processes. The identified software is Zoom, Microsoft Teams, and Google Meetings.
6. The interest in cloud computing services has increased, which mainly refers to the Microsoft 365 service (formerly Office 365).
7. Remote desktop services have become widely used outside of the classroom.
8. While in the summer semester of 2020 it was acceptable to use only asynchronous communication tools, from the winter semester 2020/2021 practically every school forced the use of real-time communication tools as well.
9. If universities had not implemented e-learning earlier, the effects of the lockdown would have been more severe for them. Thanks to such implementations, it was possible to ensure a relatively small delay (not longer than 2 weeks) for the educational service.

The conducted research allows for a positive answer to the research question. Hence, the fact is that the COVID-19 pandemic and the lockdown made Polish universities expand their own VLE. Previously, these VLEs were a configuration of at least several complementary IT systems, dedicated to the management of the teaching process, knowledge transfer and communication. Most VLE builders had been used before. In the report by M. Klimowicz, the author indicated 5 phases of distance learning in the COVID-19 era (Klimowicz, 2020). Phase one: suspension and chaos were unavoidable, but there are indications that VLE mitigated this effect.

There is much speculation about what will remain from the adopted solutions in education after the pandemic. Perhaps, long-term changes in the methods that countries use to provide education to their citizens and

the globalization of the education market, which will benefit the most elite schools, are to be expected. And this will come at the expense of lesser-known schools (Laboure, 2021). In the author's opinion, the quality of university's VLE can be an important competitive advantage.

Moving on to the summary of the work: the observations and analyses made clearly indicate that without prior orientation to modern educational technologies and appropriate steps toward educational innovation, universities in Poland would have been much more severely affected by the effects of the pandemic and lockdown. We operate in a global economy, which is increasingly exposed to global problems. The experience of resisting the pandemic crisis by universities in Poland also shows how important expenditure on research and development of new technologies (including educational technologies) is in the modern economy.

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#### Endnotes

- <sup>1</sup> Moodle, <https://moodle.org/>, access: 2021-02-15.

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