Multi-layered Higher Education E-Learning Framework

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Abstract: In a crisis such as the one in 2020 and 2021, education is undoubtedly one of the areas affected. Teachers and students faced the challenge of communicating virtually and applying different teaching methods to put them beyond their comfort limits. The learning process is conducted in a fully electronic environment, which must be organized so that the materials provided are accessible to all learners. The aim of our paper is to propose a multi-layered e-learning framework that integrates methods and tools for managing the learning process in higher education. We based the current study on the experience gained during the pandemic in the training of Latvian and Bulgarian students. As part of our study, we conducted a survey among computer science students to examine the challenges they faced during the lockdown. To process the results, we applied the methods of statistical analysis and machine learning, particularly text mining. The total number of participants is 93, of which 48% are Latvians and the rest - Bulgarians. During the pandemic, the two groups of students used different types of conferencing software - Google Meat and MS Teams, and the same e-learning platform - Moodle. Students describe learning during lockdown as successful - with the most common grades 4 and 5. Universities have generally met their expectations. Based on our research, we offer the multi-layered higher education e-learning framework, which consists of 3 layers - human resource management, technological and policy layers.

Keywords: e-learning framework, education strategy, digital transformation, text mining

Introduction

We will all remember pandemic period started in 2020 with the challenges we faced – from healthcare through education to technological progress. Humanity faces major cross-border challenges that require cooperation between governments, academic organizations, businesses and professionals. (United Nations, 2020) highlights issues that exceed the national borders and should be taken into account globally. The most important goals that they bring to the foreground are related to safeguarding peace, protecting human rights, establishing the framework for international justice and promoting economic and social progress, climate change, refugees and AIDS. Not only that but monitoring progress toward achievement of the Sustainable Development Goals and equitable and progressive opportunities and solutions such as access to education,

health, employment and gender equality. In 2020, United Nations Foundation addresses critical challenges which are targeted to delivering climate actions, meeting the Sustainable Development Goals, providing accessible and equal education, bettering health and living standards, improving connecting development work with peacekeeping and security, with an emphasis on preventing conflicts (United Nations Foundation, 2020). The global achievement should be related to sustainable and equitable future.

Education is still one of the most vulnerable areas. The European Commission works with EU countries common education challenges. Some of them are related to higher education attainment, standards of teaching and teacher education, recognition of skills and qualifications, development of skills and learning mobility (European Commission, 2020a). These issues have gathered head during coronavirus crisis in 2020 when the educational institutions accelerated many times over the digital transformation of the learning process. Many organizations face the problem of increasing their motivation and frustrating their turnover (Koleva, 2018). "The workforce is imposed with more and more requirements, because its quality is a key factor in increasing the competitiveness of companies" (Antonova and Ivanova, 2018). It is therefore necessary to study the views of both employers and current and potential employees (Sulova and Bankov, 2019) in order to link the requirements of a specific business with the educational services provided by universities.

According to UNICEF data "188 countries have imposed countrywide school closures, affecting more than 1.6 billion children and youth" (UNICEF, 2020). Teachers had to quickly come up with the best options for which technologies were most accessible and suitable for learners, how to teach through technology, how to monitor students' progress and assess adequately. As some authors point out, consumer orientation puts the customer in the focus of organizations and includes identifying and understanding customer needs and meeting them (Stanimirov and Zhechev, 2013). This also applies to the field of education - learners are placed at the center of the educational process and the universities are looking for the best options for providing quality educational services. Some researchers suggest framework for mobile learning development in higher education which goal is to improve the quality of education (Todoranova and Penchev, 2020) through the usage of information and communication technologies, including security protocols and certificates which will better the transmission of data (Petrov et al., 2020). (Dankova and Petrov, 2016) explore the adaptation of students in a multicultural environment, paying attention to their mobility and intercultural awareness, personal development, creativity and active citizenship. This study examines the many factors that put pressure on young people in today's rapidly changing environment. (Veleva et al., 2019) point out that the turbulent economic development increased the workforce mobility dynamics that caused labor market changes which could be considered in educational context – how to achieve the qualitive educational services that meet the new world requirements. Unfortunately, students from low-income countries are the most affected by the new way of accessing educational services due to the lack of access to the Internet and usage of digital devices in the learning process.

In this connection, **the aim of our paper** is to propose a multi-layered e-learning framework that integrates methods and tools for managing the learning process in higher education. We based the current study on the experience gained during the pandemic in the training of Latvian and Bulgarian students. As part of our study, we conducted a survey among computer science students to examine the challenges they faced during the

lockdown. To process the results, we applied the methods of statistical analysis and machine learning, particularly text mining techniques.

1. Higher Education Frameworks

Since 1999, Latvia and Bulgaria have been included in the European Higher Education Area (EHEA) and they are full members of the Bologna Process (WEB, a). As members of the EHEA, the countries are obliged to conduct higher education in three levels – bachelor, master and doctor; to recognize periods of study in foreign universities and to apply a quality system of education (European Commission, 2020b). It is the provision of such coherence of higher education throughout Europe that offers many opportunities for students and academics in the Member States, including mobility, a uniform qualifications framework, access to education, and international research cooperation. As a result of the Bologna Process, each of the countries has carried out significant reforms in higher education so as to meet the shared academic principles, to provide opportunities for mobility, to ensure sustainability and modern education in the latest scientific fields. The framework to be followed by EHEA member countries provides formal guidelines for the development of higher education and priorities for action. In this connection, higher education institutions are interested in implementing human resources management as a strategic part of their operations (Abu Teir and Zhang, 2016) because they are responsible for economic, social and cultural growth by presumption. That is why they have to pay attention to increase the quality of educational services through raising the qualification of the academic staff, introduction of modern teaching methods and digitalization of the learning process.

As part of the European Union Latvia and Bulgaria have to follow the formal frameworks, including the higher education area. One of these frameworks is the strategic framework for European cooperation in education and training (ET 2020) targeted to exchanging best practices in education policy, gathering and disseminating knowledge, and advancing educational policy which initiating reforms at the national and regional levels (European Commission, 2020c). It follows EU objectives, including: lifelong learning and mobility a reality; quality and efficiency of education and training; equity, social cohesion, and active citizenship; creativity and innovation at all levels of education and training. The 2020 pandemic disrupted the normal lives of people around the world, including academia. These EU goals have been transformed into new virtual ones. Thanks to the digital tools used in education, social ties between teachers and students have not been completely severed, although the standard rhythm of life has been disrupted.

In this connection, Europe 2020 takes into account new, rethought priorities, which are (European Commission, 2020d):

- Smart growth for developing a knowledge and innovation-based economy;
- Sustainable growth for promoting a more resource efficient, greener and more competitive economy;
- Inclusive growth for fostering a high-employment economy delivering social and territorial cohesion.

The above-mentioned priorities are observed by national, European and international programs and frameworks. In support of them, the European Commission identifies some areas for development, some of which concern e-learning and from this point of view they are of interest for the present study. In particular, these are Digital Agenda for

Europe, Digital Education Action Plan 2021-2027, European Skills Agenda for sustainable competitiveness, social fairness and resilience and European Education Area by 2025.

The Digital Agenda for Europe, as part of the European Commission's strategy, provides citizens and businesses with better access to digital goods and services across Europe, including the protection of their personal data and rights (European Commission, 2020e). This is achieved through:

- lower prices of telecommunications services in the European Union from 2017;

- better internet connection and coverage of mobile and satellite operators. There is already talk of the 470-790 MHz frequency band in the Union and the opening-up of broadband for 5G mobile internet. According to official data, the governments of both Latvia and Bulgaria have approved the distribution of the national 5G roadmap (European Commission, 2020f; European Commission, 2020g). Both countries have officially announced that they are working on a National Broadband Infrastructure Plan for Next Generation Access, which provides high-speed Internet access to citizens and business. However, a problem is reported in small settlements, rural and mountainous areas (mainly Bulgaria), where the coverage of mobile operators and Internet providers is below the national average. Of course, large cities are secured in this regard and there are no problems with Internet access, mobile network use, including the choice of providers. Both countries identify these problems as a weakness and outline development perspectives through their national frameworks. From the point of view of e-learning, poor technical support and internet connection are significant obstacles for students and their teachers. Many students, with whom the author's team works, share our opinion.

- better protection of consumers' personal data through Directive 2009/136/EC, Directive 95/46/EC, Directive (EU) 2016/680 and Directive 2009/136/EC;

- imposition of new rules on the portability of digital services from 2018.

Precisely due to the rapid digitalization, it has been necessary in recent years to work on a new Digital Education Action Plan, which has already been announced for the period 2021-2027 and it is based on studies from the crisis pandemic period. According to (European Commission, 2020h), people are aware of the need to improve their digital competencies, have digital devices to meet the requirements of video conferencing software and specialized software with which students work. This problem occurs mainly among students in higher education institutions, especially those studying in the field of information and communication technologies. In our opinion, this is one of the formal frameworks that universities must comply with. On the one hand, it is necessary to develop the digital skills of the academic staff so that teachers can meet the rapidly growing demands on them. On the other hand, students must be technically equipped to carry out their classes without problems. Liepaja University and University of Economics - Varna have a strong connection with business is maintained, which enables students to apply for internship and scholarship programs. In this way, they can receive additional funding to support their training.

In addition, another formal framework supports skills development and the sustainable development of the education sector. This is the European Skills Agenda for sustainable competitiveness, social fairness and resilience. It is made up of several actions that have a specific purpose. Some of theme include: Pact for Skills; Strengthening skills intelligence; EU support for strategic national upskilling action; Proposal for a Council Recommendation on Vocational Education and Training for sustainable competitiveness, social fairness and resilience; Rolling out the European

Universities initiative and upskilling scientists; Skills to support the twin transitions; Increasing STEM graduates and fostering entrepreneurial and transversal skills and Skills for Life (European Commission, 2020i). All of them are realized through developing tools that empower people to build skills throughout life.

Last but not least, higher education is supported by the European Education Area 2025 framework. It sets out perspectives for the development of higher education by summarizing the experience gained during the 2020 pandemic. (European Commission, 2020j) proposes that the European Education Area be developed in six areas: Quality; Inclusion and gender equality; Green and digital transitions; Teachers and trainers should be supported to develop their professional skills; Supporting the development of higher education institutions and defining geopolitical priorities. All of these areas for education area transformation will become a reality by 2025. The development of higher education is key to achieving Green and Digital transitions. On the other hand, we believe that the framework takes into account the importance of teachers and scientists in training quality, well-trained staff to develop the economy of the country, as well as in the creation of products and services that support people.

Based on the presented formal documents, we can summarize that the pandemic situation is forcing the processes of digital transformation in a number of areas, including higher education. In 2020, the European Commission has updated a number of frameworks, initiatives, directives and other frameworks to respond to the "new reality". We notice that priority is given to Digital Europe, the development of soft skills of learners, supporting the professional development of the academic and teaching staff of the universities, faster, high-quality and cost-effective access to the Internet, better coverage of mobile networks operators, even in the most remote settlements. Therefore, we believe that in order to offer an applicable e-learning framework, we need to take into account not only the formal guidelines for the development of education, but the other researchers' experiences and the personal experience gained, especially in the context of lockdown.

2. E-learning Frameworks

E-learning is not a new concept for Latvia and Bulgaria, which emerged during the pandemic period. Both countries have more than two decades of experience in this area. Of course, the first forms of this type of training are far different and even primitive, from the present point of view. For example, all forms of e-resources are used, such as "Internet, intranet, extranet, CD-ROM, video tape, TV, cell phones, personal organizers" (Birzina, 2012). From a modern point of view, especially as a consequence of the forced digital transformation during the pandemic period, the learning process is far more technically ensured. Much more often, a "learning on the move" approach is applied, which allows students to access their study materials from anywhere in the world and at any time of the day, to send their current course projects and assignments, to share feedback with teachers.

E-learning approaches have evolved over the years, including according to learners' needs. For example, a study by the Organization for Economic Co-operation and Development (OECD) offers a framework to guide an educational response to the COVID-19 Pandemic. It is based on an analysis of the results of a survey conducted among 330 respondents from 98 countries. The survey identifies 23 key points that assist governments in identifying best practices that can be integrated into e-learning. They are

related to: determining the personal needs of teachers and students (as support in acquiring skills to work with new technologies, access to resources by people with disabilities), technical support of the learning process (web resources, academic broadcast, printing devices, distance learning platforms, etc.), social and career services for students, means of communication between university, business and students (Reimers and Schleicher, 2020).

Vija Vagale and her team (2020a, 2020b) developed personalized adaptive e-learning system which is suitable for "sensitive" learner category (Vagale et al., 2020a; Vagale et al., 2020b). The authors study the learner model, which is used in the context of lifelong education. The system integrates 3 models - Learner, Adaptation and Content. "The learner model contains data about the learner in the system. The content model includes the content offered by the system and its logical structure. The adaptation model describes conditions and rules used in the adaptation" (Vagale et al., 2020a). In our opinion, this system can find practical application as an e-learning framework, as it is based on knowledge from various fields, including pedagogy, information technology and psychology. As a result, three types of data are generated, which are taken into account in the analysis of the learning objectives of the courses supported by the system. These are: basic, additional, and learning process data They can be used to track Key Performance Indicators of courses and training in a program as a whole.

On the other side, Güllü and team worked on found and analysed strong and weak sides of e-learning and main barriers that hinder adoption of e-learning systems in Estonian and Turkish largest universities (Güllü et al., 2016). As a result, they proposed an "integrated theoretical framework of adoption of e-learning by university lecturers based mainly on the extended technology acceptance model" (Güllü et al., 2016). The authors examine the opinion of professors at major universities in Estonia and Turkey regarding 10 factors that influence the adoption of e-learning. Among them are: ease of use, usefulness, pedagogical level, accessibility, policies, etc. Unlike Vija and team, Güllü et al. offer not a practical but a theoretical framework based on an in-depth analysis of these 10 factors. Policy adaptation, security, financial support mechanisms and productive cooperation between institutions are important for the adoption (Güllü et al., 2016).

(Avotniece et al., 2021) conducted research among adults on the development of their digital, technological and language skills, including the use of e-learning tools. They come to the conclusion that the development of technological skills is hampered by the insufficient availability of digital learning tools, and therefore digital the acquisition of basic skills requires:

- the development of a modern and interactive learning process;
- the availability of online training courses and open access to digital content;
- the development of teaching materials in the state language.

In Latvia, progress towards the integration of digital and technological skills throughout the adult in the educational process is marked together with the project "National Coordinators of European implementation of the program in adult education" (Original title is: "Nacionālie koordinatori Eiropas programmas īstenošanai pieaugušo izglītībā"). It has developed modular lifelong learning competences, including digital literacy. With this study, the authors prove that digital technologies in the work environment is increasing demand for highly skilled and qualified staff. At national level, participation in appropriate educational programs available at different levels of education helps in both formal and non-formal education. This paper proves once again

what we have stated above, namely that pursuing national and international policies would only improve e-learning in (higher) education.

Other author teams offer in their papers' conceptual learner-centered e-learning frameworks that have the potential to be used not only in tertiary education, but also in the education of adults who have already completed one of the educational levels (Glancy and Isenberg, 2013; Ali et al., 2018). Similar to the research cited above, these papers study not only the technological part of e-learning, but also the pedagogical and psychological side. The barriers that arise to e-learning are highlighted, which according to Ali et al. (2018) is 68. These include: lack of online engagement and feedback, insufficient computers, hard access to digital content, lack of ICT skills, etc.

Other research also offers e-learning frameworks, which are again based on research in three main fields: pedagogy, psychology and information technology. For example, (Ramakrisnan et al., 2012) propose a framework in which learning is an interactive process that receives teaching methods as input and as an output generates learning outcomes (skills, cognitive, affective). It is limited by the individual characteristics of the students and the support, including technical, of e-learning. The authors emphasize the importance of student control mechanisms in e-learning included in university policies too. Salmon (2005) proposes e-learning and pedagogical innovation strategic framework divided into four quadrants. It can be compared with the form of SWOT analysis, but adapted to the specifics of e-learning in higher education. It explores existing e-learning policies and resources inside and outside the institution (nationally and internationally). In a separate quadrant, new technologies are offered to be applied in e-learning and their potential adaptation to the needs of the environment, including the labour market.

The study of Kazaine and Arhipova (2018) should be taken into account in the considered frameworks, which emphasize the need for control and quality assurance of e-learning materials. The authors propose a formal procedure for the acceptance of e-learning materials, which involves the author of the material, a methodological committee and an evaluator. In our opinion, defining such a procedure in the internal policies of universities would only contribute to improving the quality of e-learning and student satisfaction. Students will use not only comprehensible but also accessible digital materials.

The cited papers outline several main tasks for our study:
- survey of students' opinions on the tools they used in e-learning during lockdown;
- methods of feedback between teachers and students;
- the consequences of working online;
- outlining a conceptual framework for e-learning that reflects our discoveries and the experience of other scientists.

3. Higher Education During Pandemic

In connection with the highlighted tasks at the end of the previous section, we should identify the main problems encountered when working online during the lockdown. Every crisis situation tests the resilience of the education system. Universities have moved into an "emergency remote teaching" mode (Hodges et al., 2020), which has undoubtedly put academic staff and students in a position of inability to switch to the new requirements as fast as it is possible. The main burden falls on university e-learning centers, which have to make quick decisions to move to an emergency mode. For

example, they need to ensure the learning process so that university e-learning systems can handle the huge number of simultaneous requests to use e-resources and conduct remote tests to minimize learner fraud attempts. That advances flexibility, innovation, and competitive advantage.

The urgent provision of technical resources and raising the qualification of the academic staff is associated with investing a serious financial resource, which in most cases is beyond the capabilities of educational institutions. As it is well known, funding for education in low-income countries is too limited, and this results in problems related to hiring and retaining well-qualified academic staff, providing a modern learning environment and opportunities for creative and timely problem solving.

One of the main lessons that educational institutions have learned in the conditions of lockdown is the need to accelerate the processes of digitalization and investment in staff development. That is why HR planning must be part of the strategic planning of higher education (Sarip and Royo, 2014).

Increasing students' satisfaction with educational practices increases their interest in the opportunities offered by the university. In turn, this influence over their motivation to develop in the areas of development. Ambitious and talented students must be motivated by the academic staff so that they feel valuable to the university and see prospects for development in education and science. But as it is written in (UNESCO IESALC, 2020), the main technical difficulties faced by students in higher education during the pandemic are related mainly with ICT hardware internet connectivity, communication with peers and teachers, keeping a regular schedule. "The situation is particularly worrying for those higher education students who are more vulnerable on account of their more fragile condition" (UNESCO IESALC, 2020). In particular, the coronavirus crisis has put on the agenda the problems of low-income students who have encountered difficulties in their seamless access to electronic resources and systems at universities. The results were a decrease in motivation, and hence an inability to cope with the assigned tasks and exams due to poor technical support.

In the conditions of lockdown, all of us - both lecturers and students, appreciated the need to use software tools to ensure trouble-free classes. As it is shown on State of Remote Work report by (Buffer and AngelList, 2020) among 3500 remote workers from around the world, the biggest benefits to working remotely are:
- Ability to have a flexible schedule – 32%;
- Flexibility to work from anywhere – 26%;
- Not having to commute – 21%;
- Ability to spend time with family – 11%;
- Ability to work from home – 7%.

Along with the advantages, the participants in the study also noted some disadvantages of the remote work, namely:
- Collaboration and communication problems – 20%;
- Loneliness – 20%;
- Not being able to unplug – 18%;
- Distractions at home – 12%;
- Being in different time zone than teammates – 10%;
- Staying motivated – 7%;
- Taking vacation time – 5%;
- Finding reliable wi-fi – 3%.

In our opinion, these data are valid not only for business, but also for education. Therefore, it is necessary to choose such software tools to ensure the reduction of the negative consequences of remote work. To observe the purpose of this paper, we made research among university students in Latvia and Bulgaria about the usage of e-learning software during the lockdown. We are interested in the remote management of the learning process in times of crisis.

4. Method

4.1. Material

In connection with the highlighted tasks at the end of the second section, we should describe in detail the research method we applied. Our study investigated students' views on the e-learning tools used in Latvia and Bulgaria during the lockdown in summer semester of 2019/2020 academic year. In order to keep the survey as simple as possible, we surveyed only academic representatives.

4.2. Design

The study used partially within-subject design, with the two main factors being the participants' age group, educational qualification degree and the country of residence (Bulgaria or Latvia). The dependent variables were the e-learning ratings provided by the survey participants, as detailed further. It is necessary to make different sections of the obtained results to perform a more detailed analysis (Bakaev et al., 2018).

4.3. Process

We have developed a questionnaire consisting of two parts:
- *Participants Details* - it contains information for users such as age, gender, study program (depends on the university), educational qualification degree (bachelor or master) and year of study (1 – 6).
- *Opinion on E-learning* – this part contains questions related to:
  - ✓ form of e-learning (synchronously or asynchronously);
  - ✓ video conferencing software products;
  - ✓ e-learning system used by lecturers;
  - ✓ form of mid-term control (synchronously or asynchronously);
  - ✓ form theoretical tests (synchronously or asynchronously);
  - ✓ form of the examinations (open question);
  - ✓ evaluation of online learning (we proposed five-point scale);
  - ✓ impressions and recommendations about online learning (open question).

There were two versions of the survey which were represented in native languages of participants. We used email and university channels to distribute the questionnaires among the students.

We processed the two questionnaires independently of each other and then compared the results. We used survey software that supports the automatic generation of graphs of closed questions. We processed the open questions through Orange and MeaningCloud

data mining software. The techniques of sentiment analysis and emotions mining are applied for studying the level of satisfaction with e-learning.

4.4. Participants

The number of Latvian respondents is 45 (19 female) who are students in Liepaja University (LiepU), Faculty of Science and Engineering. Total number of Bulgarian participants is 48 (21 female) who are students in University of Economics – Varna (UEV), Department of Informatics.

Dividing Latvian participants by age, they are between 20 and 30 years old (Mean 22,28, SD 2.765). Bulgarian participants are between19 and 29 years old (Mean 22, SD 2.498).

LiepU bachelor students are 73.4% and masters are 26.6%. UEV bachelor students are 81.3% and masters are 18.8%.

5. Results

Summarizing the results of our study, we can report that the training during the lockdown period was in synchronous form, both in the Bulgarian and Latvian universities. The connection between lecturers and students is realized in real time through video conferencing software. 95.8% of UEV students report that they have used Google Meet, 50% have used Zoom, 29.2% - Skype and 4.2% - Microsoft Teams. 86.6% of LiepU students report they have used Microsoft Teams and 26.6% have used Skype as a second web conferencing software. University of Economics – Varna has an institutional access to G Suite for Education and that is why its online classes are mainly oriented to Google Meet. Liepaja University has an institutional access to Microsoft Teams which is the main motive for popularity of this software among online classes.

Both universities use Moodle e-learning platform for publishing e-material to students and for conducting online classes, tests and sending assignments. 100% of students of both universities report they have used the institutional e-learning platform. Both students and lecturers recognize the benefits of using the e-learning platforms. From the students' point of view, the materials are available 24/7, they have both desktop and mobile access. They can communicate in a timely manner with their lecturers. From the point of view of lecturers, they can track the activity of students, as access journals are kept, as well as track their progress in mastering the curriculum and the implementation of assigned tasks.

Both universities students report they have conducted online theoretical and practical tests (mid-term control) and examinations. LiepU students have used Moodle platform, but UEV students have used both Moodle platform (39.6%) and the specialized test system of the university (60.4%). The mid-term control, including theoretical tests and practical assignments, have realized both synchronously or asynchronously. Each of the lecturers had different approach to track the activities of the students. For example, sharing the screens and cameras, real-time tracking the students' activities in e-learning platform, giving a password protected access to the assignment material, etc. The UEV and LiepU exams were conducted synchronously - the students shared their screens to show the teachers their desktops and at the same time they shared their cameras to prevent cheating attempts.

The overall evaluation of the e-learning process during the lockdown is as follows:

- UEV students: 5 (29.2%); 4 (41.7%); 3 (14.6%); 2 (10.4%); 1 (4.1%).
- LiepU students: 5 (26.7%); 4 (26.7%); 3 (33.3%); 2 (8.9); 1 (4.4%).

The students' assessments show that they are completely satisfied with the training conducted at both universities. In addition, they have some recommendations that we think should be taken into account when developing e-learning. Basically, they are related to orienting the teachers to only one web conferencing software and recording video of the classes and publishing in the e-learning platform, so that they can later return to the topic.

The sentiment analysis of the open questions (Table 1) is made by applying MeaningCloud - an Excel plugin. We used its built-in basic model based on WordNet. The analysis confirms that the attitudes of students from both countries towards online learning are predominantly positive. In 5% of the answers no emotional attitudes were identified, and in 12% - they were neither positive nor negative, i.e., the opinions are impartial.

Table 1. Results of sentiment analysis of open questions

Polarity	All	Latvians	Bulgarians	Percentage
P+	14	4	10	15%
P	42	24	18	45%
NEU	11	9	2	12%
N	18	5	13	19%
N+	3	1	2	3%
NONE	5	2	3	5%

We processed the open questions' answers via Orange too. An analysis of emotional attitudes was performed by using the Tweet Profiler module (Fig. 1), which supports several methods of content classification. These are classes based on the classifications of Plutchik, Ekman and Profile of Mood States (POMS). Each of them identifies a different number of basic emotions.

Fig. 1. Configuration of emotion analysis in Orange

According to Plutchik (1980) these are: anticipation, acceptance, joy, surprise, anger, disgust, fear, sadness. Ekman (1982) distinguishes joy, surprise, anger, disgust, fear, sadness. POMS classifies the emotions of tension, anger, vigor, fatigue, depression, confusion (Renger, 1993). The common emotion for the three classifications is anger, which is considered a primary negative emotion, thanks to which individuals defend and survive, both physically and verbally.

The results generated by Orange after applying the Plutchik classifier are shown in Fig. 2. It is noticed that the positive emotions joy and trust are the highest percentage - 83.87% of all answers.
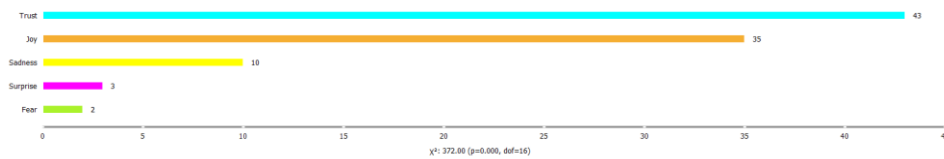
Fig. 2. Results of the emotions analysis in Orange according to the classifier of Plutchik

The results according to the Ekman classifier (Fig. 3) are similar to the previous one - again, positive emotions prevail. Orange identifies emotion joy in 64.52% of all answers.
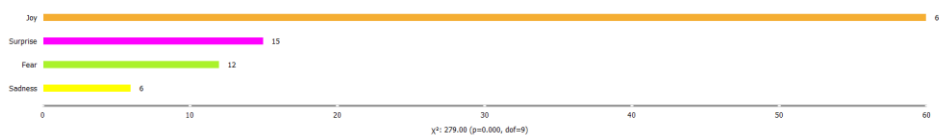

Fig. 3. Results of the emotions analysis in Orange according to the classifier of Ekman

In Fig. 4 it is noticed that the diagram changes when applying POMS. The reason is that this classification is oriented entirely to negative emotions.
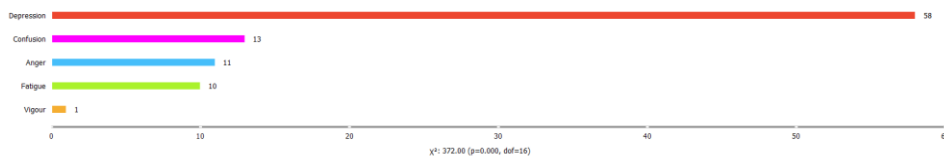

Fig. 4. Results of the emotions analysis in Orange according to the classifier of POMS

The differences in the results of the application of the different classifiers also arise from the pre-defined set of words that is applied for sentiment analysis of Orange. Emotional analysis confirms the grades given by students. As mentioned above, grades 4 and 5 of e-learning prevail at both universities. This is an indicator of the successful lockdown education in both universities.

In support of the results of our study, we can share worldwide statistics. The outbreak of COVID-19 has led to revised growth expectations for enterprise software spending in 2020 (WEB, b). Companies spend more money on remote work software: web conferencing software (67%), collaboration tools (57%), remote desktop tools (52%), security software (41%), learning management software (23%), time tracking tools (14%). According to (WEB, c) most used collaboration tools used for remote work are Zoom (36%), Microsoft Teams (19%), Skype (17%), Google Hangouts (9%) and Slack (7%). Other statistics show that Zoom is the leader among web conferencing software followed by Cisco Webex Meetings, Google Meet, BlueJeans, GoToMeeting, Skype, Adobe Connect (WEB, d).

On the basis of above-mentioned statistics, we could identify some web conferencing tools that are most used worldwide: Zoom, Microsoft Teams, Skype and Google Meet. Table 2 summarizes the main characteristics of this type of software.

Table 2. Web Conferencing Software Comparison

Criteria	Zoom	Microsoft Teams	Skype	Google Meet
Platform	Windows, macOS, Linux	Windows, macOS, Linux	Windows, macOS, Linux	Web
Capacity (in hosted participants)	100 - 1000	250-10000	50-1000	100-250
Video quality	HD	VGA, HQ, HD	VGA, HQ, HD	HD
Desktop sharing	yes	yes	yes	yes
File sharing	yes	yes	yes	yes
Collaboration tools	Whiteboard	Whiteboard, MS Office, PowerBI, third-party apps integration	no	Integration with Google Jam Whiteboard
Chat	yes	yes	yes	yes
Mobile app	yes	yes	yes	yes
Encrypted communication	yes	yes	yes	yes
Meetings recording	yes	yes	yes	yes
Meeting's scheduling	yes	yes	yes	yes, using Google Calendar
Contact list	yes	yes	yes	no

Source: Own Elaboration

According to the data shown in Table 2, Google meet is the most basic web conferencing software because it supports the smallest number of hosted participants. Skype is more for remote meetings not for collaboration because it is not integrated with other real-time tools like whiteboards for example. The most complex software among the included in Table 1 is Microsoft Teams. It provides opportunities to create a shared workspace, including creating teams and channels for individual activities, scheduling meetings, sharing documents, and integrating with multiple applications from Microsoft or other companies.

6. Discussion

As a result of our research, our main findings are the following:

- establishing a synchronous connection with the students through the conference software of the university - the choice of specific software depends on the preferences of the institution and the licensing agreements with the software companies. As it became clear, the above-mentioned software is the subject of preferences not only in UEV and LiepU but also worldwide, from which we can conclude that it provides the necessary functionality for organizing online classes;
- preparation of electronic lectures and exercises that follow a certain structure - purpose, subtopics, tasks, cases, questions and tasks for self-examination, additional literature;
- mid-term control through the e-learning environment - to prevent incorrect behavior, the synchronous implementation of control forms is preferred;
- synchronous session exams through the e-learning environment – Moodle or specialized test system.

We used them to outline an e-learning framework. In order to develop practically applicable framework, we believe that national, European and international requirements for higher education must be taken into account in the first place. These are: laws on higher education, strategies for digitalization of education, European policies, frameworks, directives, agendas, etc. On the other hand, the e-learning framework should offer guidelines for the formation of soft and hard skills of learners, both by applying appropriate teaching methods for the e-environment and by using technical tools (software and hardware).

Similar to (Udupi, Malali and Noronha, 2016), to present the model we have developed, we use the layered organization of the individual components to show more clearly the relationships between them. We propose that the e-learning framework consist of the following three interconnected layers: Human Resource Management Layer, Technological Support Layer and Policy Layer (Fig. 5).
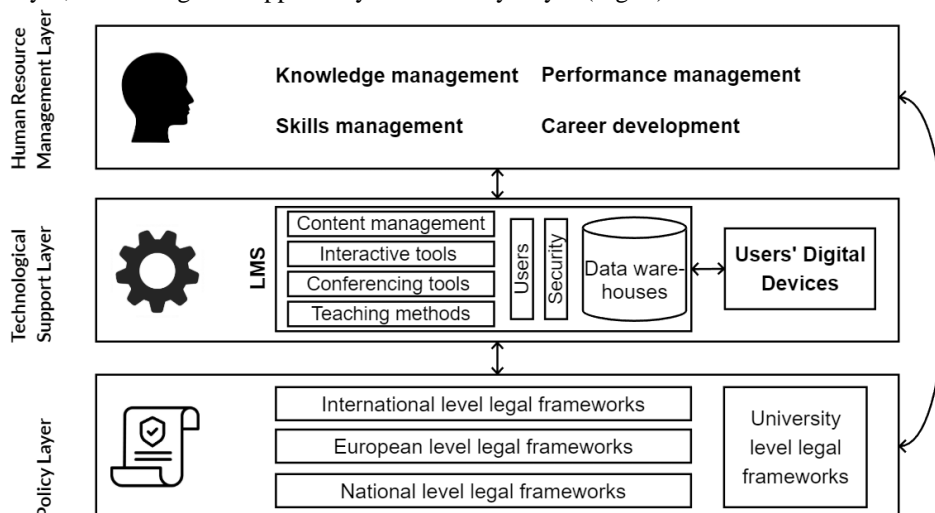

Fig. 5. Proposed E-Learning Framework
Source: Own Elaboration

The **Human Resource Management Layer** is based on basic postulates in people management related to the management of knowledge, skills, productivity and career development. Here it is important to mention that human knowledge is of key importance for the successful development of e-learning.

Technological Support Layer encapsulates the software and hardware tools used by stakeholders to access training resources. On the one hand, it is a learning management system (LMS) with its associated data warehouses, learning content, visual and interactive tools of communication with users, video conferencing and security modules. Each such system integrates a set of teaching methods, which are manifested through the supported LMS modules and plugins. On the other hand, it is the combination of all the hardware devices that users use to access the system, as well as the server equipment used to host it.

Policy Layer is about integrating all legal frameworks at national, European and university level, which restrict stakeholders in using the system, but also protect their personal data. Strict observance of the legal framework gives assurance to all parties that their rights and freedoms are protected, the guidelines for digitalization are followed both at national and European level. Opportunities for career development of students, academic and teaching staff are also provided. Examples are: Sustainable Development Goals, Digital Agenda for Europe, Digital Education Action Plan, European Skills Agenda for sustainable competitiveness, social fairness and resilience, European Education Area, General Data Protection Regulation (GDPR) and National and universities level higher education strategies and laws.

We believe that results of our research will be useful for improving e-learning in higher education, as well as to shape it in formal way.

Conclusion

Based on our research, we can conclude that e-learning has been successful in both universities. Students appreciate the opportunities provided by their teachers to master the material in the disciplines, namely the publication of full-text lectures and exercises, additional literature, video lectures and synchronous communication. But on the other hand, they also take into account the negative consequences of this type of training. For example, too many hours in front of the computer, lack of real connection with teachers and other students, problems with internet access, power outages in emergency situations, poor technical support (some of them do not have the appropriate hardware).

We must also mention the limitations of this study, in particular of the chosen design and collected data. There is insufficient number of the participants. They are not enough to make a comprehensive statistical analysis of e-learning in the world, but only of the good practices that follow the two universities. The results of the survey cannot be used to make general statistical conclusions, but only to help determine a e-learning framework.

Whatever tools are chosen, it is necessary to take into account that online learning cannot replace the traditional educational form, but in the conditions of lockdown it is an irreplaceable solution.

Based on the research presented in this paper, the author's team offers a multi-layered framework for e-learning. It consists of three layers: Human Resource Management Layer, Technological Support Layer and Policy Layer. The specific content of each of

them depends on the specific needs of the university. We offer a high-level model that summarizes the experience gained by both universities in the direction of digitalization of the learning process, our research and our professional experience.

The future work of the authors of this paper is related to the expansion of the e-learning framework, exploring in detail the best methodological practices of teachers. We turn our attention in the future to the pedagogical and psychological aspects of e-learning that will help us to better the motivation of our students.

Acknowledgements

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