UZEP: A CLOUD-BASED DISTANCE EDUCATION PLATFORM FOR HIGHER EDUCATION INSTITUTIONS

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Received: 12/10/2022 **Accepted:** 28/12/2022

ABSTRACT

Covid-19 coronavirus pandemic has affected higher education institutions all over the world, causing face-to-face education to cease. Schools have tried to carry out educational activities through online teaching either by using on premise infrastructure or by leasing cloud based online platforms. Although these platforms are convenient, most of them do not meet all the requirements for higher education institutions. Not knowing where the personal data is stored in a public cloud creates another problem for some countries according to laws. In this study, a new online learning platform has been developed for higher education institutions to solve these problems using state-of-the-art cloud technologies. The new system enables implementation of individual curricula of many higher education institutions in one software system, and it can be taken into service quickly in emergencies. It expands dynamically by activating a large number of streaming servers to meet the demand. The new system provides easy to use-learn interfaces, offers an economical solution for e-learning by sharing the resources, and compliant with the law on protection of personal data. The new platform was in service at 12 universities in Turkiye during the fall 2020, and its performance was measured with surveys at various levels.

Keywords: Distance education, internet based online learning, online assessment, educational technology, Covid-19.

INTRODUCTION

Covid-19 coronavirus pandemic has affected higher education institutions all over the world, causing face-to-face training to cease. In the beginning, some institutions postponed their education programs considering pandemic lasts soon, while others with ready infrastructure switched to online learning immediately. For more than a year, online learning platforms have been the main tool of education at almost all levels. Some online platforms are required to work on university servers due to their architectural structure, some of them are used by leasing on the public cloud. Very few universities have sufficient infrastructure on their premise, most of them had to lease from the market such as Zoom, Google-Classroom or Microsoft Teams. However, most of these online learning platforms are not very well match for higher education institutions since they are designed broader considerations. Although cloud based approaches are more economical solution, protection of personal data becomes an issue at some countries since they store the personal data (student and teacher records) in a public cloud.

After online learning became the only training method, some other problems have come to scene as well that need to be worked out for higher education to be still effective as much as face-to-face training. Some of these can be listed as rapid adaptation of instructors and students to the new teaching environment, how to perform education at courses with practical contents and exam safety etc. It was observed that before the pandemic, most of the teachers had low performance in focusing on innovation, research and dissemination in online learning, and experienced problems such as negative perception, material development and getting used to the system during the pandemic period (Akbulut et al., 2007). At the student level, the increase in negative perceptions of online learning, learning motivation problems, digital competence deficiencies and cheating behaviors have been an important problem (Bozkurt and Sharma, 2020; Lee et al., 2021).

The disadvantage of online learning is not the physical distance, but the communicative and psychological gap that can lead to misunderstanding between student and teacher. In order to eliminate this gap, the student must effectively communicate and interact with the content, instructor, other students and the platform (Moore, 1989). Hence, online platforms should be supported with interactive and collaborative student-centered learning by providing other components such as the learning management system and assessment and evaluation tools (Bonk, 2020). The way to provide communication and interaction here is the use of technology, and the educational institution must be effective in providing the infrastructure and use of this technology.

Computers, mobile systems, data communication networks and software technologies, which are the cornerstones of online learning infrastructure, are developing at a dizzying speed. In particular, developments in video distribution techniques have resulted in Internet television, and the rate of watching live and on-demand video channels such as You Tube and Netflix has increased. There are many commercial and

scientific studies in which developing video distribution techniques that are adapted for online learning systems. Examples of open source and commercial applications can be given as BigBlueButton, Adobe-Connect, Zoom, Kalkuta, Skype, Microsoft-Teams and Google-Meet etc. Higher education institutions should not stay away from these technological studies and achievements; however, it may be both difficult and wasteful for every university to specialize in these areas.

Purpose of the Study

This study aims to develop and evaluate a learning management system that can meet the distance education needs of educational institutions in emergency situations, which can be easily integrated with the software currently in use and horizontally extended as needed to meet immediate high demands. The prominent features of the new system can be counted as being easy to learn and use, scalable and in compliant with the law on protection of personal data. Within the scope of the study, first a technological model was created and then a prototype system has been implemented. The new system includes a specially designed modules for higher education institutions such as learning management system that supports document sharing and communication, online assessment and evaluation tools. The new system was implemented using *Education as a Service (EaaS)* cloud model, and called as UZEP.

RELATED WORK

Distance education has been in use for years in different ways by using various technologies. It is a form of education in which the teaching takes place in a different environment from the place where it is offered, and in which learning requires special methods of communication through special course design techniques, special teaching methods, electronics and other technologies as well as special organizational and managerial arrangements (Moore and Kearsley, 2011). In order for an education to be distance education, the teacher and the student should be in different places during the learning process. In this case, it is necessary to use technological media such as printed material, sound, video, Internet and computer to provide two-way interaction in order to bring the teacher and the student together. The educational institutions play important roles in the planning of distance education, the preparation of learning materials and the provision of student support services (Keegan, 1996).

Models used in distance education can be synchronous or asynchronous, passive or interactive depending on the purpose and the tools used. For example, in a simultaneous interactive model, the lectures given by the lecturer can be followed by the students in different environments at the same time, and the students can ask questions and get answers to the lecturer within the given time. Here, students can be completely dispersed or in groups. However, in the asynchronous interactive model, students can access the audio and visual course material prepared by the instructor via the Internet at any time and send their questions to the instructor via e-mail. If the model used is synchronous-interactive, the required infrastructure is more expensive than the asynchronous-passive model, for example. Additional consultancy and written documentation are required in order not to compromise the quality of the training in all models. Both synchronous and asynchronous models can only operate with a sufficient Internet infrastructure, but the synchronous model requires uninterrupted and wider bandwidth. Although these components such as LMS and teaching modules exists in both models, they differ in their functions that they perform. For example, on platforms where courses are operated synchronously, virtual classrooms should be organized priori and the training activities should be conducted on time according to weekly programs.

Depending on the needs, a synchronous or asynchronous training model is preferred for teaching. For example, asynchronous learning may be a more suitable model for reaching learning resources at any time or continue learning at individual learning pace. However, when face-to-face training stopped due to the Covid-19 pandemic, synchronous education has become the widely preferred model at educational institutions such as K-12 and universities. In fact, Internet based platforms that implement synchronous model usually provide asynchronous access to recorded course video later. However, the opposite is not true.

The modules in which training activities are carried out on the platform structure also shows significant differences depending on synchronous or asynchronous. Synchronous platforms deliver the training activity

to participants in digital form instantly. Asynchronous platforms, on the other hand, provide uploading, downloading or watching tools for training videos on the system. Such platforms have been put forward to bring together those who teach on a particular subject and those who want to take a course. These type of systems are sometime used for training large masses which is called in this case, massive open online course (MOOC).

Moodle is the most widely used, user-friendly, easy-to-use and open LMS in the world (Escobar-Rodriguez and Monge-Lozano, 2012). Moodle also comes with a distance education platform that has over 80 million users from 222 countries (De Medio et al., 2020). Moodle has a flexible architecture that can be expanded with plug-in modules. Instructors can perform all educational activities using Moodle that are supposed to be done with distance education (S´anchez and Hueros, 2010). In addition to online virtual lessons, Moodle platform offers learning material distribution and links, chat and discussion environments. Apart from that, feedback, tasks, workshops, quizzes, online tests and self-peer assessment questionnaires can be used in the system to evaluate the learning processes of students (Piotrowski, 2010). In expert evaluations, it is found that students preferred Moodle compared to Moocs (Pireva et al., 2015). However, it has seen that its establishment, operation and use may be a problem in terms of speed and practicality in the context of the pandemic period.

Apart from Moodle, there are some other platforms that support online learning: Canvas, ATutor, Claroline, Dokeos, Ilias, Sakai, ABC, Webct, Blackboard, dotLRN etc. It is seen that Moodle comes to the fore in the literature reviews (Acosta and Luj´an-Mora, 2016; Cavus and Zabadi, 2014; Martin et al., 2008; Subramanian et al., 2014; Totschnig et al., 2013).

MOOC platforms are generally used to provide free, global and online access to lectures prepared by faculty members of distinguished universities (Lambert, 2020; Zawacki-Richter and Naidu, 2016). These platforms provide support for students of all ages, income levels, languages, colors and from everywhere (Stich and Reeves, 2017). Examples of existing MOOC environments include Udemy, Udacity, Coursera, and edX. Universities become members of such platforms and operate predominantly on a non-profit basis (Littenberg-Tobias and Reich, 2020). Access to the course content offered on these platforms is generally free, but if you want to get a certificate or a diploma at the end of the training, it becomes paid. In this section, several MOOC systems developed for different purposes are examined.

Coursera

Coursera is an Internet-based distance education platform created by Stanford University faculty members in 2012. It is the largest and most used MOOC platform worldwide with over 37 million users (Espada et al., 2014). Coursera has a learning management platform that is based on asynchronous content delivery and includes interactions. The content on the platform is video and text-based, and learning is supported by discussion platforms.

In partnership with universities and companies, Coursera offers a wide range of online courses from computer science to personal development. More than 150 partner institutions, including select universities such as Yale, Stanford and Princeton, offer high quality courses through the platform. There are free and paid courses on the platform (Espada et al., 2014). The platform also supports assessment and evaluation activities. There are process evaluation activities for assessment activities such as homework or projects as well as questions that can be evaluated by the system such as multiple choice, right-wrong, and short answer questions.

edX

edX was established in 2012 by MIT and Harvard as a major non-profit and asynchronous content delivery platform. More than 100 renowned universities offer free and paid courses to approximately 14 million students on the platform (Espada et al., 2014). edX is a learning management system that will increase and facilitate content delivery and interactions with distance education.

Universities become members of the edX system and faculty members of those universities can open courses here. If an institution that is not a member of the edX system wants to use this learning management system,

it can offer its own courses by installing the open source software called open edX on their own servers. Discussion environments are supported with video and text-based content on the platform. In the edX learning management system, there is a studio component that can be used by trainers to develop course content. This component facilitates the work of instructors in educational activities. The platform also supports assessment and evaluation activities. For example, process evaluation activities such as homework or projects can be performed in addition to multiple choice, true, false or short answer questions that can be evaluated by the system (Garcia-Loro et al., 2020). In addition to expert evaluation, peer and self-evaluation activities can also be performed on the platform.

MOOC platforms such as edX and Coursera are learning management systems that will increase and facilitate content delivery and interactions with distance education (Zhu et al., 2018). These platforms, which aim to offer massive open online courses, are hierarchically independent, there is no semantic relationship between courses and are based on asynchronous content delivery. When these platforms are logged into the system, access is provided on a search basis. Searching is based on accessing the lecture with lecture search, such as searching for a book in a traditional digital library. There are generally learning resources in the form of videos, articles, homework and/or presentations in the lessons (Zhuhadar et al., 2015). While the contents in the system are video and text-based, learning is supported by discussion platforms. Measurement and evaluation can also be done on these platforms. For measurement activities, process evaluation activities such as homework and projects can be performed in addition to questions that can be evaluated by the system such as multiple selection, right, wrong, and short answer questions. In addition to expert evaluation, peer and self-evaluation activities can also be performed during evaluation (Formanek et al., 2017).

METHOD

The main goal of this research is to develop a new distance education platform using state of the art hardware and software to meet emergency demand for distance education in higher education during the pandemic period. This proposed new model should include innovations that will be preferred after the pandemic as well. In line with these goals, firstly, a distance education model was determined, and in the second stage, a technological infrastructure was designed and created to support this model.

Developmental research model has been preferred as a method in this study. Developmental research model is one type of the designed based research model described as producing new materials, new products or devices by using existing knowledge from research and/or practical experience (Kuzu et al., 2011; Richey et al., 2003). In this model, systematic efforts are directed towards establishing new processes, systems and services to improve the existing ones. In this context, throughout the study development research method has been used for developing and evaluating educational software.

The proposed platform is built using the Internet-based synchronous distance education model. In this approach, it is aimed to eliminate both financial and managerial problems on universities by sharing the necessary resources such as servers, Internet bandwidth etc. The new platform is designed considering that it should start servicing in a short time regardless of the infrastructure at the universities.

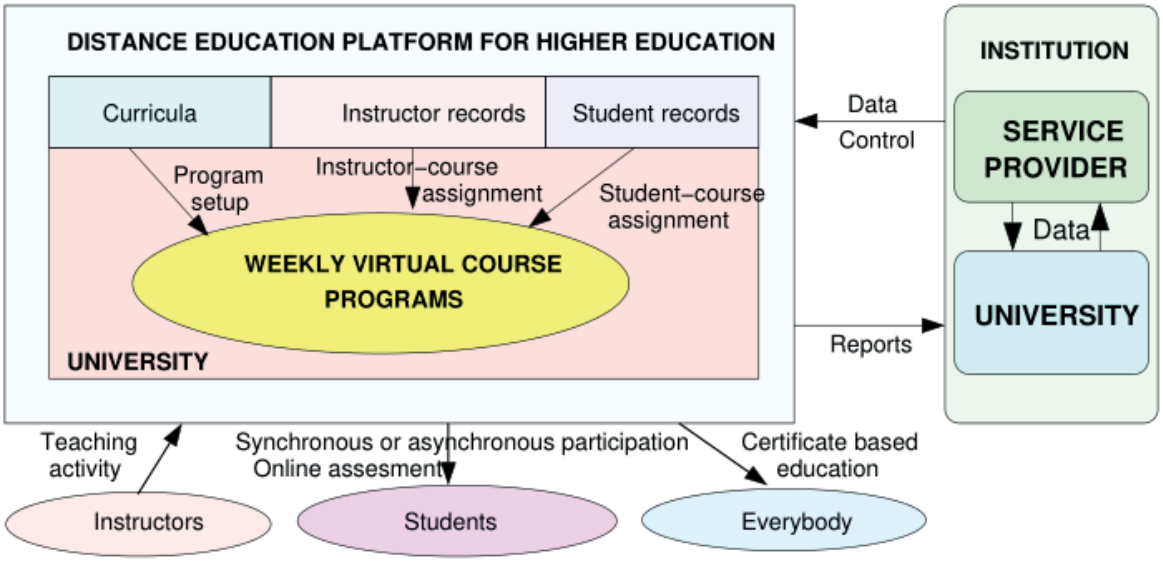

Figure 1. Conceptual block diagram of the distance education platform for higher education

With the goals mentioned above in mind, a new cloud-based distance learning platform has been developed for higher education institutions. The new platform is called UZEP, and the block diagram is shown in Figure 1. With the use of cloud architecture, the server and Internet bandwidth needs of universities for online learning have disappeared. Within the scope of the study, a special cloud structure is created at high performance computing branch of TUBITAK (The Scientific and Technological Research Council of Turkiye).

In this way, a university with many departments, thousands of students and requiring to switch online learning due to emergency, is able to transfer all of its courses and users in a very short time and continue teaching on UZEP.

UZEP designed and implemented in a model of *Education as a Service (EaaS)* in cloud terminology. In this approach, universities do not necessarily own the software or the underlying infrastructure, but use the platform as a service. They have the authority to organize and supervise the parts allocated to them in the system. For example, authorized persons are able to organize online courses, designate lecturers for the courses, and give access to students who have registered for the courses. After the virtual classes are over, they can see the statistical data such as how many people have participated online classes or re-played later. The platform can be accessed via e-government gateway or the login page provided by the universities. Figure 2 shows the components of the developed system.

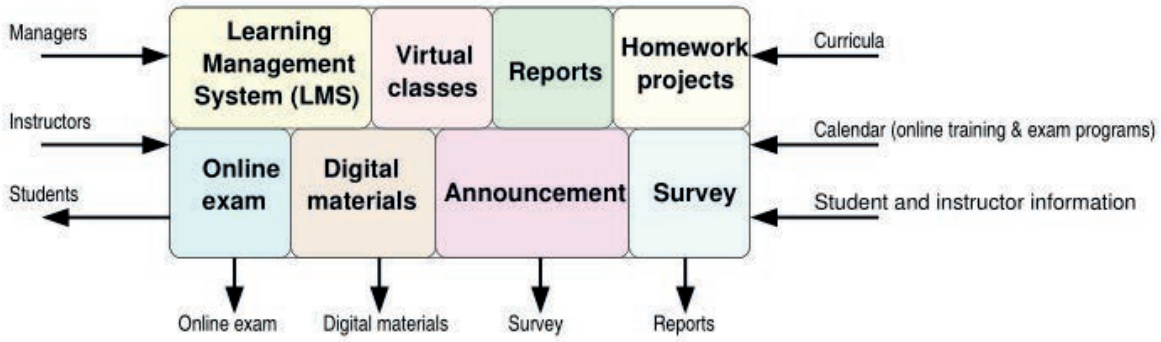

Figure 2. Block diagram showing UZEP input-output relationships and internal modules

Learning Management System (LMS): This module is the core of the system that helps organizing and monitoring training activities conducted on UZEP such as virtual classes, online assessments etc. throughout a semester or pre-defined period of time. Roles at various levels are defined in the system to control the access rights.

In order to organize weekly online classes on the system, the following data are needed: 1) Curricula, 2) instructors who teaches, and 3) student records who take the courses. Most of these data are fetched from the university management systems which are confidential. They must be handled carefully. UZEP is equipped with various interfaces to communicate with existing university management systems. Data exchange between these systems can be done quickly in a sterile way using these interfaces.

Virtual classroom module: An open source software (BigBlueButton) is integrated into the UZEP as virtual classroom module. A perfect harmony has been created between the LMS module and the video streaming server, so the user feels these components as whole. A load balancing software has been developed in front of this module to meet the demands optimally. The video streaming servers are the most CPU, memory and Internet bandwidth consuming component of the system.

Online exam module: Multiple-choice, correct/incorrect or open ended questions can be used in mixed forms through the exam using the online exam module. The module can manage up to 10,000 students for an exam at the same time. Questions can be classified into groups and equivalent question sets can be created. The questions and/or answers can be randomized. The online exam module includes many measures for copying the exam questions, such as blockage of screen copying, showing questions one by one, and it also offers a wide variety of session monitoring and logging options. Exam results can be downloaded collectively by the instructor and analyzed with various tools.

Homework-project module: Homework module has been developed for assessment of research studies or conducting online exams. In the homework module, the start and end dates of the homework to be seen by the student, and the answer upload time can be entered separately. When the exam is over, the documents uploaded to the system are evaluated by the course instructor. As in the exam module, exam results can be examined and evaluated collectively in this homework module, while the students can only see their own individual results.

Digital material sharing module: Instructors can share all kinds of digital materials (such as documents, presentations, video) with their students over UZEP. No quota or limit has been set for the documents to be shared on the system. Only students of the relevant course can view and download shared documents for one semester.

Announcement module: Instructors or administrators can send announcements to students enrolled in the course or to the users in the system. Students can send a message to the instructor of the course in case of emergency. Similarly, instructors can report a problem they encounter to distance education representatives as a message.

Survey module: Course satisfaction surveys can be made in the UZEP. The results of these surveys can be examined by both academic staff and authorized managers. Surveys can contain multiple choice options or can be organized as collecting opinions.

Reporting module: Every module produces desired reports online using available data. For example, completed virtual classes of the lecturers and the student participation reports can be viewed or downloaded through the system at any time. In addition, some managerial reports such as virtual classroom density map and statistics can also be obtained from the system.

Participants

During the study, a presentation was made to get a test-bed from the Higher Education Council of Turkiye. The council advised 12 universities to use UZEP starting from Fall-2020 semester (see Table 1). Testing the system in the real environment and the feedbacks were very important for improvements.

Table 1. Table shows user, online course, instructor, exam and session count for each university in the system between 1 October 2020 and 1 February 2021

No	University	User	Virtual Classrooms		Online Exams	
			Course	Instructor	Exam	Session
1	Agri I.C. University	13163	1840	627	3539	118613
2	Artvin University	11728	2551	386	3098	102593
3	Bayburt University	5845	1225	146	1273	43309
4	Gumushane University	20282	1226	113	852	17472
5	Hakkari University	155	1225	146	135	513
6	Kilis University	10687	2969	316	1811	57129
7	Munzur University	5977	1175	312	4	0
8	Mus Alparslan University	4744	20	44	55	17697
9	Bitlis Eren University	351	211	99	289	640
10	Sakarya University	3086	26	54	16	108
11	Igdir University	1360	446	200	227	551
12	Sirnak University	1354	266	79	15	32
	Total	78732	13180	2522	11314	358657

UZEP project team have held online meetings with these university representatives every week throughout the semester, and urgent feedbacks have been collected regularly from other channels. Requested adjustments such as synchronizing the user transfer of universities via web service, differentiating the question types to be used in the exam according to needs / demands, creating user-based, activity-based, exam session-based reports specific to universities have been added to the system after extensive evaluations with project team. At the end of the semester, a general evaluation survey was conducted with selected experts from the peer university representatives. Table 1 shows the universities that use UZEP, and some statistical data about the usage.

Data Collection and Analysis

Widely used teaching software evaluation method is considered as process evaluation, which is the evaluations performed during the development and pre-use of the software (Heinich et al., 2002). UZEP has been systematically evaluated by expert, pilot and user evaluations after Fall-2020. Process evaluation is usually performed by field experts, designers, trainers or target audience as a result of examination and/or use. At the end of this examination, the deficiencies and positive aspects of the developed system are revealed. In process evaluation, an expert or pilot evaluation is used to collect more quantitative and qualitative data. Expert evaluation is done by getting opinions from field experts and/or by comparing and scoring criteria with software in terms of certain qualifications. Pilot evaluation, on the other hand, is based on collecting data through questionnaires, tests and/or observations after the software is used by the target audience. Expert evaluation was carried out with 6 people who are easily accessible in accordance with the appropriate sampling method, who are experts in the field were asked to use UZEP sufficiently enough time and report

the opinions. The pilot evaluation was conducted with the staff working in distance education center who stayed outside the developer team. Finally, user opinions were collected and evaluated. Users consist of three categories: administrators, lecturers, and students.

FINDINGS

The UZEP platform developed in this research has been systematically evaluated by expert, pilot and user evaluations. These evaluations including discussions are presented in this section.

Expert Evaluation

The expert evaluation results are shown in Table 2. Participants in the expert evaluation are 2 professors (S1 and S2), 2 associate professors (S3 and S4) and 2 doctor lecturers (S5 and S6), who are experts in the field of computerized teaching technologies or online learning. Among them, two are directors and the other one is vice director in distance education centers at universities. Firstly, they were asked to evaluate the UZEP platform over 5 points in terms of ease of use, perceived usefulness, ease of learn, ease of access and appearance. In the second stage, they were asked to answer the questions about the positive aspects of the UZEP platform after use and what are the aspects that need improvement. Finally, they were asked to compare the well-known and used software such as Moodle, Edx, Google Suite (Classroom, Meet and Forms) by using a table containing criteria including *LMS*, *Virtual classrooms* and *Assessment* features.

Table 2. Comparative expert evaluation of distance learning systems: Moodle, edX, Google and UZEP. Each criterion was evaluated over 5 points, and the values shown in the table show the average of all criteria within a module.

Module	Criteria	Moodle		edX		Google		UZEP	
LMS	Social Tools	√	4.60	√	4.28	√	4.13	χ	4.54
	File exchange	√		χ		√		√	
	Internal messaging	√		√		χ		√	
	Group work	√		√		√		χ	
	Student community build.	√		√		√		√	
	Authentication	√		√		√		√	
	Course authorization	√		√		√		√	
	Registration integration	√		√		√		√	
	Student tracking	√		√		√		√	
	Curriculum management	√		√		√		√	
	Course catalog	√		√		χ		√	
	Data import/export	√		√		√		√	
	Client browser request	√		√		√		√	
	Open source web server	√		√		√		√	
	Installation (hosted, local, SaaS, cloud)	√		√		√		√	
	Maintanance (bacups etc.)	√		√		χ		√	
	Mobile access	√		√		χ		√	

Virtual Class.	Interactive white boards	√	3.50	χ	0	√	4.57	√	4.52
	Chat	√		χ		√		√	
	Streaming media	√		χ		√		√	
	Session recording	√		χ		√		√	
	Streaming audio and video	√		χ		√		√	
	Screen sharing	√		χ		√		√	
	File sharing	√		χ		√		√	
	Breakout rooms	χ		χ		√		√	
	Polling	χ		χ		χ		√	
	Attendance and ntifications	√		χ		√		√	
Assessment	Live video presentations	χ	4.70	χ	4.38	√	3.98	√	4.63
	Attendee management	√		χ		√		√	
	Coursework grading	χ		√		χ		χ	
	Exam engine	√		√		χ		√	
	Survey management	√		√		χ		√	
	Test building	√		√		√		√	
	Test scoring	√		√		√		√	
	Testing	√		√		v		√	
	Grading	√		√		√		√	
	Assignment	√		√		χ		√	
	Built in assessment tools	√		√		χ		√	
	Quizzes	√		√		χ		√	

According to responses from experts (see Table 2), it is seen that UZEP is easy to use and has a simple structure (S1, S3, S4 and S6). For example, an expert (S1) states that the overall interface is simple, it is beneficial in many ways. It is certain that it will provide convenience for individuals with low IT literacy, who feel inadequate in using the system or do not prefer a complex environment. The other two experts (S3, S4) highlight the simple design of the relevant modules to meet the target and the need. Another expert (S6) emphasized that the ease of use and management of UZEP is the most positive aspect, stating: It is meaningful that it can be processed immediately by higher education institutions where the need is felt especially for emergencies such as pandemic. The other positive aspects highlighted by the experts on UZEP were emphasized as follows:

> *It is an important and positive aspect that there are modules that will allow the realization of all the activities necessary for a course to be carried out with distance education and that these modules are offered with a single password and a single software (S2).*
>
> *One of the important advantages is that it is very fast to be ready for use and that it has synchronization interfaces with university information systems (S5).*
>
> *Especially in curriculum management and transferring student records (course-student matching, etc.) to the system, its easy-to-manage infrastructure and modules suitable for higher education ecosystem are one of the most important features that distinguish UZEP from other equivalent systems (S6).*
>
> *It is very beneficial to automatically associate the student and lecturer registered to their courses once in the platform with all created activities such as live lectures, materials, announcements and exams, and access with one click (S4).*
>
> *In addition to the realization of live lessons, automatic recording, being open to watch again from the same place, reporting of participation based on person both for alive lectures and for replay are the positive aspects of UZEP in terms of simultaneous learning (S5, S6).*

The exam module does not contain unnecessary details and has a direct target-oriented structure. Creating a question bank and preparing questions in the most frequently used types makes it easy for teaching staff in terms of measurement and evaluation (S6). In addition, it is advantageous to give different points to the questions and to generate different questions for the same gain for different users with equivalent questions for an outcome (S1).

The reporting module provides access to information on students' performances needed for higher education institutions. The features that make UZEP stand out are that system usage statistics can be easily obtained on the basis of both institutional and individual courses, and the reporting module does not burden the system (S3, S6).

All these expert opinions have shown that UZEP serves its purpose in terms of being easily prepared, easy to use and used by users with low IT knowledge in higher education institutions that switch to emergency online learning during the pandemic period. In addition, experts made suggestions for improvement. The most important of these suggestions is the lack of communication and social tools. One of the field experts, (S6) said, "*There are no modules with the necessary tools for students to communicate and socialize over the system. Therefore, it can be suggested to carry out discussion and reflection activities, and to integrate a messaging module into the system where students can communicate with both the instructor and their peers*". Other suggestions are as follows:

On the question bank page, a question search function can be added according to the question type and difficulty level. The variety of exam types such as portfolio and project can be added (S1, S2, S3, S6).

Although the system has a reporting feature, it does not have a learning analytics module. In the later stages, it can be ensured that students' interactions and learning performance with lecture pages, virtual classroom sessions, material pages and exam activities can be followed on a panel (S4, S6).

In general, it offers fewer outputs than Moodle in terms of reporting. It is not easy to process the data to generate reports in Moodle, but at least it may be good to report which files (uploaded materials) have been viewed in the system and how long students have spent in a virtual class (S4, S6).

When creating a virtual classroom, a labeling feature can be activated regarding which subject or unit it is related to (S6).

It will be beneficial if HTML5 compatible contents can be uploaded to the system and made playable on the system (S5, S6).

The UZEP logo can link to the home page. Student number or ID numbers can also be added on the Students tab (S6).

As a result of expert opinions, it has been revealed that the system needs to be improved in reporting, assessment and evaluation modules. These modules have been prioritized in development and update studies in the future.

Pilot evaluation

The pilot evaluations were conducted by people who are not part of the UZEP development team, but who do work related to distance education at the university where UZEP was developed. Pilot evaluations were made urgently due to the pandemic, but later on, when the real system was activated, other evaluation methods were used. The feedback generated as a result of the pilot evaluations was immediately used in the development processes. Thus, significant improvements were made during local tests before the system was put in fully service.

User evaluation

UZEP users are roughly divided into three groups: administrators, lecturers and students. In this section, the opinions of each user group have been collected and evaluated. Administrator evaluation was carried out using widely used questionnaire questions (Wang et al., 2007). 22 distance education center managers who

were responsible for ensuring the use of the UZEP platform in 12 different universities were participated to the survey. Of these participants, 13 are men and 9 are women. The ages of the participants ranged from 21 to 70 and the average was found to be 37.73 (Std.Dev. = 9.34). 5 of the participants are faculty members and the rest are lecturers. Respondents were asked to rate each question about UZEP on a scale of 1-5 where 1- bad, 2 - poor, 3 - moderate, 4 - good, and 5 - very good. The results of the questionnaire and the mean and standard deviation values for the items are given in Table 3.

Table 3. Administrator survey results conducted with institution representatives that use the UZEP. The respondents were asked to rate each question about UZEP on a scale of 1-5, where 1 is bad and 5 is very good. Table shows the mean value and the standard deviation of the responses.

No	Survey Question	Mean	Std.Dev.
1	UZEP is easy to learn and use	4.18	0.665
2	UZEP is user-friendly	3.59	0.854
3	UZEP provides interactive features between users and system	2.86	1.082
4	UZEP provides a personalized information presentation	3.00	0.926
5	UZEP has attractive features to appeal to the users	2.87	0.990
6	UZEP provides high-speed information access	3.36	0.954
7	Adequate information was presented for the use and integration of UZEP	3.41	1.182
8	UZEP provides a proper level of on-line assistance and explanation	3.23	1.478
9	The information we needed about integration was presented at the right time	3.41	1.368
10	UZEP team provides high availability for consultation	3.64	1.255
11	UZEP team responds in a cooperative manner to your suggestion for future enhancements	3.50	1.336
12	UZEP team provides satisfactory support to users using the e-learning system	3.46	1.439
13	The frequency of use UZEP is high	3.14	1.037
14	Most of the users bring a positive attitude or evaluation towards UZEP	2.91	1.065
15	You think that the perceived utility about UZEP is high	3.09	1.377
16	You are satisfied with UZEP	3.23	1.412
17	UZEP helps you think solve through educational problems	3.05	1.431
18	UZEP enables the universities to respond more quickly to change	2.96	1.253
19	UZEP helps the universities provide better education or services to students	3.09	1.151
20	UZEP helps the universities save cost	3.18	1.097
21	UZEP helps the universities to achieve its goal	3.05	1.090
22	As a whole, the performance of UZEP is good	3.14	1.167
23	As a whole, UZEP is successful	.318	1.097
24	By using UZEP, we did not have to buy a server	3.27	1.032
25	UZEP is a distance education platform open to development	3.86	1.082

When the results of the user surveys were examined, it was shown that the participants' answers to the 22 items out of 25 were above the midpoint but 3 items were below. The 3 items with the highest scores in this survey were determined as UZEP is easy to learn and use, UZEP being a distance education platform open to development and UZEP team provides high availability for consultation. These findings show that UZEP has been developed appropriately for use in the emergency distance education period, that it is open to development will continue to be used with features to be added after the pandemic period, and that the team is easily accessible, making it easier to find solutions to the problems encountered. In addition to all these, the items UZEP enables the university to respond faster to change [2.96], Most of the users have a positive attitude or evaluation towards UZEP [2.91] and UZEP has attractive features to appeal to the users [2.87]. These items were found to be lower than the midpoint. It shows that university administrators who are also users of UZEP have deficiencies in responding quickly to change, developing a positive attitude and

having attractive features. In the meeting with the relevant people, they expressed their opinion that the presence of innovative and remarkable support and communication tools and measurement tools on the UZEP platform will close this gap. In this respect, UZEP developments were decided to be in this direction.

Lecturer Evaluation

In this evaluation, a satisfaction questionnaire was applied to the lecturers who conducted their courses at UZEP during one academic semester. The academic staff satisfaction questionnaire was conducted via forms on the Internet. The questionnaire was shared as an announcement from the system to 51 lecturers, 30 people filled the questionnaire and 29 responses were found to be acceptable. 12 of the instructors who filled out the questionnaire are women, 14 are men; 18 of them are lecturers and 11 are doctor lecturers. While 26 of the participants felt moderately competent in using technology, 2 felt very adequate and one was less sufficient, and only two participants stated that they had previous experience of teaching with distance education. While the ages of the participants ranged from 25 to 50, the average was found to be 36.17.

The questionnaire included 10 questions in 3 basic dimensions, which were determined as satisfaction for the *1. Distance learning process*, *2. Meeting expectations* and *3. Usefulness of the system*. Sample items for the dimensions in the questionnaire are as follows: "*I am pleased to do my lessons*" in dimension 1, "*I was able to perform the measurement that I needed in my classes*" in dimension 2, and "*I carried out my lessons easily*" in dimension 3. Internal consistency coefficients (based on Cronbach's alpha) for the three dimensions of the questionnaire were found as $\alpha = 0.82$ for dimension 1, $\alpha = 0.75$ for dimension 2 and $\alpha = 0.76$ for dimension 3.

During the lecturer evaluation, when asked to score the learning management system (LMS), the virtual classroom software and the assessment software in UZEP between 1 and 5; it was observed that the mean of their their responses are 3.48, 4.24 and 3.90 respectively. In this respect, the instructors gave highest scores to the virtual classroom software, then the assessment software and the lowest scores to the learning management system. These scores show that making the LMS on the platform simpler by considering emergency distance education falls short of meeting the expectations. However, the fact that all scores are above average shows that all components of the platform are found functional.

Student Evaluation

A questionnaire was applied over the system to 150 students studying in an associate degree program of a university and participating in the emergency distance education process due to Covid-19 pandemic. The students study in the same education unit throughout a semester. While 115 people filled out the questionnaire, the answers of 111 students were used as acceptable. Of the students who participated in the application and filled out the questionnaire, 52 were women and 59 were men. 63 of the participating students are first year and 48 are second year students. All of these students are those who have not experienced distance education before the pandemic, and their ages vary between 18 and 24, the average is 20.28.

A modified version of the instructors' questionnaire was used with 10 questions in all dimensions for 3 basic dimensions. The sample items for the dimensions are I am pleased to take my courses in this platform for dimension 1, I have learned sufficiently in the lessons for dimension 2 and I easily accessed the virtual classes and replays for dimension 3. The internal consistency coefficients of the questionnaire were found as $\alpha = 0.84$ for the distance learning process dimension, $\alpha = 0.89$ for meeting the expectations and $\alpha = 0.73$ for the usefulness of the system, respectively.

During the student evaluation, when they were asked to score each dimension between 1 to 5, a mean of each dimension were found 3.69, 3.12 and 3.72 respectively; it is seen that satisfaction in all three dimensions is higher than the midpoint. In this respect, it has been understood that student satisfaction is positive but not very high. It has been understood that especially students need social tools to communicate with their peers in order to meet their expectations. It was also revealed that in the failures should be reduced in the measurement and evaluation module. In addition, it has been requested to facilitate an easy access method to reach teaching staff. In this respect, the processes of improving the measurement system and adding instant communication mechanisms to the system have been put forward.

DISCUSSIONS AND CONCLUSION

With the Covid-19 coronavirus pandemic, many universities in the world were caught unprepared for the sudden transition from face-to-face training to remote teaching. In order for universities to switch to remote teaching, either they own proper on premise infrastructure and software or they use available cloud based systems. The first solution is very expensive and is not suitable for emergencies if the institution not having before, and the second one has some problems dealing with the confidential data. Hence, lack of proper online learning systems for higher education institutions caused problems at some countries, as happened in Turkiye. On the other hand, transferring users' records, complete curricula of departments and creating weekly schedules of online courses on a platform are stressful tasks and require teamwork. Meanwhile, establishing and managing online learning systems requires high expertise in both informatics and education field.

In this paper, a new online learning platform, called UZEP, is presented to overcome these problems for higher education institutions. UZEP has been developed using Education as a Service (EaaS) cloud model, hence it does not require any kind of infrastructure from its clients, and it can be used without installation. UZEP offers interfaces that prioritize easy learning and use, so it can be switched on quickly in emergency situations. It also provides multiple mechanisms such as advanced APIs and file upload for integration to any university management system. Due to its cloud architecture and container technologies, UZEP scales much better than the other competitor platforms like Moodle, and comply with laws and policies for confidential data.

The ultimate goal of the research is to meet the remote teaching platform needs of many universities in a country or a region by sharing the IT resources. In this way, universities could continue their training activities even if they do not have a necessary infrastructure. UZEP has been developed for this purpose and its performance evaluated by surveys conducted at various levels.

In the evaluation, the experts were asked to compare Moodle, Edx and Google Suite with UZEP in terms of their features. As a result of the comparison, it was seen that Edx had the lowest average score. The purpose of MOOC software (Edx), a massive, open, and online delivery of open course resources, prioritizes skill acquisition and certification in open and online courses (OpenCourseWare, 2006; Bozkurt, 2015). In this regard, UZEP is better suited for distance education applications in higher education.

On the other hand, Google Suite provides fast and easy access to learning content, collaboration, secure cloud storage, management, and a communication platform that enables an effective, paperless online classroom (Apriyanti et al., 2019; Sudarsana et al., 2019). Compared to G-Suite, UZEP lacks social networking and online collaboration components, while G-Suite is one of the most powerful software in this regard. It shows that G-Suite offers more effective solutions than UZEP in terms of collaboration components.

Moodle has been widely known due to its flexibility and open-source nature (Rahim et al., 2018). Moodle contains many features in its structure, which consists of 6 modules. For example, communication modules include file sharing, internal and external discussion forums via email, and real-time chat. Student engagement modules include a workshop module, a group work module, a student portfolio module, and a self-assessment module (Kumar et al., 2011). Compared to Moodle, UZEP is shown to have shortcomings in terms of social networking and group work, as well as grading coursework. However, when evaluating the whole, it appears that UZEP's integrated structure stands out in terms of the learning management system, virtual classroom, and assessment and grading. Uzep's main goal is to help universities quick transition to distance education in emergency situations, and its integrated and scalable structure have been identified as important advantages.

On the other hand, this study has some limitations that should be considered when evaluating the results. One of these limitations is that the data was collected using a self-reported questionnaire and compared and analyzed only with 4 LMS software (UZEP, Moodle, Edx and Google Suite). An extended comparative study can be conducted with other LMS software as well. In addition, UZEP was evaluated during the pandemic period in which the emergency demand was very high, hence another evaluation study can be done after this period. Moreover, it was seen that there was a need for improvement in the exam and communication modules based on the findings obtained as a result of the use of field experts, administrators, teachers and students. In this respect, it has been planned to use artificial intelligence techniques to support both in the security and in the assessment parts of the exam module. Social media and communication channels with interactive learning environments and materials will be included UZEP in the future studies.

Authors' Note: This research was supported by The Scientific and Technological Research Council of Turkiye (TUBITAK) under the Grant No: 120K200 and titled "A New Distance Education Model and Application Platform in Higher Education".

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