Online education and monitoring of quality indicators of e-learning use

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Abstract. This article analyses the results of the proposed approach to quality assessment of the use of online courses in the system of Ukrainian Engineering Pedagogics Academy e-learning and to assess its effectiveness in solving the problem of improving the quality of education. The courses were inspected after the Spring 2020 semester, according to the following criteria: activity of the process participants; interactivity of the process when using an online course; the intensity of the process by the elements of a course; dynamics of students’ educational achievements and management of the process of using an online course. This article shows that without painstaking daily systematic work regarding supporting the use of each online course, one should not hope for the effective impact of this form of studying. This should be done in every educational institution because the COVID-19 pandemic is not over and a significant part of educational institutions will spend the 2020/2021 academic year under the strict quarantine.

1. Introduction
The continuous IT revolution is forcing educational institutions to constantly introduce innovative learning technologies concerning the changes and emergence of new educational computer technologies. So, the technologies of MOOC (Massive open online course), Blended Learning, Game-Based Learning, Cloud-Based Education, and others are being successfully implemented. Against this background, simple e-learning technologies look like something familiar and commonplace, something that is used by almost every educational institution at all levels of education. However, the latest events of 2020, related to the epidemiological situation in the world, have actualized the problem of e-learning and made it a priority.

For many years, the Ukrainian Engineering Pedagogics Academy (UEPA) has been creating an information environment that has successfully developed and improved in many directions. Today, this environment is quite rich with a variety of information resources, some of which are successfully used for organizing e-learning. A detailed description of the UEPA information environment is presented in [1]. Over this long time, approaches to assessing the quality of e-learning resources have undergone a significant transformation. If at the initial stage of creating e-learning system at UEPA, the quality of
the online course was assessed by one indicator: the online course either exists or not. Then at the next stage, a comprehensive system for assessing the quality of the online course was introduced [2]. However, with the introduction of e-learning for all disciplines at the Academy, the issue of the effectiveness of using this form of education in the training of future engineers-teachers was put on the agenda.

The UEPA is an example of the framework that we described for online education, namely the creation of online courses and the use of online platforms. E-learning on the Moodle platform was implemented into the educational process of the UEPA for all academic disciplines. All the lecturers were using it under conditions of blended learning which has been compulsory since 2015. Requirements for online courses were set and included the criteria regarding two directions: content and use. E-learning technologies, although playing an important part, were focused on providing the traditional educational process with both resource materials and students’ feedback.

The priorities changed immediately in the spring of 2020, when Ukrainian Engineering Pedagogics Academy, like the majority of educational institutions all over the world, had to go through quarantine measures caused by the COVID-19 pandemics and completely transformed the whole educational process in e-learning. Under these conditions, only e-learning technologies ensured the quality of education and one had to constantly monitor how successfully they were used and make changes in order to ensure the quality of education. The indicators of monitoring, its results and requirements for the educational process contain new data which solve the scientific and practical problem of providing the educational process under the conditions of full e-learning.

The research aim is to analyze the results of the proposed approach to quality assessment of the use of online courses in the system of UEPA e-learning and to assess its effectiveness in solving the problem of improving the quality of education.

2. Literature Review

Our society is assimilating technology as never before. The vertigo of informational and digital progress now affects all domains of our lives and is changing education frameworks in a continuous process that leads us to rethink Higher Education as a whole, including teachers, researchers, students and policymakers [3].

The current COVID – 19 pandemics challenged the world to undertake a giant step into technology-based teaching and learning and UNESCO highlighted the need and the challenge to update our universities to online teaching. Connecting information and communication technologies with innovative pedagogical strategies are, therefore, a path that gained strength as a global answer to current issues imposed by confinement and closing of universities. The global closures were massive and impacted over 91% of the world’s student population [4]. Online education has been growing steadily worldwide and its history is now facing another challenge, due to the pandemics conjuncture. Universities have been the frontline for bridging the gap of distance, exclusion and educational system breakdown and now online education is truly on track to become the predominant system by 2025 [5].

Due to the lack of constraints of time and place, e-learning is expanding in two main ways: University-Based Online Education, for obtaining degrees and diplomas and MOOC, Flexibility is the keyword for online education and this characteristic is present in teaching, learning and the creation and development of online courses. This construction has different settings from the physical classroom and universities must undertake a complex analysis of all these procedures to guarantee courses with quality learning outcomes. So, it is very clear that in this century, online education will continue to grow [6] and give new opportunities for students, to engage university degrees or enhance skills by using MOOC.

Online education is also very important to universities that want to meet effectively with the needs of the workforce, constantly changing and integrating new skills and literacies. Employers also value the online education as an opportunity to bring together higher education and the world of work, taking into account curricula, projects and internships, so that online courses can help young or adult students, working students and students with different characteristics, requiring self-paced, flexible learning. Nowadays, the online learning community is rising as never before and social, educational and economic
issues are all coming together to lead universities into a steady and profound change, broadening online education and determining the creation and monitoring of well-designed online courses [7]. A recent study pointed out this need and suggested four high-impact principles for online education: “1. We need to continue development of open educational platforms which allow access to the high quality of learning resources; 2. We need to conduct quantitative and qualitative research and evaluate current models of online teaching and learning, with a particular focus to their long-term sustainability; 3. We need to develop staff—teachers’ capacity for online teaching, and professional staff capacity for supporting teachers and online systems; 4. We need to encourage cooperation between universities, international organizations, private sector, civil society, and other stakeholders, to promote high-quality online learning throughout society.” [8].

Analysis of works devoted to the use of information technologies in education [9] leads to the conclusion that approaches to assessing the quality of e-learning mainly cover the stage of developing an online course. If in separate works the problems of assessing the e-learning quality in the process of use are considered, then they offer separate assessment indicators that do not cover the process of operating the online course as a whole [10, 11].

For example, it is proposed three blocks of criteria to assess the work of a lecturer in the e-learning system: criteria for assessing general pedagogical skills; criteria for assessing special skills; criteria for assessing the results of the lecturer's activity (mainly the skills and abilities acquired by students). The author himself admits that this set of criteria is difficult to implement in the context of e-learning [12]. O. Zolotarova describes the results of a questionnaire survey of students, users of e-learning courses, according to which students themselves identified important factors of the quality of e-learning. However, there are no specific values for assessing the quality of an organization and conducting this form of training in the publication [13].

The paper [2] proposes an integrated approach to assessing the quality of online learning courses based on a process approach to quality management. This approach differs from the generally accepted one, which is proposed, for example, in several works [14 - 16], where a comprehensive assessment of the quality of e-learning tools is understood as an assessment of their quality by a set of parameters: content, technical and technological, didactic, methodological, and design-ergonomic. This set of parameters characterizes online course as a software product for pedagogical purposes but does not give an idea of the effectiveness of its use in the educational process.

Certainly, it is possible to predict the achievement of the online course quality at the design and development stage of the system by conducting a systematic analysis of the initial requirements and assignments, however, a reasonable judgment about its quality can be made only after its experimental approbation in the learning process. And if we take into account the fact that the processes of obsolescence of the on-line course, in addition to the meaningful factor, are aggravated by the limitations of its full-fledged use as a software product due to the appearance of new, more advanced or more popular versions of similar software, equipment, and technologies, then it is necessary to implement procedures for monitoring the process and the results of their use to solve the problem of maintaining the quality of online courses in the e-learning system.

3. Approach
In order to obtain complete and objective information about the effectiveness of using online courses, user activity analysis was performed. The information was collected according to the following criteria: activity of the process participants; interactivity of the process when using an online course; the intensity of the process by the elements of a course; dynamics of students’ educational achievements; management of the process of using an online course.

Dynamics of individual tasks completion by students was not monitored, because it is the prerogative of a teacher who leads an online course. However, our experience shows that student activity in the course correlates quite closely with the number of completed tasks. That is, by tracking student activity in the e-learning system we get an index indicator, which in this case characterizes the latent variable "Student Achievement" which in turn is determined by the number of completed tasks.
The interactivity of the process is assessed by the number of interaction procedures between participants in the educational process when using an online course: the number of forum visits, the number of webinars, online surveys, interactive educational lectures and so on.

The intensity of the process of using an online course by its elements is set based on the analysis of user interaction with the elements of the course and displays the number of referring to organizational (forums), educational and methodical (lecture notes, guidelines for practical and laboratory work) and control and measuring (test, task) materials.

The dynamics of students' academic achievements are studied on the basis of an electronic journal of students' progress in a course. Based on the results of analyzing the given journal, an individual trajectory of studying a course by each student can be built and the results of diagnosing a whole group can be presented in a graphic form.

The effectiveness of using an online course in the educational process largely depends on how the management of the process of its use is organized, in particular, how the registration (removal) of users, accumulation of the students’ data in an online course, creation of learning groups are performed, how the management of educational events is conducted using the built-in calendar, announcements of events, mailout of messages and warnings; how the management of taking tests is implemented based on available functionality for the management of using an online course.

4. Outcomes

The e-learning system at the UEPA is based on the Moodle learning management system. This system is loaded with online courses in all subject matters that are taught at the Academy. Let’s consider how the Academy assesses the quality of the process of using online courses.

The activity of the participants in the process is characterized by the following indicators:

- dynamics of changes in the number of users’ (study group) appeals to online learning courses during the specified period;
- dynamics of change in the number of unique (by IP-address) users’ (study group) appeals to the online learning course;
- the dynamics of changes in the percentage of appeals to online learning courses by users of a given study group;
- the rate of active use of the course (the number of active actions of users with the course to the number of the course views);
- specific assessment of activity per user by courses (in this case, the activity of content use does not depend on the number of registered users).

The above proposals for a comprehensive assessment of the quality of using online courses in the e-learning system were the basis of the Regulations on the educational portal of the UEPA. These Regulations govern the uniform requirements, procedure, and rules for the formation and provision of the Academy's educational portal and, in particular, the creation of online learning courses for students of the UEPA in the subject matters provided for by the curriculum for all specialties of educational levels “Bachelor” and “Master”.

The Regulations govern the following procedure for monitoring the quality of the use of online courses in the Academy e-learning system: specialists of the information and computing centre of the Academy, together with those responsible persons for e-learning in UEPA departments, provide reporting on the creation, use, and periodic assessment of the quality of online courses. After the end of the academic semester, a report, which is the basis for determining the rating of lecturers for using online courses in the educational process, following the Time Standards for planning and accounting for educational work and lists of the main types of methodological, scientific, and organizational work of pedagogical and research and educational staff of UEPA, is drawn up based on monitoring the use of online courses.

Examination of support provides for the assessment of the following indicators: enrollment of students for an online course; correctness of assignment dates; the presence of a list of students in the group with the numbers of options; correctness of links in the course to Internet resources; timeliness of
assignment check; the presence of comments to the answers; submission of operational news; student activity; attendance records; feedback, online communication; survey. Each indicator is assessed in points. Depending on the degree of influence of the indicator on the quality of using the course, its maximum score in points can be from 5 to 30 points. All indicators are subdivided into two groups: mandatory indicators (without scores for, at least, one of these indicators, the course will not be certified); additional indicators (their presence has a positive effect on the certification assessment of the course, providing additional points). All work on monitoring the quality of using online courses is coordinated by the head of the education quality monitoring group of the Academy.

In normal operation, the use of online courses is monitored once a semester. However, under conditions of quarantine, due to the fact that online learning became the only and main form, this check was carried out based on the results of two weeks of training. The results of monitoring the use of online learning courses for the specified period are shown in Table 1.

Table 1. Results of monitoring the quality of using distance courses.

|               | Enrolled students | Correct assignment dates | Correct hyperlinks | Timely check of assignments | Comments on the estimates | Submission of relevant news | Students’ activity | Attendance records |
|---------------|-------------------|--------------------------|--------------------|----------------------------|----------------------------|---------------------------|-------------------|-------------------|
|               | 10                | 10                       | 5                  | 5                          | 30                         | 10                        | 10                | 20                | 5                 |
|               | 100%              | 78%                      | 50%                | 100%                       | 66%                        | 50%                       | 61%               | 73%               | 73%               |

The first row of Table 1 data contains the maximum values of the indicator. The second row is the obtained values of indicators as a percentage of the maximum value. Figure 1 shows the results of monitoring the activity of users of online courses (number of actions) by calendar dates.

![Figure 1. The activity of users of online courses by calendar dates.](image)

The data obtained indicate that not all students realized the fact that e-learning is the only form of education at this time. Thus, the activity of students in the online learning system is not one hundred percent (73%). Under these conditions, lecturers do not have time to ensure a timely check of assignments (65.7%). The same can be said about the presence of comments on the answers (50%), that is, monitoring the process of using online courses in the LMS in the current conditions is an effective mechanism for determining the problems of the educational process and, accordingly, ways to solve them.
Another aspect of this monitoring is associated with modern approaches to determining the quality of goods and services. In the international standard ISO 8402 86, quality is defined as the set of properties and characteristics of a product or a service that give them the ability to meet the conditioned or implied needs of the customer. Therefore, it would be completely illogical to assess the quality of online courses only based on expert assessments and not to take into account the opinion of direct consumers (students and lecturers).

It is possible to identify the advantages and disadvantages, problems faced by students, as well as to determine the directions for improving the LMS using online courses, based on the results of their survey. We have conducted a survey of students, in which they had to assess the overall level of organization of the educational process using e-learning, to assess how convenient and comfortable it is for them to work with e-learning materials that are presented in the structure of the online course (presentation, design, clarity of materials, etc.), to list the problems they encountered while working with the system, to assess how the study of the subject matter using the online course contributed to the formation of the necessary knowledge and skills among students, as well as the skills of using modern information and communication technologies.

To the question: “What, in your opinion, is the effectiveness of e-learning?”, almost 45% of students answered “High” and “Above average”, 32%—“Average”, 23%—“Below average” (figure 2, a). These results are explained by the attitude of students towards e-learning. To the question: “How do you feel about e-learning?”, 60% of students answered, “Studying in the usual way is more interesting because there is personal communication”. E-learning as an auxiliary form of education is considered by 15% of students. The same number of students believes that e-learning is worse than traditional education, and 10% of students attribute this to the fact that e-learning diplomas are not valued.

Figure 2. Student surveys results.

To the question: “Please assess the organization of the educational process and the work of the e-learning website (feedback, timeliness of assignment check, the presence of a comment on the answer, etc.)”, 15% of students gave an assessment of “excellent”, 45% — “good”, 23% — “satisfactory”, 17% — “not satisfactory” (figure 2, b).

At the request to note the main problems in the organization of e-learning, almost 40% of students answered, “Insufficient control of the acquired knowledge and skills”. The same number of students noted that online learning programs do not always meet educational needs.

As a result, to the question “Are you satisfied with the quality of online learning courses?”, 65% of students answered “Yes”, 25% of students found it difficult to answer, the rest of the students (10%) answered “No” (figure 2, c).

The Google Meet video meeting service was selected to conduct online classes. Students are happy to join an online lecture or online practice, because this is a good opportunity to “live” communicate with the lecturer, because, according to the survey, they decided in the majority that “it is more interesting to study in the usual way, because there is personal communication”. Even students who do not usually attend classes on a daily basis join video meetings, because the Meet app is easy to install on a mobile device and to connect to the class anywhere. This organization of the educational process has increased the effectiveness of training and provided an opportunity to apply the feedback.
5. Conclusions
The experience of the UEPA's e-learning system has shown that without painstaking daily systematic work regarding supporting the use of each online course, one should not hope for the effective impact of this form of studying. Moreover, this work should be done in several ways: analysis of teachers' work with online courses, student activity, interactivity of the e-learning process and so on. This should be done in every educational institution, because the COVID-19 pandemic is not over and a significant part of educational institutions will spend the 2020/2021 academic year under the strict quarantine. To implement the proposed approach, it is necessary to establish effective institutional structures in educational institutions, in particular, a group for monitoring the quality of online education.

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