Complex System of Automation of the Educational Process, Implemented with the Application of Distance Educational Technologies in the System of Higher Education

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Abstract

The development of modern digital services in the field of education is the main direction of modernization of higher educational institutions. One of the key aspects of implementing the concept of a digital university is the introduction of distance learning technologies into the educational process. The distance learning format has become more relevant than ever during the period of restrictive measures related to COVID-19 pandemic. Within the framework of this study, based on the example of the Orenburg State University, a comprehensive technical solution is presented that makes it possible to automate the key elements of the digital educational environment and implement a single platform for organizing services of a digital university.

Keywords [1]

Distance education technologies, video conferencing, Moodle, proctoring, digital university

1. Introduction

Modern educational technologies allow participants of educational process to move interaction from offline to online. In the modern digital educational environment, there are practically no restrictions on access to information required in the learning and development process.

The priority tasks of the development of the education system are noted in the Decree of the President of the Russian Federation of May 7, 2018 No. 204 "On national goals and strategic objectives of the development of the Russian Federation for the period up to 2024". During this period, it is planned to "modernize education, including through the introduction of adaptive, practice-oriented and flexible educational programs", as well as "the creation of a modern and safe digital educational environment that ensures high quality and accessibility of education of all types and levels." As part of the implementation of the program of the Government of the Russian Federation "Digital Economy", it is planned to develop an industry platform for digital education, providing for the maximum use of information and communication technologies in the educational process, including the latest technologies for processing big data, machine learning and artificial intelligence.

These tasks are closely related to each other, since it is effective to ensure the adaptability and flexibility of learning, to make it as personalized and accessible to the student as possible, is possible only within the framework of an adaptive digital educational environment that uses all the possibilities of distance educational technologies. Nevertheless, visual contact between the teacher and the student is an integral part of the educational process, therefore, to implement the full cycle of training, it is necessary to use modern online services to organize online meetings and collaborate in real time via the Internet.

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A modern approach to the implementation of the educational process using distance learning technologies is the use of massive open online courses (MOOCs). As a rule, universities use Learning Management Systems (LMS) to host online courses. The functionality of such systems allows organizing the interaction of students and teachers on a single platform for accessing the information resources of the university [15]. Thus, each educational institution of higher education faces the problem of providing the educational process with a set of organizational and technical solutions aimed at implementing high-quality personnel training for the digital economy of Russia.

In the paper [12] OV Usachevoy, an analysis of the readiness of universities for the transition to a digital educational environment was carried out. Olkhovaya TA [11] and OV Narimanova [13] in their respective works consider aspects of the modern concept of higher education "University 3.0". In the paper [14] Budarinoy AO and Polupan KL, the features of the concept of "digital management of the educational process" in a university are revealed in comparison with traditional approaches to organizing education.

2. Purpose and objectives of the research

The purpose of the research is to ensure an effective transition of the educational processes of the university to a distance format using modern technical means of organizing online broadcasting and posting educational and methodological materials.

3. Literature review

The authors of paper [16] examine various features of commercially available and most commonly used modern LMS systems, including a comparative analysis of Saudi Arabian practices on the usage of online learning in universities.

One of the key aspects of choosing tools for organizing distance learning is to assess the usability of the LMS, the variety of LMS functions, etc. The authors of paper [17] note that the use of high-quality and functional online learning platforms contributes to the active involvement of students in the educational process, which, in turn, has a positive effect on the dynamics of academic performance and the quality of education.

The practice of using various LMS is widespread throughout the world. In the paper [18] the behavior of students in LMS is investigated and patterns of interaction of specific subjects of the educational process are built. The collected data is analyzed using education data mining (EDM) and learning analytics. Analytics systems are also used in the paper [19]. The authors build a decision-making model based on these learning management systems. The usage of intelligent recommendation systems of LMS allows you to offer students courses, discipline modules, additional training materials, based on information about the history of education.

The authors of paper [1] present the main aspects of the “Teaching Classes, Continuous Learning” initiative, launched by the Chinese Ministry of Education, which provides flexible online learning to more than 270 million students from their homes. Researchers from the University of Business and Technology of Georgia in their paper [2] shared their experience in organizing the process of distance learning in secondary education organizations using Microsoft Teams software for public schools and using alternative software sets for organizing remote communication sessions (Zoom, Slack, Google Meet as well as the EduPage platform). Also, the authors of the paper [3] suggest using the G-Suite service package for education as the recommended software, which includes Gmail, Classroom, Calendar, Forms, Jamboard, Drawings, Drive, Hangouts Meet, as well as Open Broadcaster Software. The paper [4] is devoted to the description of innovative solutions for the organization of the educational process in a distance mode, including the principle of teaching "Flipped classroom", online practice, and teleconferences as an alternative to traditional face-to-face lectures, procedural modeling and the usage of education videos. In paper [5], the main disadvantages of the transition of educational organizations to the remote functioning mode were identified. Among them, there are technical problems associated with unstable network connections, as well as lower attendance, lack of personal contact and lack of interaction due to existing connection problems.

Tsyrenova MI in paper [6] describes a positive experience of work in a distance format in the study of the Russian language by Chinese students. As a technical solution, the Zoom platform is used for organizing video conferencing sessions. In addition to the mentioned platform Zoom, the authors of paper [7] also recommend use the Moodle e-learning system for organizing the educational process. Open source software for video conferencing sessions BigBlueButton is used within the Webinar module of the electronic educational system of the MSTU STANKIN [8]. In paper [9], the procedure for conducting test tasks in a remote form is carried out on the basis of the freely distributed adaptive testing complex Proxima Test Suite.

To implement the assigned objectives in the Orenburg State University (OSU) modern LMS were reviewed. Hybrid systems with domain-specific details are mainly used. Intelligent recommendation systems of LMS offer courses, discipline modules, additional educational materials to the student, based on information about him and the history of interaction with him. Comparative characteristics of LMS are presented in Table 1.

Table 1

Comparative analysis of learning management systems

	Adaptation of tasks	Schedule adaptation	Passing an exam with proctoring services	Support for external tasks databases	Broadcast	Conferences	Tutors
Moodle	-	-	+	+	+	+	+
ATutor	-	-	-	+	+	+	+
ILIAS	-	-	+	-	+	+	+
SAKAI	-	-	-	+	+	+	+
OpenEDx	+	-	+	+	+	+	+
Claroline	-	-	-	-	-	+	+
Open OLAT	-	-	+	+	+	+	+
Canvas	-	+	-	+	+	+	+

The analysis showed that LMS Moodle is the most popular one. On the basis of open source code it allows to create specialized extensions and add-ons aimed at integration with existing information systems of educational organizations. The ATutor-based LMS is used to manage and host primarily online courses, and to create and distribute compatible electronic content. The ILIAS-based learning management system enables the implementation of e-learning functionality via the Internet. The LMS Sakai is designed to support learning, research and collaboration. The Open edX LMS platform is used by leading online course providers (such as Coursera) to provide continuous learning for a significant number of students in real time.

Modern training systems, as a rule, are integrated with technical solutions aimed at organizing video conferencing (VC). The most common solutions in this area are OpenMeetings – a video communication system aimed at organizing online broadcasts over the Internet, webinars and seminars. The BigBlueButton system has the ability to integrate API-based with LMS Moodle and allows you to organize a web conference. The Jitsi-based service allows you to conduct webinars for a large number of users (more than 250 users), using modern video broadcasting technologies based on WebRTC. The traditional software tool for organizing one-to-one student consultations and organizing small meetings is the Microsoft Skype platform. Recently, the Zoom service has gained popularity, which made it possible to organize quick and convenient meetings between the subjects of the educational process during a pandemic.

Corporate video conferencing systems are widely represented in the market. The Cisco WebEx Video Conferencing Solution is a full-featured web conferencing system with high image transfer rates. Adobe Connect has a wide range of tools for creating meetings, virtual classrooms, remote access to computer screens, chats and drawing boards. Among the systems of the corporate level, we highlight the Microsoft Teams service [10], which is part of the Microsoft Office 365 cloud platform.

Microsoft Teams allows not only organizing video conferencing, but also implements the functionality necessary for online learning and collaboration.

4. Methodology

Within the framework of the electronic information and educational environment (EIE) of the Orenburg State University, to control the progress of the educational process, the results of intermediate and final certification, the department for support of distance educational technologies has deployed specialized services that allow organizing the interaction of all subjects of the educational process. The platform based on LMS Moodle (https://moodle.osu.ru/) is used to host online courses. Based on the data of the information and analytical system (IAS OSU), automatic generation of courses and content is carried out. Each OSU teacher received a platform in LMS Moodle, which provides support for independent educational work, the formation of an electronic journal of the results of educational activities, the organization of individual and group interaction between students and teachers. To organize the educational process in the electronic information and educational environment, more than 5,000 new courses have been created in the Moodle system based on the data of the IAS OSU on the assignment of teachers to academic disciplines for the spring semester of the 2019/20 academic year.

To organize support for the procedure of conducting the state exam and presentation of final qualification works using distance learning technologies, the platform "State final certification" (https://exam.osu.ru) has been developed. At the moment, it has 334 courses used as online platforms for remote interaction between the teachers and students in the areas of undergraduate, graduate, specialist and postgraduate studies, completing their studies in 2020.

To organize online interaction of the subjects of the educational process, the platforms based on LMS Moodle were integrated with the Microsoft Teams service. The main feature of using the Microsoft Teams service lies in the seamless integration of the Microsoft Office 365 cloud platform and the IAS OSU user base. Figure 1 shows a general diagram of the organization of distance learning at Orenburg State University.

Within the framework of the element "Users of the IAS OSU" of the scheme described above, six main functional roles can be distinguished: "Administrator", "Scientific supervisor", "Moderator", "Secretary", "Member of the state examination commission" and "Student". The main functional roles are illustrated in the UML use case diagram as it shown in Figure 2.

These functions include:

1. Management of an e-learning platform that allows you to: view the content of each course; manage course content (create, edit and delete a course); manage course users (assign roles); manage courses.
2. Management of the Microsoft Teams video conferencing service, which allows you to: manage a scheduled video communication session; analyze statistics on the use of the service; manage users (set and reset passwords).
3. Uploading files to the created course.
4. View course content.
5. Participate in planned video conferencing meetings.
6. Carrying out a personal identification procedure.
7. Organizing of the examination ticket selection procedure.
8. Implementation of proctoring of the state final certification procedure.
9. Editing course content.
10. Configuring a videoconferencing meeting, which allows you to: schedule a video conference session; manage a video session (edit and cancel a meeting); manage teams (create, edit and delete teams); manage users (add and remove from teams, assign roles).
11. Registration of consent with the procedure for conducting the state final certification, confirming the availability of technical capabilities to work in remote mode.
12. During the state final certification procedure, the responsible moderators and secretaries had the opportunity to automatically add graduation groups of students to the teams of the Microsoft Teams service.

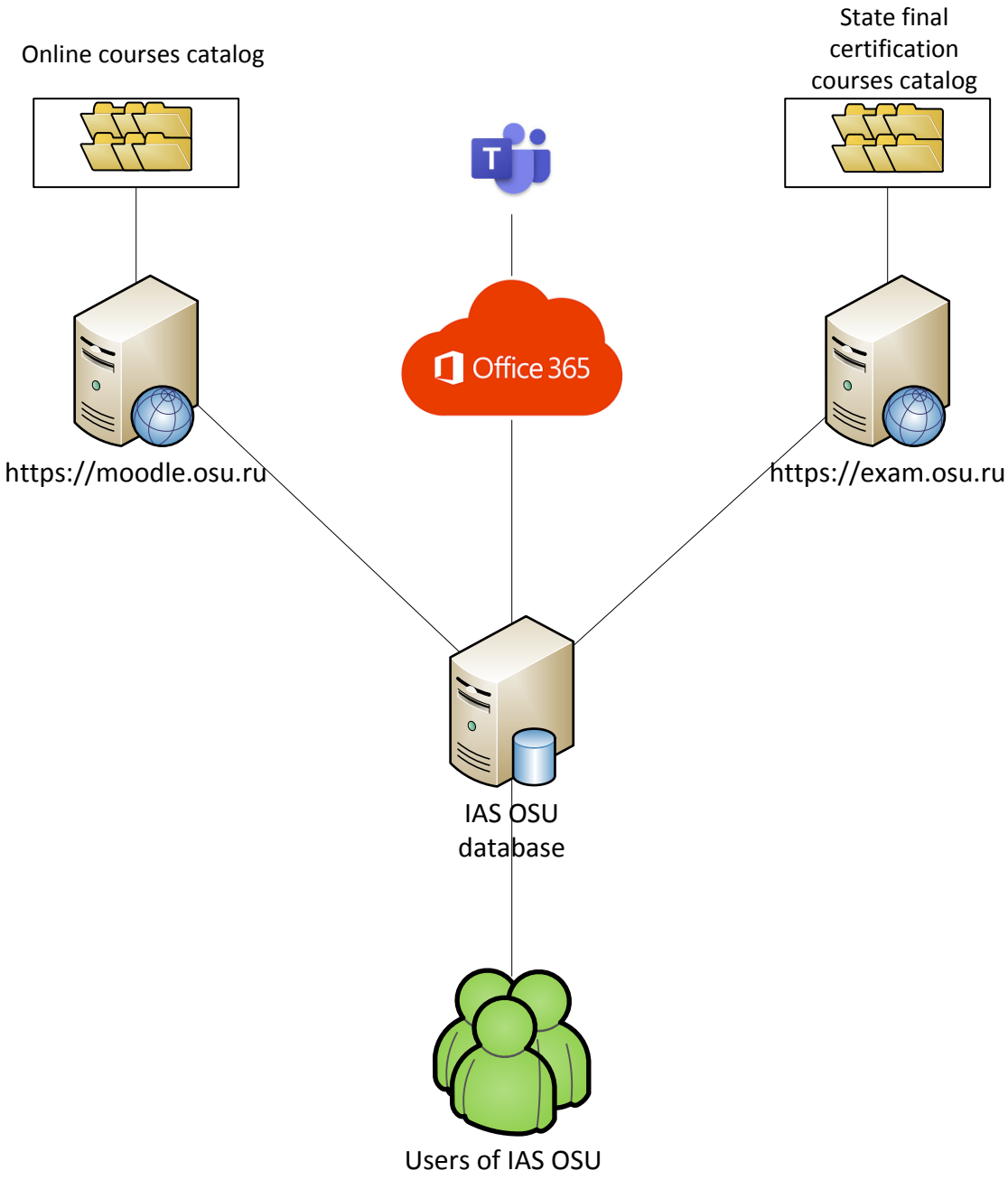

Figure 1: Diagram of the organization of distance learning at Orenburg State University

In order to comply with all the procedural features of the state final certification procedure in remote format, the problem of choosing examination tickets for students was implemented using the following organizational and technical solutions: The scenario for performing a state examination commission meeting with the use of distance technologies necessarily includes the procedure for selecting and familiarizing the student with the examination ticket. The secretary calls the student by his full name and carries out personal identification procedure. The secretary shares a screen of his personal computer, which contains files with prepared examination tickets, numbered in order. The student chooses one examination ticket. The secretary assigns the full name of the student to selected examination ticket and demonstrates the content of ticket by opening the file. The student examines the content of the examination ticket and verbally confirms the understanding of the questions. The secretary sends the selected examination ticket file to the student using the Microsoft Teams chat element.

In the process of conducting the state final certification, the executive secretary (moderator) performs proctoring over the observance of the rules for conducting the state final certification using distance learning technologies.

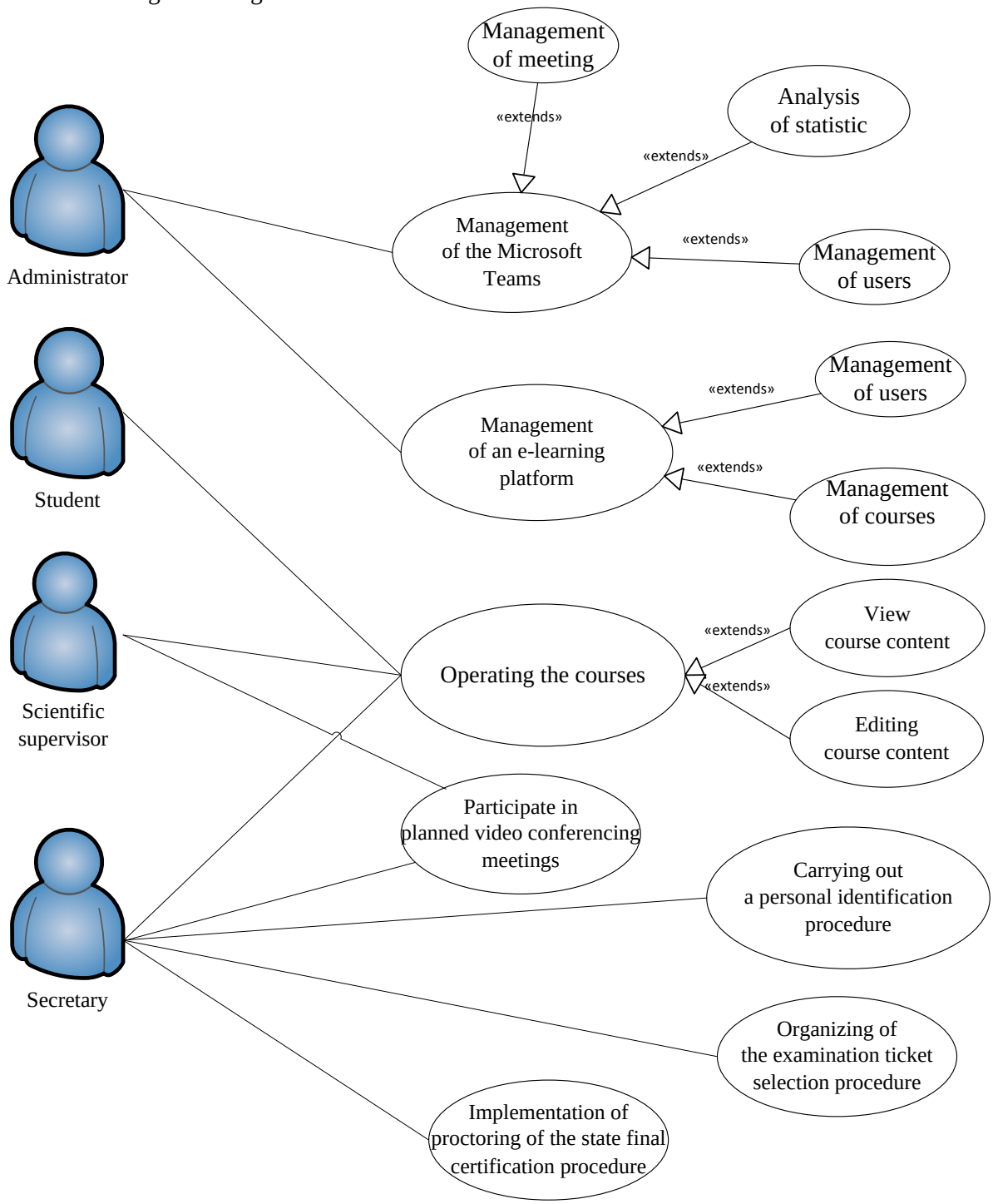

Figure 2: Use case diagram for the main roles

Monitoring the performance indicators of information systems involved in organizing distance learning indicates the effectiveness of the selected technology stack, which correlates with a high level of user activity of all subjects of the educational process. Figure 3 shows a graph of the total number of views on the exam.osu.ru platform for the time period from 05/20/2020 to 07/02/2020. The statistics of user visits to the platform for the same period of time is shown in Figure 4. Aggregate statistics on the usage of the Microsoft Teams service for the time period from 04/20/2020 to 07/02/2020 is presented in Figure 5.

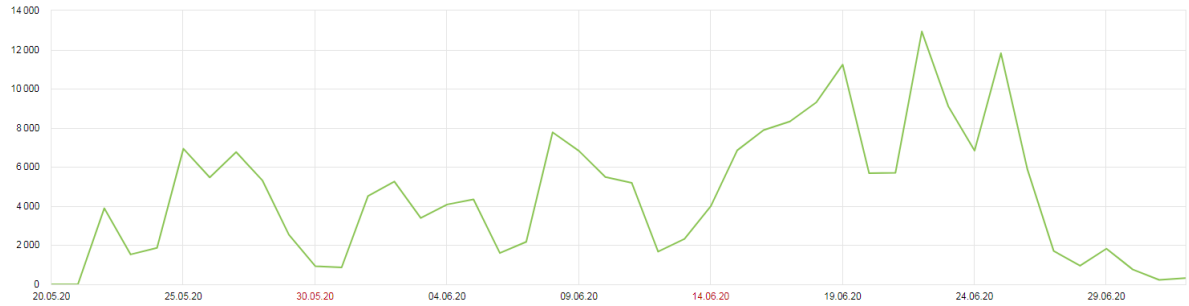

Figure 3: Statistics of views of the exam.osu.ru

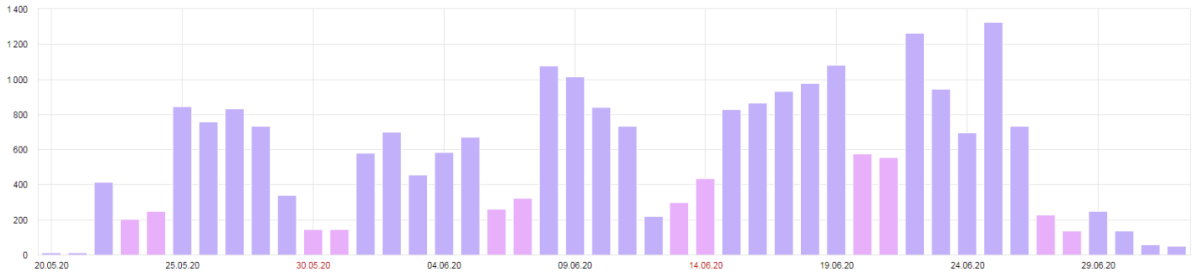

Figure 4: Statistics of visits of the exam.osu.ru

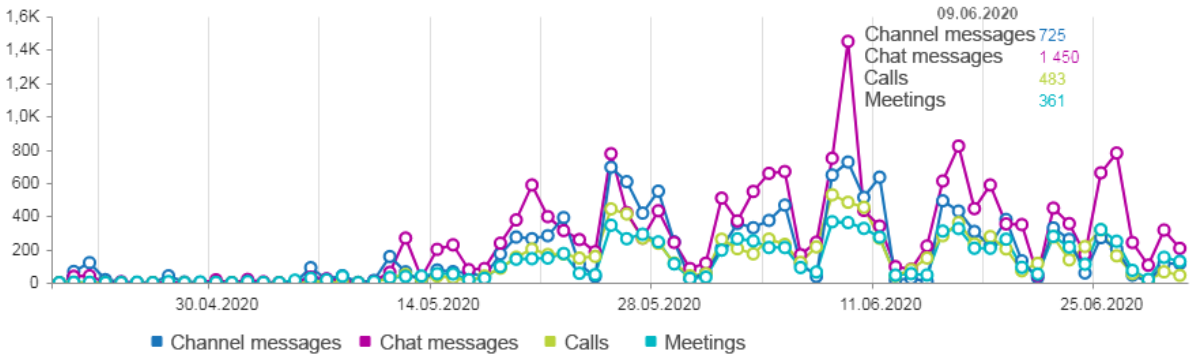

Figure 5: Microsoft Teams service usage statistics

5. Results

Orenburg State University has successfully completed the state final certification using distance technologies. An analysis of the qualitative indicators of the state final certification of OSU graduates demonstrates that, despite a difficult epidemiological situation and a rapid shift to distance educational technologies, the level of student performance remains at the same level, and the results of exams show a slight increase relative to the 2018/2019 academic year. An increase in quality indicators is observed in the undergraduate program (0.8% of the "excellent" grade, 1.19% of the "good" grade); in the specialty there is an increase in the "good" grade – 5.5% and the number of "satisfactory" grades decreases by 3.51%; in the master's program there is an increase in the "excellent" grades – 2.62% and the number of "satisfactory" grades is decreasing by 1.06%.

6. Discussion

Despite the various technical and psychological aspects associated with the rapid shift in learning technologies from full-time to distance learning for the entire contingent of students of an educational organization, the usage of organizational and technical solutions proposed in this paper has shown its

effectiveness and positively affected the quality of education. Evaluating the results of the state final certification, we can say with confidence that the use of distance learning technologies during pandemic or other special circumstances is the most effective solution to ensure the continuity of the educational process at a university. Among the main disadvantages of the usage of the digital educational environment the need for self-control and self-discipline of both students and teachers. The lack of full-fledged technical solutions is an objective factor influencing the provision of all forms of organizing the educational process in a distance format. Nevertheless, the proposed methods of online interaction between subjects of the educational process made it possible to implement new approaches to traditional teaching methods.

7. Conclusion

Accelerating the implementation of advanced solutions in the field of higher education will allow organizing a qualitative transition to a new paradigm of education in the era of digital transformation. To increase the effectiveness of distance learning technologies, it is recommended to develop online proctoring systems and develop mechanisms to stimulate student motivation, embedded in the electronic educational systems of universities

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9. References

[1] Huang, R.H. Handbook on facilitating flexible learning during educational disruption: The Chinese experience in maintaining undisrupted learning in COVID-19 outbreak. Beijing: Smart Learning Institute of Beijing Normal University (2020) URL: http://www.alecso.org/nsite/images/pdf/1-4-2.pdf.

[2] Basilaia G., Kvavadze D. Transition to online education in schools during a SARS-CoV-2 coronavirus (COVID-19) pandemic in Georgia. Pedagogical Research. Vol. 5, no. 4, (2020) 1-9. doi: 10.29333/pr/7937

[3] Basilaia G. (2020) Replacing the Classic Learning Form at Universities as an Immediate Response to the COVID-19 Virus Infection in Georgia, in: International Journal for Research in Applied Science and Engineering Technology (IJRASET). Vol. 8, pp. 101-8.

[4] Chick R. C. Using technology to maintain the education of residents during the COVID-19 pandemic. Journal of Surgical Education (2020). doi:10.1016/j.jsurg.2020.03.018

[5] Arora A. K., Srinivasan R. Impact of Pandemic COVID-19 on the Teaching–Learning Process: A Study of Higher Education Teachers, in: Prabandhan: Indian Journal of Management. Vol. 13, no. 4, (2020) 43-56. doi:10.17010/pijom/2020/v13i4/151825

[6] Tsyrenova M. I. Experience of using mass open online courses for distance learning of chinese students during the Covid-19 epidemic, in: Modern humanities success. no. 5, (2020) 31-35.

[7] Agafonova N. A. Implementation of general didactic principles in the application of distance technologies in the educational process in the conditions of Covid-19, in: Priority directions for the development of science and education (2020) 114-117.

[8] Bukeikhanov N., Gvozdkova S., Butrimova E. Evaluation of the effectiveness of digital teaching technologies in the conditions of COVID-19, in: Russian regions: a look into the future. Vol. 7. no. 2, (2020) 62-75.

[9] Gomzyakova E. M. Information technologies in training bachelor's degree in law, in: New legal studies. (2020) 170-172.

[10] Microsoft Teams Teamwork without barriers. URL: https://www.microsoft.com/ru-ru/microsoft-365/microsoft-teams/group-chat-software.

[11] Olkhovaya, T. A., Prikhodko O.V. Value dominants of the concept of "Education 3.0", in: University complex as a regional center of education, science and culture. (2020) 3249-3254.
[12] Usacheva, O.V., Chernyakov, M.K. Assessment of University Willingness to the Transition to Digital Educational Environment. Higher Education in Russia. Vol. 29, no. 5, (2020) 53-62. (In Russ., abstract in Eng.) doi: 10.31992/0869-3617-2020-29-5-53-62.
[13] Narimanova OV University 3.0 Concept: prospects for implementation in Russia under the conditions of a new technological revolution, in: Personality in a changing world: health, adaptation, development. Vol. 7., no 2., (2019) 350-363, doi:10.23888/humJ20192350-363.
[14] Budarina, A.O., Polupan, K.L. Digital Quality Management in Higher Education, in: Higher Education in Russia. Vol. 28. No. 4, (2019) 93-97. doi: 10.31992/0869-3617-2019-28-4-93-97.
[15] Zaporozhko V., Parfenov D., Parfenov I. Approaches to the description of model massive open online course based on the cloud platform in the educational environment of the university, in: International Conference on Smart Education and Smart e-Learning. – Springer, Cham. (2017) 177-187. doi:10.1007/978-3-319-59451-4_18
[16] Aldiab A. et al. Utilization of Learning Management Systems (LMSs) in higher education system: A case review for Saudi Arabia, in: Energy Procedia. – Vol. 160. (2019) 731-737. doi:10.1016/j.egypro.2019.02.186
[17] Rabiman, R., Nurtanto, M., Kholifah, N. Design And Development E-Learning System By Learning Management System (LMS) In Vocational Education. Vol, 9, p. 6.
[18] Juhaňák L., Zounek J., Rohlíková L. Using process mining to analyze students' quiz-taking behavior patterns in a learning management system, in: Computers in Human Behavior Vol. 92. (2019) 496-506. doi:10.1016/j.chb.2017.12.015
[19] Al Amoush A. B., Sandhu K. A New Model for Acceptance of Analytics in Learning Management Systems at Jordanian Universities (JLMS), in: Modern Technologies for Teaching and Learning in Socio-Humanitarian Disciplines. – IGI Global (2019) 138-161. doi:10.4018/978-1-5225-7841-3.ch007