# Problems and Prospects of Using Remote Learning Technologies in Different Countries

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**Abstract.** Modern society is faced with such unprecedented challenges as COVID-19, which in the globalization context can lead to a collapse in all activity spheres, including education. During the lockdowns, which will be similar to those undertaken against the pandemic backdrop, there is a need for a forced transition from class teaching to online forms. At the pandemic beginning, enough time has passed to assess the accumulated experience, comprehend the problems, both those that were resolved and those that could not be resolved promptly. The study made it possible to compare the effectiveness of using different virtual environments for organizing training for engineers, as well as to analyze the training content and its differences from what is used in traditional class training. Different students' groups were selected for the case study in order to compare their participation in the process with traditional and online forms of education, as well as their performance. In addition, an analysis was carried out of how the education form affects the quality of their projects and recommendations were formulated for the further development of new education forms.

**Keywords:** Remote learning · Digital learning · Learning motivation

## 1 Introduction

Although the engineering education system has been improving in recent years through the use of new e-learning opportunities, the forced rapid transition of universities to online education in the pandemic context a required the active introduction of new digital resources, methods and technologies of distance learning into the educational process. In the event of a forced "switch", problems arise due to both the "internal" unpreparedness of the participants for changes, and the need for a quick transition to another way of implementing the process, which may not be prepared both from a technical and organizational point of view, and from regulatory legal. Thus, many university professors, in view of their unwillingness in a tight schedule to master and use the new forms of teaching, tried to transfer the existing experience of traditional teaching in the classroom to an online format, which caused a number of problems. To increase the educational system sustainability and its readiness to work under stress conditions, it is necessary to identify the risk situations causes and measures to manage the system in non-standard conditions. Therefore, this article goal is to study the experience of the online learning implementation and his perception by engineering


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students in different countries to identify problems and factors affecting the educational motivation, as well as on successful acquisition of competencies necessary for professional activity in a digital society. Under these conditions, the relevance of analyzing the students position about new educational formats has increased. As a result of the forced transition to a remote learning format, students who previously studied in the traditional form gained experience of using these two education forms and could compare them. In turn, we, as researchers, used a unique chance to generalize students' perception of the learning process in two ways to explore the possibilities for the further development of these two formats in the higher education system, taking into account the positive and negative aspects. For the study, an online survey in the Google Forms format was used. The survey participants were undergraduate and graduate students of automobile department the Kazan Federal University and other universities. The study made it possible to assess the attitude of students to digital learning technologies. To find out the influence of online technologies on educational motivation and the formation of the required competencies for professional activity, the respondents were asked questions grouped according to features that allow making the following conclusions. First, to assess how prepared the students turned out to be in technical and technological terms for the new learning format. Secondly, what changes have occurred in the everyday teaching practices of students. Third, what are the advantages and disadvantages of the distance learning format adopted in the university? Fourth, what is the degree of satisfaction with the educational process when using distance technologies, depending on the hardware base chosen by the student and the educational platform, and how it affects the motivation for learning. Based on this analysis, recommendations were formulated for the further development of online technologies in the educational process.

## 2 Background: Online Education During COVID-19

During lockdowns, which will be similar to those announced a year ago against the pandemic backdrop, there is a need for a forced transition from traditional classroom learning to online forms. Now enough time has passed since the pandemic beginning, so many universities have accumulated experience, identified problems, as well as solutions that will help in the future.

### 2.1 Challenges of Transition to Online Education During COVID-19

The COVID-19 pandemic has triggered a global and sharp shift from regular face-to-face (F2F) classes to online in many educational institutions. According to the authors [1], measures are needed to mitigate the negative pandemic effects on engineering education, traditionally based on lectures, practical exercises, laboratory and projects. The authors surveyed 110 lecturers and 627 students from six engineering departments using forms that contained quantitative and qualitative questions to identify problems encountered during online learning in the spring of 2020. Negative issues included the following: logistical and technical, learning and teaching, privacy and security, and lack of sufficient hands-on training. Among the main problems, students noted lack of

activity in the classroom, fatigue from online sessions and difficulty concentrating, as well as the difficulty of passing exams online. According to the authors, sharing the results of this study with other educators can help improve the effectiveness of online engineering education by choosing new teaching methods both during crises and after a pandemic. Article [2] describes a study to online teaching and learning (OTL) readiness of 739 higher education teachers in 58 countries during a pandemic by (a) defining teacher profiles based on a set of key readiness parameters; (b) explaining profile membership by individual teacher characteristics, contextual aspects of the transition to OTL, and country-level indicators representing educational innovation and cultural orientation. The authors found that teachers in higher educational institutions are not a homogeneous group: three profiles of teachers with consistently high or low training or an inconsistent profile of readiness were identified. Important aspects are key individual and contextual variables such as teacher gender and previous OTL experience, OTL shift context, educational innovation potential, and cultural orientation. Obviously, a deeper understanding of the profile of teachers' readiness is an important step towards understanding how best to support them during the transition to OTL.

Article [3] presents the research survey results of 61 students about their opinion on online support systems. This survey provides the first recommendations for developing an online support system for university students. Most of the students indicated that the system should be designed with user preferences in mind, interactive and personalized, with an emphasis on time and money management, relaxation exercises and social skills development. Research shows that university students will welcome online support in overcoming the challenges they face at university. Article [4] is devoted to the role of the engineer in the modern world and the he ethical duties. As the authors point out, engineering education in the United States has always valued technical competence over social or ethical competence. To assess ethical issues that are not being addressed in US engineering education, a survey was conducted among 165 graduates of engineering departments of the US State University. The form asked two open-ended questions: 1) How can engineers cope with the COVID-19 pandemic? 2) How important is it for engineering classes to focus on issues of modern society, such as the COVID-19 pandemic? The survey results showed that engineering students have a genuine interest in improving society and tackling the challenges posed by the pandemic. However, engineering education often focuses on technical knowledge rather than ethical development, which is reflected in the themes that emerged in the responses. The role of ethics in the engineering profession, whether in general or in specific circumstances, is often taught as a fluent lesson rather than woven into the curriculum.

The study [5] examined the problems of online engineering education in 4 higher education institutions (HEIs) in the Eastern Visayas, Philippines. Results of an online survey of 25 lecturers and 421 students using Google Forms show, that 98% of respondents were ready for online learning using gadgets. The majority of respondents (94%) believe that the education quality has suffered from the sudden shift to online learning, and 64% believe that it is not as effective as traditional face-to-face classroom interaction. After Covid-19, 60% of educators prefer blended education (BE); while students (65%) prefer traditional face-to-face communication in the classroom.

### 2.2 Capabilities of Remote Laboratories

The authors [6] believe that since as a result of the COVID-19 pandemic there have been radical changes in engineering education, and change in the classical learning process paradigm, the main task in these conditions is to teach future engineers to work with real equipment, which cannot be accessed online mode. The digital twin concept implementation for industrial equipment can partially solve this problem, which has arisen in the process of distance learning, as well as improve the professional training quality after the pandemic ends. The paper [7] analyzes the impact of remote classrooms and laboratories as a result of "social distancing" during the COVID-19 outbreak. In developing countries, there is a problem of the Internet services availability for the engineering courses online delivery and assessment methods used during this global pandemic. The authors note that the crisis has made it possible to use a variety of distance learning tools for teaching and assessment. It emphasizes that Online Certification decision matrix for Evaluation of Online Learning Readiness is critical to maintaining quality by certifying online courses at different levels and incorporating student feedback as a key performance indicator.

The report [8] states that the pandemic had to rethink and replace laboratory and practical training in engineering education, and in addition, practice and internships almost disappeared. Universities were forced to innovate, with the biggest problem being the loss of hands-on work and contact hours when students were suddenly unable to visit and use laboratories, equipment and manufacturing facilities. At the same time, some felt the courses became more effective and flexible, while many others struggled with difficulties, including low motivation, lack of in-depth training and problems with Internet connectivity. The overall article [9] goal is to propose a viable approach to quality education in the field of energy in the COVID-19 period, for which developments were used to introduce augmented reality (AR) technology to train future engineers. The authors analyzed the necessary paradigm shift to maintain the benefits of using AR, highlighting the usefulness of AR in energy education as part of online learning, and suggesting a possible way to expand the use of AR in education and learning.

Thus, developing virtual labs will allow students to study the design features of units and parts of systems, mechanisms' operation, technological processes of repair and transportation [10, 11], contemporary concepts like reverse logistics [12], modern technologies like Digital Twins [13], but collaboration more effectively is becoming another important issue for successful acquirement of skills.

### 2.3 Self-motivation During COVID-19

The study [14] goal is to find out how the global emergencies such as Covid-19 affects graduates studying supply chain management, as uncertainties due to such events affect the employment of graduates, causing anxiety and stress. The authors explore what employers look for in students at critical times. This study shows that one must actively seek opportunities for improvement, be flexible, ready to be creative and adapt to new situations in order to successfully enter the labor market at critical times.

This essay [15] explores the emotional experiences of students during online engineering education. Because change can lead to significant increases in student

stress levels, the success of engineering education, both in the near and long term, depends on positive learning experiences. In addition, the online learning environment requires more self-motivation and self-regulation on the part of learners, as the computer-based learning environment causes difficulties. The emotional problems faced by students warrant further study, as new teaching methods must be taken into account as to how best to meet the academic intellectual and emotional needs of engineering students in order to ensure the quality education.

The article [16] focuses on a learning environment designed for e-learning for engineering students, studying student behavior, self-learning and self-assessment before and during COVID-19. While student engagement in online learning has increased, at the same time, teachers must interact with students, work together, and study student behavior across courses. The study [17] aims to examine the impact of the online learning climate on student engagement, as well as the relationship between online learning and student engagement according to basic psychological needs. The web survey involved 689 students attending online classes at ten (five public and five private) universities in Pakistan. The results show that the learning climate can stimulate more active student participation to get the most out of online learning, making online learning more resilient to similar challenges in the future. Such platforms provide more interactive and personalized experiences, and educators can regularly receive feedback from students to continually improve their online learning methods.

The study [18] goal is a statistical rating analysis of the students in the Department of Civil, Environmental and Civil Engineering (CCEE) of the San Diego State University (SDSU), obtained in the course of a self-standing online survey, in order to was to find out the scale of changes in the assessment of students of their own training in accordance with the requirements of ABET. The results showed that 81% of comparisons of student grades did not reveal statistically significant differences at the 5% level. According to student assessments, the core expectations for accreditation in the form of mandatory learning outcomes were satisfactorily met both before and under the COVID-19 restrictions. This transition led to a decrease in grades only in 21% of cases, and the transition had the most negative impact on the results of those courses in which the emphasis is on laboratory experience and teamwork. The most difficult and demanding adjustments were in courses with significant laboratory components.

The authors [19] argue that online courses, which are an integral part of basic higher education, often lack teacher feedback and all forms of communication. Student engagement is essential to effective learning and enhancing student satisfaction. There are online learning strategies that can improve students' perception of engagement. Educators should design courses using modern technology that will improve the online learning environment and increase student engagement, retention and satisfaction.

### 2.4 Problems of Monitoring and Evaluation of On-Line Learning Results

The article [20] discusses the relevance of evaluating student online learning processes for university degrees by assessing the students' perception of the online learning quality in five specific courses at the Faculty of Engineering at the University of Burgos, Spain. According to students' perceptions, teachers had the technical knowledge, social skills and personality to adapt their courses to online methodology during

COVID-19. The results showed that the quality scores of both F2F and online learning were very similar and highly dependent on the teacher's work, and in some cases the quality of learning improved according to the students. However, the general disadvantages of online learning are associated with the lack of direct contact between teacher and student, and between the students themselves, as well as with the personal qualities of students, their ability to self-regulate their learning. The use of web tools (Skype, Microsoft Teams) increased when it was needed to explain practical concepts.

Study [21] presents the impact of COVID-19 on the practice and implementation of Geotechnical and Geoecological Engineering (GGE) training modules, based on feedback from teachers from 14 countries. Key challenges for educators appear to be how to maximize learning flexibility and meet physical distance requirements without compromising learning outcomes, educational equity and interpersonal interactions in traditional F2F learning. Three future opportunities are identified, namely smart learning, flip learning and interdisciplinary education, which can provide learners with a more sustainable, engaging, interactive technology-driven learning environment, and equality of opportunity and interpersonal communication, can help GGE educators develop a more sustainable educational environment. Article [22] discusses a possible solution to help teachers track students' attention using a computer program for facial analysis. The article states that the program can automatically determine attendance by analyzing face detection data, and also determine if any student leaves the class early. The authors come to the conclusion that the program can provide attentiveness to all students in an online classroom. It is shown that a useful user interface will allow the program to be used more intuitively, and the development of a mobile application will allow teachers who use the phone for online classes to make their work easier.

## 3 Analysis of the Automotive Faculty Students Transition to Online Learning

The forced and rapid transition of universities to digital education in the context of the pandemic has actualized the issues of attitudes towards it among students who are focused on traditional forms of education at a university, and the possibilities for the further development of this scenario in the higher education system.

### 3.1 Problems of Transition: Student and Lecturer Assessment

About 15% of the entire faculty took part in the survey. The results of the study showed that teachers are organizationally ready for the transition to online learning formats, but psychologically they do not accept such a sharp break with traditional daytime education. A skeptical attitude towards what is happening is associated both with the peculiarities of the disciplines taught (for example, technical and experimental), and with conservative views on the educational process. Although, two positive social characteristics of the professional lecturer community were recorded: the adoption of a state policy to counter COVID-19 and the availability of skills and abilities to work in an online format. The main results of the survey are shown in Fig. 1. According to the majority of both teachers and students, a blended education form will be the most

rational [23, 24], since not all types of distance learning are effective. The survey of students was carried out using online in Google Forms. In a pilot study of students' positions towards online learning, 344 full-time students (85.1% of bachelor's degrees and 14.9% of masters) took part. The age respondents' structure: 20 years old and younger - 25.6%, 20–25 years - 70.3%, 26–30 years - 1.7% and over 30 years - 2.3%. To determine the technical and technological preparedness of students for the transition to the online learning format, questions were asked about the problems and positive aspects. Among the most significant technical problems, students noted the communication instability during the classes (25%), the need for stable access to the Internet (24.9%), low Internet speed (19.8%), feedback lack, technical means lack and other reasons. The survey showed that only 65% of students were satisfied with the Internet quality when connecting to classes. At the same time, 74.4% of students were satisfied with the personal communication capabilities. The most frequently used for online training: laptop (desktop) - 49.4% of students, smartphone (tablet) - 49.1%. This shows that not all students can use computers for online learning.

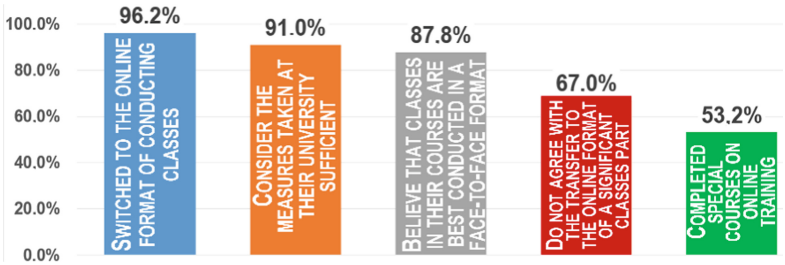


**Fig. 1.** Results of the teacher survey

Although the online survey does not show the full picture of difference in access to online learning, the problem of "digital inequality" exists and its causes can be both material reasons and lack of access to broadband Internet in their living places.

### 3.2 Educational Process' Difficulties in the Online Format

The survey showed that the transition to online learning caused a number of problems for students: only 51% of the surveyed students adapted well to online learning. At the same time, in addition to technical difficulties, there were problems associated with the specifics of online learning itself, as well as the lack of the necessary skills. The main problems of online learning identified by students are shown in Fig. 2. Another problem, identified during the survey is low self-motivation and self-control, as well as inability to plan one's time and untimely feedback from the lecturer (Fig. 3). There were also problems with the lack of educational and methodological materials, especially for disciplines that require the acquisition of practical skills. The most frequently used methodological university guidelines (62.8%), methodological guidelines on the Internet (56.4%) and video materials provided by the university (40.4%) (Fig. 4).

At the same time, to search for educational resources and methods of their development, students turned to teachers - 33%, used the experience of other students - 32%, searched independently - 32.2% and "failed to find" 2.8% of students. To interact with teachers in online learning, students used: Microsoft Teams (56.7%), "Virtual classroom" of the university (26.2%), Zoom, Skype (13.4%) and other platforms (3.7%).

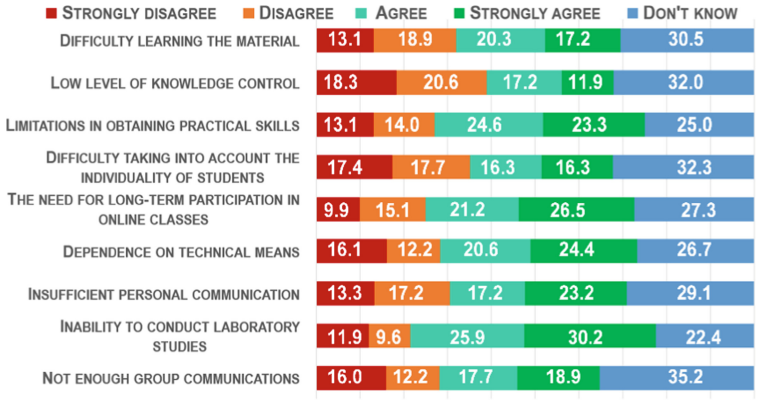


**Fig. 2.** The main problems of online learning


**Fig. 3.** The main problems at the self-dependent students work

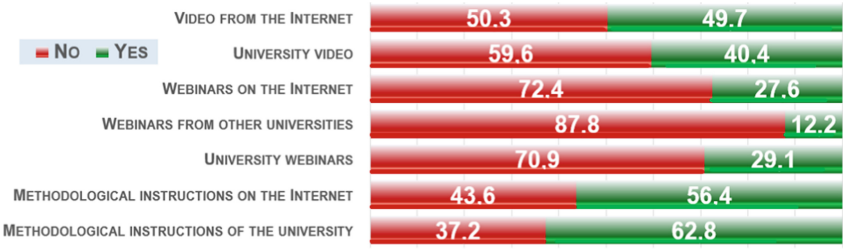


**Fig. 4.** Using additional teaching materials

Students see the such advantages of online learning as: the possibility of combining study with work; increasing the skills of independent work; the availability of materials and the ability to use them at a convenient time and in a familiar environment, and the such disadvantages as: the need to spend a lot of time at the computer during classes and independent work; lack of personal communication, both with teachers and with other students; inability to access the laboratory and gain practical skills; dependence on technical means and a decrease in the education quality.

### 3.3 Dependence of the Exam Session Results on Various Factors in Online Learning

To search for educational trends and assess the exams results after online training in the spring of 2020, were analyzed the summer session results of students-engineers of 1–4 courses of KFU (1191107-Materials Science and Technology of Materials; 1191109 - Mechanical Engineering; 1191111 - Design and technological support of engineering productions; 1191113 - Vehicle designer; 1191115 - Repair and maintenance of vehicles; 1191116 - Vehicle and automobile economy; 1191121 - Transport and logistic; 1191133 - Vehicle service). As a result, the average score in the theoretical (lecture) part of natural-sciences disciplines turned out to be higher than for the implementation of practical tasks. The resulting dependencies by disciplines: mathematics (M), structural materials technology (SMT), information technology (IT), descriptive geometry and computer graphics (DG & CG) are presented in scatter diagrams (Fig. 5, 6).

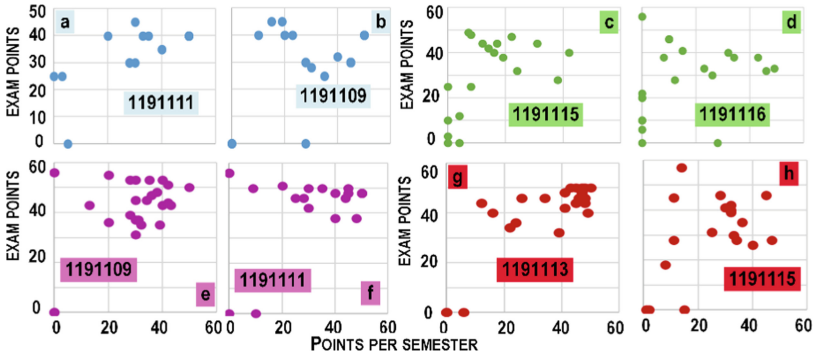


**Fig. 5.** Exam results in maths (a, b - teacher 1, c, d - teacher 2) and in SMT (e, f - teacher 3, g, h - teacher 4)

As can be seen from the diagrams, the teacher personality does not affect the grades, which depend only on the curriculum, therefore, the feasibility and effectiveness of online classes is higher for a lecture course, and personal communication between the student and the teacher is required to obtain practical skills. On the scatter diagram of results in physics (Fig. 7a, b), two clusters are clearly visible: students who received low scores both in the semester and on the exam, and students with scores

above the average. Students of the first cluster note problems with the use of teaching materials, which forces professors them to solve the issue of using online technologies for courses related to obtaining practical skills.

Similar results for foreign languages (Fig. 6c–e) are explained by the complexity of organizing paired language practice when using some online platforms (MS Teams) or the lack of such an opportunity (Virtual classroom). Comparison of exam results in IT and other disciplines showed that IT proficiency directly affects the results of the session. For example, students of the fourth group (Fig. 7a) have a high average score in both IT and other disciplines (see also Fig. 5). Students from this group, when surveyed, indicated that they did not experience any difficulties in the transition to online learning.

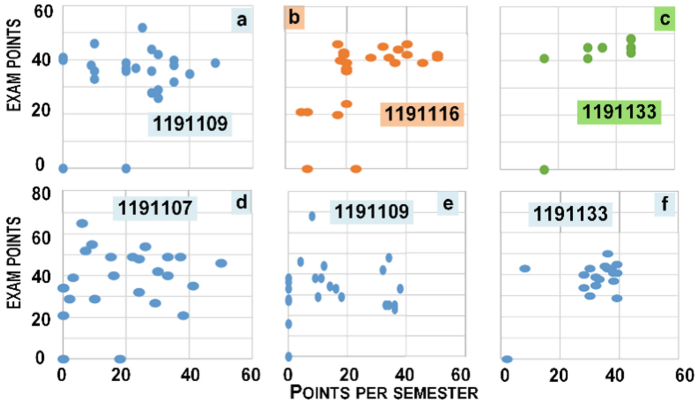


**Fig. 6.** Exam results in IT (a - teacher 1; b - teacher 2; c - teacher 3) and in DG & CG (d, e, f - teacher 4)

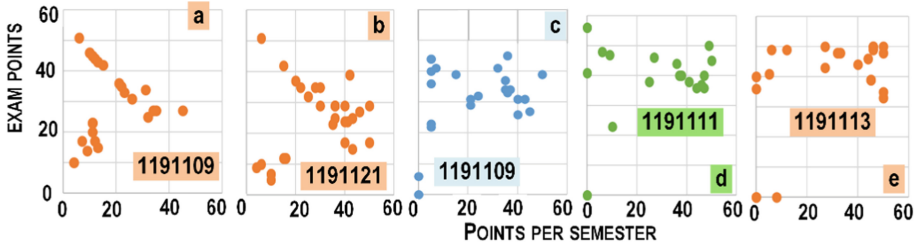


**Fig. 7.** Exam results in physics (a, b - teacher 1) and foreign languages (c - teacher 2; d - teacher 3; e - teacher 4)

In addition, the exams result in the same discipline of the same course to different teachers (Fig. 8b) demonstrate that students receive approximately the same scores in M and IT, with the exception of the last two groups in which M-classes were taught by

another teacher, who, according to the "Teacher with the eyes of a student" survey results, has a low score. Thus, academic performance depends not only on the individual student qualities, but also on the teaching methodology.

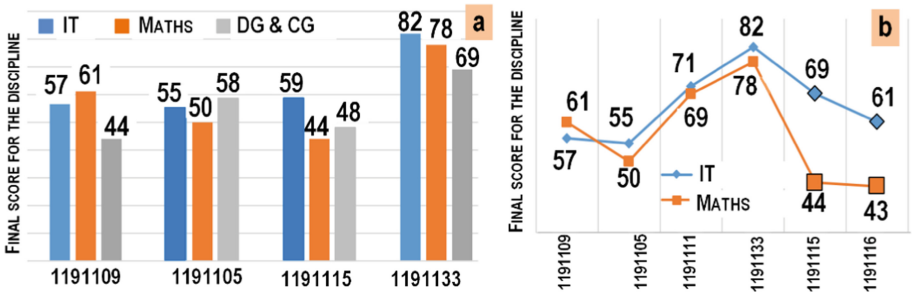


**Fig. 8.** (a) Average scores based on exams' results; (b) comparison of average scores in IT and Maths

## 4 Conclusion

Based on the online survey results, the advantages and disadvantages of online educational technologies were established, the main limitations and factors of reducing educational motivation in online learning were identified. Regardless of the university territorial location, the majority of students spoke in favor of the fact that the use of distance technologies is a necessity in modern society and will be actively used in the higher education system, due to a number of advantages. However, existing digital learning tools are insufficient to stimulate learning motivation, especially for students with a low initial training level. In addition, in engineering education, online learning cannot completely replace traditional laboratory and hands-on training in a traditional form. The educational content existing at the lockdown time could not ensure the proper education quality level and understanding of the real processes' essence, although at a certain elaboration level, practical exercises can be replaced by VR laboratories, therefore, it is necessary to develop specialized virtual laboratories. Based on the research results, we received answers to the following questions: (1) What difficulties arise in the implementation of online education forms, and what its advantages help to increase the motivation of engineering students. (2) How socio-demographic factors affect the mastering success and the distance learning perception. (3) What virtual environments are most effective in terms of process management, education quality, student engagement, and increasing their motivation. (4) For the implementation of what learning forms is best suited online form. (5) What resources and software should be developed to control the learning quality and process organization?

## References


1. Asgari, S., et al.: An observational study of engineering online education during the COVID-19 pandemic. https://doi.org/10.1371/journal.pone.0250041. Accessed 29 June 2021
2. Scherer, R., et al.: Profiling teachers' readiness for online teaching and learning in higher education: who's ready? Comput. Hum. Behav. **118**, 106675 (2021)
3. Goozée, R., et al.: Survey to inform the development of an online support system for higher education students – higher education and online support. Health **10**, 351–364 (2018)
4. Roy, A., et al.: Ethics in engineering education during COVID-19 pandemic. Issues Educ. (2020). https://doi.org/10.1287/orms.2020.06.10
5. Perante, W., et al.: Challenges to online engineering education during the Covid-19 pandemic in Eastern Visayas, Philippines. Int. J. Learn. Teach. Educ. Res. **20**(3), 84–96 (2021)
6. Rassudov, L., Korunets, A.: COVID-19 pandemic challenges for engineering education. In: XI International Conference on Electrical Power Drive Systems (ICEPDS), pp. 1–3 (2020)
7. Khan, Z.H., et al.: Distance learning in engineering education: challenges and opportunities during COVID-19 pandemic crisis in Pakistan. Int. J. Electr. Eng. Educ., 1–20 (2021). https://doi.org/10.1177/0020720920988493
8. FEATURE: 5 ways the Covid-19 pandemic has changed engineering forever. https://www.imeche.org/news/news-article/feature-5-ways-the-covid-19-pandemic-has-changed-engineering-forever. Accessed 29 June 2021
9. Opriş, I., et al.: Challenges and opportunities to overcome. The impact Of COVID-19 pandemic on power engineering education. TEM J. **9**(4), 1687–1691 (2020)
10. Vakulenko, K., et al.: Designing optimal public bus route networks in a suburban area. Transp. Res. Procedia **39**, 554–564 (2019)
11. Galkin, A., et al.: Last-mile delivery for consumer driven logistics. Transp. Res. Procedia **39**, 74–83 (2019)
12. Makarova, I., et al.: The role of reverse logistics in the transition to a circular economy: case study of automotive spare parts logistics. FME Trans. **49**(1), 173–185 (2021)
13. Shubenkova, K., et al.: Possibility of digital twins technology for improving efficiency of the branded service system. In: Proceedings, GloSIC 2018 (2018)
14. Stratton, A., Curkovic, S.: Global emergencies: how do they affect supply chain management students? Creat. Educ. **12**, 231–264 (2021)
15. Park, M., et al.: Online engineering education under COVID-19 pandemic environment. Int. J. Multidiscip. Perspect. High. Educ. **5**(1), 160–166 (2021)
16. Jamalpur, B., et al.: A comprehensive overview of online education – impact on engineering students during COVID-19. Mater. Today Proc. (2021). https://doi.org/10.1016/j.matpr.2021.01.749
17. Shah, S.S., et al.: Online learning during the COVID-19 pandemic: applying the self-determination theory in the 'new normal.' Revista de Psicodidáctica **26**(2), 168–177 (2021)
18. Supernak, J., Ramirez, A., Supernak, E.: COVID-19: how do engineering students assess its impact on their learning? Adv. Appl. Sociol. **11**, 14–25 (2021)
19. Mitchell, A.: Online courses and online teaching strategies in higher education. Creat. Educ. **5**, 2017–2019 (2014)
20. Revilla-Cuesta, V., et al.: The outbreak of the COVID-19 pandemic and its social impact on education: were engineering teachers ready to teach online? Int. J. Environ. Res. Public Health **18**, 2127 (2021)
21. Ning-Jun, J., et al.: Geotechnical and geoenvironmental engineering education during the pandemic. Environ. Geotech. **8**(3), 233–243 (2021)

22. Ghani, T., et al.: Development and analysis of a machine learning based software for assisting online classes during COVID-19. J. Softw. Eng. Appl. **14**, 83–94 (2021)
23. Makarova, I., et al.: An integrated platform for blended learning in engineering education. In: Proceedings of the 9th International Conference on Computer Supported Education - Volume 2: CSEDU, pp. 171–176 (2017)
24. Makarova, I., Pashkevich A., Shubenkova, K.: Blended learning technologies in the automotive industry specialists' training. In: 32nd International Conference on Advanced Information Networking and Applications Workshops (WAINA), pp. 319–324 (2018)