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► The impact of the COVID-19 pandemic on further learning in Vocational Education: analysis and best practices

The College of Electric Power and Mechanical Engineering (CEM) is part of the structure of the Institute of Engineering-Pedagogical Education of the Russian State Vocation Pedagogical University (RSVPU). The College carries out educational activities based on educational programmes of intermediate Vocational Education. Adapting to the new reality showed that bite-size learning can be called one of the most successful approaches to solve the problem of students' scattered attention. Virtual/augmented reality and immersive technologies have become a powerful and promising tool in education thanks to their unique technological characteristics that distinguish them from other IT applications. However, the forced transition to a distance mode of operation was a serious challenge for all participants in the educational process and was associated with great difficulties for the administration of the institutions and for teachers as well as for students.

During the pandemic, total digitalization was one of the most important topics throughout the world, and the most acute and important subtopic was the digitalization of the educational process. Unlike in higher education, a so-called electronic informational and educational environment (EIEE) is not a mandatory requirement in the intermediate Vocational Education system in Russia. Therefore, the complete and forced transition to a remote mode of operation was a serious challenge for all participants in the educational process and was associated with great difficulties for the administration of the institutions and for teachers as well as for students.

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In April and May 2020, the RSVPU conducted a survey of both students and teachers on the topic of "E-learning and Distance Educational Technologies (DET) Assessment by Students and Teachers."

In this survey conducted immediately after the start of the pandemic, 43 percent of students reported that the effectiveness of their educational process had decreased, 12 percent said it had increased, and 45 percent said it had not changed. When asked to “Specify your preferences for the mode of education,” 49 percent of students expressed a preference for a combination of in-person and e-learning, 33 percent for traditional in-person education, and 18 percent for e-learning and DET only.

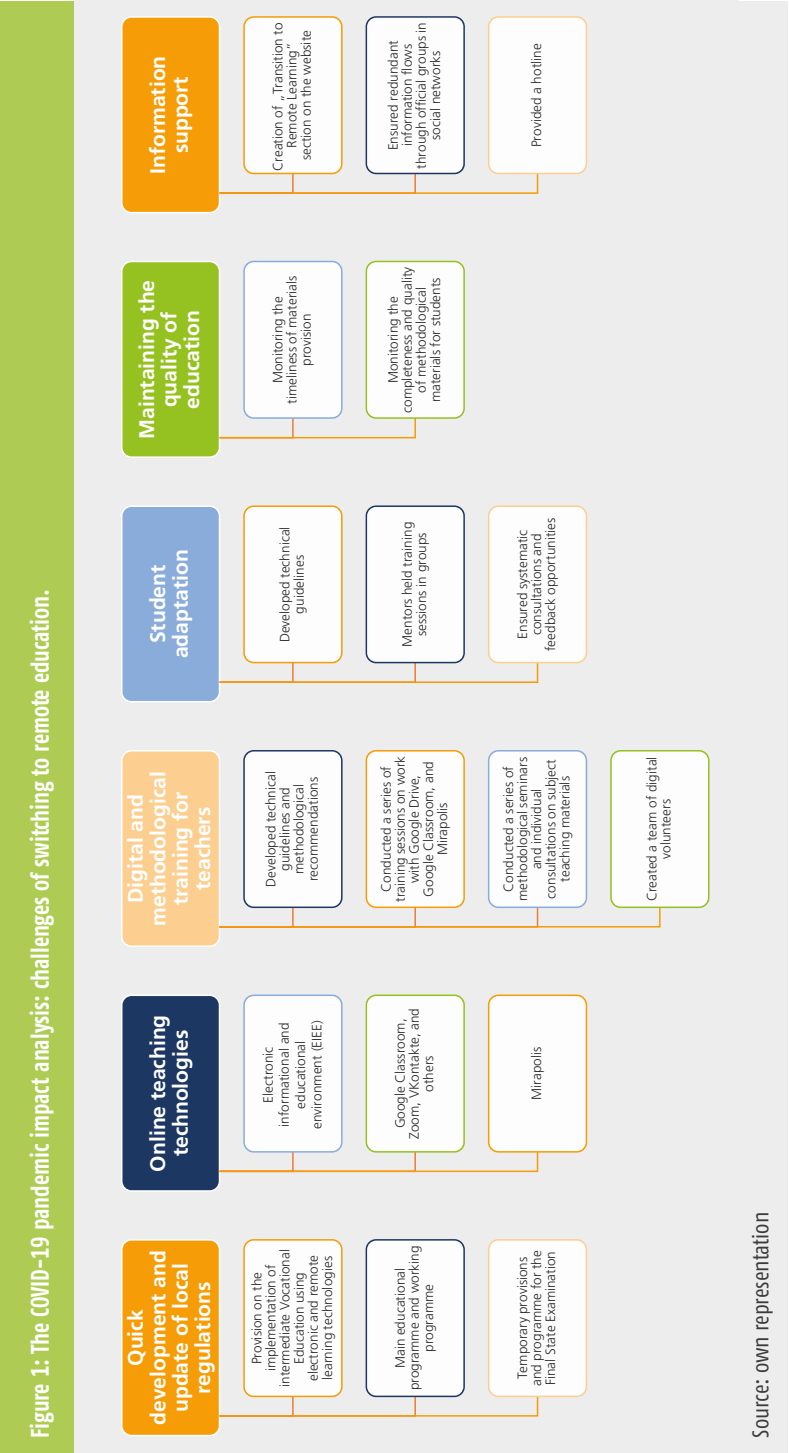
We also surveyed students about their opinions on the benefits of e-learning and DET. 65 percent said that with this type of training, “There is no need to spend time traveling to the place of study,” 61 percent mentioned “Saving money on transportation expenses,” 44 percent mentioned a “More flexible daily schedule,” and 28 percent said they liked “The ability to perform other tasks while studying online.” Teachers, on the other hand, noted the following advantages of switching to distance learning:

1. Complementing educational materials with interactive tools: 54.4 percent
2. Development of skills and knowledge in accordance with the latest modern technologies and standards: 48.9 percent
3. Update of educational materials: 42.2 percent
4. More flexible daily schedule: 32.2 percent
5. Convenience of monitoring the level of achievement through a system of tests and quizzes: 24.4 percent
6. Providing assistance for the in-depth study of issues of interest to students: 12.2 percent
7. More time for online professional development: 11.1 percent
8. Ability to make learning materials more accessible for students: 6.7 percent

The information systems that teachers used for e-learning and distance education varied and included MS Teams, Skype, the Mirapolis LMS, and Zoom.

As V. Grishin, Rector of the Plekhanov University of Economics, notes, “...If you don’t have problems, you don’t have remote learning” (ZERNOV et al. 2020). Our problems were solved in stages, since the problems themselves were multifaceted.

At RSVPU, all the problems related to the transition to distance education were systematized (Figure 1).



The first set of problems was organizational; it was necessary to quickly develop and update local regulations for the implementation of the educational process using e-learning and DET.

The second set of problems was methodological and tool-related. The university administration and the teachers held a series of joint methodological and informational seminars and trainings as well as intensive courses on conducting online classes. Also, technical and methodological recommendations for the use of DET were developed. A team of digital volunteers at RSVPU was trained to support the online classes. The digital volunteers assisted with simultaneous classes, helped teachers master digital tools, and facilitated the creation of electronic content. In addition, the students also needed to adapt. Now, they needed instant feedback from teachers on their assignments. A section called “Transition to distance education” was added to the website of the university. It included a hotline for both students and parents who were concerned about the implementation of the educational process.

The third block of problems was informational. The heads of structural units had to continuously monitor the timeliness, completeness, and quality of educational and information materials.

During the pandemic, the question of which principles and approaches are best applied to online education has become quite acute. SberUniversity’s *EduTech* magazine lists the following approaches to engaging learners in the educational process, which in our opinion are also applicable to online education (SBERUNIVERSITY 2020):

1. Personalized learning: learning designed around the interests, experiences, methods, and the learning speed most suitable to a particular learner
2. Problem-based learning: an approach that immerses students in a real situation even before they acquire knowledge about the object being studied. They need to analyze the problem, examine additional information, form a hypothesis, choose the best solution, and achieve a specific result
3. Learning through experience: a set of educational techniques that involve the participation of students in an activity and the acquisition of relevant experience, as well as the evaluation of this activity and acquired experience and the identification and acquisition of new knowledge and skills
4. Challenge-based learning: students are challenged to autonomously solve a real problem encountered by an existing company
5. Social learning: sharing information and experiences, collaboration between learners and external participants, and the joint creation of content within social networks

Of course, the pandemic has shown the need to use modern digital technology as part of the educational process. Currently, the most relevant technologies in online education are gam-

ification technologies, video content, technologies of virtual and augmented reality, digital twins (simulators), and smart assistants (chatbots).

Let us examine some of them. *Gamification* allows you to motivate and stimulate learning through game thinking and game techniques. Teaching material that incorporates gamification techniques should be clearly structured, lead to a positive attitude for the learner, and contribute to a competitive spirit. It spurs an individual to be a better learner, and at the same time it improves the team spirit.

It was recently, during the pandemic, that the availability of instructional videos increased significantly. According to researchers, the viewers' maximum level of concentration is in the first 5–8 minutes; thus, in order to maximize the acquisition of knowledge, the *video content* should be delivered to the learner in portions, and the learning results evaluated. Bite-size learning can be called one of the most successful approaches to solve the problem of students' scattered attention. For learning in "small chunks," modules of up to 15 minutes in length are created using a variety of tools (videos, blogs, and games) and tests. As a result, a person receives specific and targeted information, thereby significantly saving their own time. In addition, all modules can be studied repeatedly. When combined, they can be used to introduce broad topics and provide a more detailed view of the subject matter than traditional linear presentations.

Virtual and augmented reality and immersive technologies have become a powerful and promising tool in education because of their unique technological characteristics that distinguish them from other IT applications. Some experts talk of a radical change in the familiar world, a coming revolution that will affect learning as well (KORNILOV 2019). In this process, one major challenge is changing educational technologies and creating promising integrated learning systems where the immersive approach, a set of progressive techniques implemented under fundamentally new conditions, will play a key role. It should be noted that most teachers are not ready to implement new methods and technologies, including innovative approaches such as the immersive approach.

A *digital twin* is a virtual computer model of a production line or another physical piece of equipment that displays the actual state and operational parameters of its twin. It includes the exact geometry of the equipment with the possibility of element-by-element study (three-dimensional atlas), as well as databases containing technical and operational documentation, equipment characteristics, and basic parameters. The digital twin enables an interaction with real equipment at all stages of its life cycle. At the manufacturing stage, the developed model will help in determining the required tolerances and manufacturing accuracy to maintain the performance characteristics and resilient operation of the equipment during its entire service life, as well as allow to quickly identify the causes of failures during the testing process. At the operation stage, the digital twin model can be refined and used to implement feedback, to diagnose and predict failures, to improve performance, as well as to recalibrate the machine, and identify new consumer needs and required upgrades (EXPERT 2021).

The pandemic has accelerated the transition to the new digital world. Technical, methodological, and psychological practices were also needed to regulate the relationship between the learner and the faculty.

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