Modern trends in the digitalization of education

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Abstract. The process of education digitalization has been on its way for a long time. However, a strong surge of interest arose during the period of temporary communication restrictions associated with Covid-19 and the widespread transition to a completely remote format of interaction between all participants in educational process. Digitalization has affected all levels of education and directly the activities of students, teachers, administrators, or stakeholders. The purpose of the study is to evaluate the current state of education digitalization. The objectives of the research are to study trends in the global and domestic online education market, identify the features of digital educational activities implementation in the Russian Federation, and comparatively analyze the willingness of secondary and higher education to put digital distance learning into practice.

1. Introduction
The digital educational technology market today is in an extremely favorable ecosystem formed by the massive transition of users to online learning. Over the past year EdTech has become one of the leaders in private and venture capital investments for startups. Such organizations as the UN, UNESCO and the World Economic Forum have shown serious interest in them. Digital technologies are becoming a factual driver of social change around the world, which gives particular importance to research in this area.

The theoretical aspects of training with the direct use of EdTech are widely discussed in higher education [1], social and legal aspects of applying digital technologies in secondary [2] and higher education [3], pedagogical approaches to the use of electronic educational resources [4, 5], and health problems in the era of digital education [6]. Of particular interest is the formation and development of continuous digital education [7]. The problems and prospects of education digitalization are massively covered from various points of view, however, the current state of this area in the Russian Federation, taking into account the experience gained during the period of temporary communication restrictions, for all participants in the educational process currently does not have an unambiguous evaluation and is an urgent research topic.

2. The current state of the EdTech (Educational Technology) labour market
At the beginning of 2020 all educational organizations without exception faced a “digital challenge”. Regardless of whether educational organizations have experience in the implementation of educational programs in digital format, the desire to implement such programs and current technical capabilities, at the end of March 2020 the transfer was made online. That forced experiment, which lasted for more than three months, made it possible to identify numerous features of education digitalization to gain
insight into the key trends and prospects for its further development. At all events, traditional education received a strong motivation for transformation. Representatives of the education system, who prior to the pandemic adhered to patriarchal views and were supporters of an exclusively full-time classical version of interaction between a teacher and students, were forced to accept digitalization and recognize if not its unconditional effectiveness then at least its applicability and viability. The digital revolution, which began in the field of education in the early 2000s, maximized its resources during the pandemic. This was largely due to unexpected ongoing "emergency" transition to a remote format of interaction.

The average annual growth of global online education market back in 2019 was estimated at 8.2%, however, Covid-19 made significant adjustments to the predicted values of its development. According to analysts, the total online educational market has grown by almost 10 times in less than half a year, and, despite the expected slowdown in its growth after passing extremely high values, it will continue to show slightly more active growth than had been previously predicted. Figure 1 shows a comparison of 2019 trends and the current forecast of the online educational market by the British marketing research agency Technavio (Research Report: Distance Learning Market (2019-2023)).

Regardless of the sharp rise in the global online education market, its projected structure has not changed. Analysts expect that by 2030 the secondary education segment of the digital technology market will account for 55% of the total volume of digital education, 25% will be the share of higher education, 8% - preschool education, 6% - corporate training and 8% of the market will be occupied by the lifelong learning.

Today all projects involving education digitalization, regardless of educational level in which they are most applicable, are divided into four categories: educational services and platforms; services for managing the educational environment and content delivery; various digital tools used in teaching (virtual reality, proctoring, gamification, etc.), and projects aimed at innovative methods of development in pedagogics. At the same time, one cannot but agree with the existing variety of classifications of digital technologies in education: for example, the authors of the interactive registry "Global Learning Landscape" have identified over 50 clusters-subsets to which the modern project EdTech (Educational Technology) in the field of education digitalization can be attributed.
The domestic online education market in the structure of the global EdTech industry does not occupy the best positions (about 1%), however, similarly to the world market, it shows a stable growth (depending on the segment, by 17-23% per year). The period of temporary communication restrictions associated with self-isolation has become a driver for the Russian EdTech market, the volume of which according to the current Interfax-Academy estimates in 2020 is accounted for about 60 billion rubles. At the same time, it should be noted that the Russian EdTech market demonstrates significantly higher growth rates compared to the world situation. This fact can be explained by the influence of the low base effect.

3. Evaluation of the distance educational process features
The forced transition to distance interaction between teachers and students affected three main areas: secondary education, higher education and corporate training, which have their own advantages and disadvantages that affect the success of transition to online format. The author's relative evaluation of the features of digital educational activities in the Russian Federation is presented in Table 1. Clearly, the average evaluation is quite generalized, and individual educational institutions can demonstrate both the least and the most successful indicators of criteria for digital activity evaluation.

Table 1. Evaluation of the distance educational process features.

| №  | Evaluation criterion                                      | Secondary education | Higher education | Corporate training |
|----|----------------------------------------------------------|---------------------|-----------------|--------------------|
| 1  | Technical and hardware capabilities                      | low                 | average         | high               |
| 2  | Software capabilities                                   | high                | average         | low                |
| 3  | Teaching staff competence                               | low                 | high            | average            |
| 4  | Students’ competence                                    | average             | high            | low                |
| 5  | Teaching staff level of responsibility                   | average             | average         | average            |
| 6  | Students’ level of responsibility                        | average             | average         | high               |
| 7  | Digital etiquette of educational process participants    | average             | average         | high               |
| 8  | Digital inequality of educational process participants   | high                | average         | low                |
| 9  | The level of student requirements for digital content    | average             | high            | low                |
| 10 | Use of educational gamification                          | average             | low             | high               |
| 11 | Use of synchronous communication                         | average             | high            | average            |
| 12 | Personalized training delivery                           | average             | average         | average            |
| 13 | Microteaching technology                                | low                 | average         | high               |
| 14 | Use of digital resource                                 | average             | high            | high               |
| 15 | Taking exams «online»                                    | low                 | high            | average            |
| 16 | Engaging open, ready to use contact                      | low                 | high            | average            |
| 17 | Resistance to the digitalization process                 | high                | average         | average            |
The grounding for each of the criteria in Table 1 is presented below:

Technical and hardware capabilities of digitalization are primarily about the availability of personal computers, mobile devices and a stable Internet connection for all participants in the educational process (both at the workplace and at home). In addition, the use of a number of platforms implies that users have webcams, microphones, etc. Such conditions are best implemented in corporate training, where most of the trainees are provided with the necessary technical means due to their responsibilities and professional requirements. Secondary, education is considered to be the least developed in technical terms [8]. According to the data provided by the Higher School of Economics, about 25% of schoolchildren (those from low-income families) do not have the opportunity to study online due to the lack of either a high-quality Internet connection or a personal computer. Higher education, in comparison with secondary education, is in a more advantageous situation, since most of the universities are located in large cities where a stable Internet connection is provided and the majority of students have devices that allow a distance learning process or can be supplied by educational organizations (libraries, specially equipped rooms in hostels for nonresidents, etc.).

The software features of digital education lie in the absence of unified universal platforms suitable for learning even within the framework of one educational organization. With all the variety of digital educational resources, the creation and practical application of any resource that is equally acceptable for all possible subjects and training courses does not seem realistic at the moment. This question turns out to be the simplest for corporate training: each educational organization is able to use one resource suitable for its specific purposes [9]. Higher education today is able to implement the "one university - one online platform" scheme, or create a package of educational resources limited to 3-5 platforms that are compatible with each other and have a single access window. However, there is clearly no possibility for universities to centralize platform solutions (due to the narrow-focus specifics of each single University). For secondary education this problem takes on a different character. As the experience of the pandemic has shown, teachers within one school used up to 10 different resources that were incompatible with each other, which certainly had a negative impact on the educational process. However, secondary education has a more universal framework and is theoretically capable of using a single platform that meets general requirements of all disciplines.

The competence of teaching staff. The greatest problems concerning the competence of teaching staff arise in the field of secondary education. Thus, 55% of teachers over 60 years old (and a third of them between 45 and 59 years old) practically do not know how to use the Internet, specific educational platforms in particular. Representatives of universities teaching staff have relatively good digital competencies. The fact is that according to federal state standards of higher education, representatives of teaching staff are required to systematically participate in advanced training programs on the use of electronic educational resources. Such regulatory requirements make it possible to provide employees with digital competencies at least at a basic level that allows them to successfully interact with students. Digital competencies of teachers involved in corporate training cannot be unambiguously evaluated, since they depend on specific educational organizations and training courses implemented on their basis. At the same time, it should be noted that according to the NAFI analytical center, the digital competence of employees engaged in the field of education is generally much higher than the average Russian indicator of this parameter and amounts to 87%.

The digital competence of students can be evaluated based on their age. For example, students between 17-22 years old are more proficient than younger students. Among trainees of the corporate sector, on the contrary, there are people of the older age group (45-60 years old) who lag behind in the degree of mastery of information and communication technologies from university students and senior schoolchildren or, due to their professional specialization, do not use digital technologies to a sufficient extent.

The level of teaching staff responsibility incorporates, first of all, the desire of teachers to work in an online environment, which entails the quality of such criteria as the content component of the
course, agility of checking the students actions, timeliness of synchronous interaction with the audience, and provision of a feedback process.

The level of students' digital responsibility is closely related to their digital competence, but is not completely dependent on it. The presence of general motivation has a significant impact on the level of students' digital responsibility. In this case, it can certainly be stated that the most motivated group of students belongs to the corporate training sector. Students of educational institutions in secondary and higher education comparable in age have approximately the same degree of motivation [10].

Digital etiquette of the educational process participants is, first of all, professional and ethical qualities of teachers presented in the digital environment and the ability of students to correctly interact with teachers and peers, carrying out educational process in digital format. The main problems of digital etiquette according to researchers [11, 12] are "psychological isolation between digital and "real" world and the ability to observe the boundaries of personal digital space. This means that it is sometimes difficult for a user to position themselves in the same social role in online and offline environments, and to adhere to the usual standards of behavior as in real life. Corporate training, in this case, has the advantage of closely matching the age groups of teachers and students, who often belong to the same generation. This same feature helps corporate learning to successfully overcome the next item - digital inequality.

The competence-based meaning of digital inequality of participants in the educational process is, first of all, based on the different ways of perception and thinking of people belonging to different generations. A significant role is played by the fact that users gain previous experience in using digital technologies and digital educational resources in particular. On the other hand, the phenomenon of digital inequality can arise not only in the "teacher-student" tandem, it can manifest itself in the pedagogical community, between colleagues who know digital technologies at different levels, or between teachers and administrations having different views on the educational process digitalization.

The level of trainees' requirements for digital content in the sphere of corporate training remains at the same level. This is due, in the first place, to the widespread practice of "blended learning" [13] in the corporate sphere, when most of classes are carried out in an online environment, and some of the interaction takes place in a traditional face-to-face manner. The demands of university students for digital content are quite serious and continue to rise. They either do not perceive or "refuse" to receive information presented in an insufficiently interactive format, low-dynamic or visually unattractive style. School children's requirements for digital content are slightly lower than those of students.

The misconception of education gamification is based on the belief that knowledge and skills obtained in a playful way can be only effective for younger students [14] or even for preschool training. In fact, gamification methods in education are being actively implemented in both secondary and higher education. Moreover, for the field of corporate training gamification is the most relevant solution to a number of problems associated with the need for virtual simulation of production processes. The frequency and success of gamification in corporate training seems to be the most significant of all [15]. The real possibilities and cumulative potential of gamification are quite extensive and at the moment is an urgent area of research into the possibilities of education digitalization.

Synchronization of interaction between teachers and students is achieved through various digital tools that allow communicating and sharing content in "real time": webinars, video lectures, joint work on documents, or live broadcasts on social networks. The importance of synchronous format of interaction cannot be overestimated, and during the period of communicative restrictions it was actively used in schools, universities and corporate training. This format is most widespread in the field of higher education.

Opportunities for personalized approach in education today have the same development scenario: both for secondary, higher and corporate training. The experience of not only building, but also successfully implementing individual educational trajectories is relatively small, while the need for personalized education is quite significant.
Microteaching involves delivery of educational material dividing it into independent (relatively independent) small units that allow to evaluate a separate "microskill". Corporate sector occupies the leading position in microteaching. Higher education is at the stage of microteaching recognition as an effective method of education digitalization. In secondary education this method is used the least actively.

The use of mobile digital educational resources [16], which should be understood as an organized, controlled, purposeful process of interaction between a teacher and a student using mobile devices [17], is carried out applying adapted educational content and ergonomics of the corresponding electronic educational resource. Students and teachers, both technically and psychologically, are ready for the active use of mobile technologies in the educational process and agree that they greatly simplify and make the process of digital interaction more flexible (with respect to the time and place of its implementation). The most common method of using mobile digital resources in higher education is applications adapted for LMS, as well as multimedia educational web resources, the widespread demand for which explains the high degree of mobile technologies use in higher education and corporate training. The tasks of secondary education are implemented using mobile technologies in fragments as separate narrowly focused digital resources designed to solve specific problems in various subjects.

The task of conducting distance exams for corporate training is the least urgent, since most often in this sector the defense of graduation work is required, and the current certification of trainees is done in the form of tests or monitoring activities that are successfully implemented using digital technologies. Secondary education today turned out to be reluctant to hold exams in distant online format. Thus, the graduates of 2020 did not take the main state exam, but obtained certificates of basic general education and secondary general education based on annual assessments. The unified state exam was held in the traditional full-time format and in compliance with the relevant epidemiological standards at a later date and only for those graduates who planned to enroll into universities. Higher education due to a significant number of exams in the curriculum was forced to solve the problem of their implementation in online format in various ways (depending on the form of the exam and technical capabilities of the university). In addition, the state final certification for educational programs of higher education has been provided for in a distance form since 2015, which is indicated in the act No. 636 of the Ministry of Education and Science of the Russian Federation dated June 29, 2015. In this regard, the readiness of higher education to conduct distance exams turned out to be high enough. Holding written exams in the online format requires proctoring [18], which can be implemented with specific technical and human resources, but is successfully delivered by a number of universities. An alternative to proctoring is an open-book exam method. Higher education has successfully used a variety of videoconferencing platforms to deliver current oral examinations.

The demand for ready-made open content (mainly MOOCs) is the least relevant for the corporate sector, due to the narrow-focused specifics of the courses studied. Third-party resources with open content in higher education are most in demand, although their share in total academic courses is very small. In secondary education, ready-made content is not in demand; however, it is actively used by teachers to prepare for classes, and for self-development.

Resistance to education digitalization is more prevalent among teachers in secondary education. This is due to the absence of psychological or pedagogical theory of digital learning [19], on which teachers could rely in their work when using digital technologies in practice. Higher education and corporate training are exposed to this problem to a lesser extent.

A comparison of indicators showing employees’ willingness level for transition to digital interaction in the field of secondary and higher education in the Russian Federation is shown in figure 2.
The general level of educational institutions willingness to carry out the distance educational process with the help of digitalization and possibilities of its effective implementation is not unambiguous [20]. Technical, methodological and organizational difficulties arise both in secondary and higher education, and in the field of corporate training. In addition, such criteria as personnel, legal and psychological readiness of educational institutions for the new reality are important.

4. Conclusion
Digital technologies in education create a new dynamically developing sector of the market, the demand for which is enormous in the context of the widespread transition to a distance format of interaction. A study of the trends in the global and domestic online educational market showed that the first half of 2020 had an impact on the development of the EdTech industry. However, the current market structure as well as its projected indicators has not changed, so secondary and higher education remain the leaders in the consumption of digital technologies. The Russian EdTech market is by no means a leader in the structure of the global EdTech industry, nevertheless, it demonstrates positive growth rates. In addition, the period of temporary communication restrictions associated with self-isolation has become a driver for the Russian EdTech market and has allowed to show significantly higher growth rates relative to world values. The logical evaluation of distance educational process
features, implemented in digital format for the sphere of secondary and higher education, as well as corporate training, made it possible to formulate and justify the value of a number of most relevant criteria. Justification of each of the presented criteria for evaluating the distance educational process implemented in a digital format contributed to the identification of problems and shortcomings of online learning, which can serve as a topic for further research in this area.

References
[1] Abdulkadyrov A S, Aliyev R M and Badavov G B D 2019 Edtech: the scientific and educational platform for training digital personnel for the cyber economy Contributions to Economics Part F 2 (in Russ) 163-8
[2] Bolotova E L 2019 The first academic year of a new era Proc. of Sources of research on the pedagogical past: interpretation of problems and problems of interpretation ed. Goncharov M A (Moscow: Moscow Pedagogical State University) (in Russ) 477-91
[3] Semyonova Yu E and Kurochkina A A 2019 Problems of digital technologies implementation in education Science and Business: Ways of Development (in Russ) 11(101) 265-7
[4] Kolchina V V 2019 Pedagogical approaches to the use of social and digital technologies in vocational education Problems of modern pedagogical education (in Russ) 65(1) 158-62
[5] Osipova O and Lomonosova N 2019 Application of online courses in the higher education sistem Proc. of the 19th Int. Multidisciplinary Scientific GeoConf. SGEM 2019 19 49-54 doi: 10.5593/sgem2019/5.4/S22.007
[6] Fetisov A S and Aristova I V 2019 Problems of formation of health saving in digital education Perspectives of Science (in Russ) 2(113) 231-4
[7] Stepanov S Yu 2019 To the problem of strategic choice in the development of digital education as a continuous one Continuous Education: XXI century (in Russ) 1(25) 18-27
[8] Zair-bek S I, Mertsalova T A and Anchikov K M 2020 Readiness of Russian schools and families to education in quarantine: assessment of basic indicators vol 2(27) ed Gumerova I (Moscow, National Research University “Higher School of Economics”) p 32
[9] Sarkisov S S, Lomonosova N V, Zolkina A V and Sarkisov T S 2020 Integration of digital technology in mining and metallurgy industries Tsvetnye Metally (in Russ) 3 7-14 doi: 10.17580/tsm.2020.03.01
[10] Fiodorova O N 2014 Comparison of motivational spheres of students of college and students of other types of educational institutions Yaroslavl Pedagogical Bulletin (in Russ) 3(2) 31-7
[11] Yamschikova Ye G 2017 The problem of developing network etiquette and teachers’ professional and ethical quality in information media Man and Education (in Russ) 1(50) 54-8
[12] Gutrorova N A 2019 Teacher and student communication in social networks: the ethical dimension Media and Education (in Russ) 2(32) 7-16
[13] Lomonosova N V and Zolkina A V 2018 Digital learning resources: enhancing efficiency within blended higher education Novosibirsk State Pedagogical University Bulletin 6 121-37 doi: 10.15293/2226-3365.1806.08
[14] Zolkina A V, Lomonosova N V and Petrusevich D A 2020 Gamification as a tool of enhancing teaching and learning effectiveness in higher education: needs analysis Science for Education Today 3 127-43 doi: 10.15293/2658-6762.2003.07
[15] Featherstone M and Habgood J 2019 UniCraft: Exploring the impact of asynchronous multiplayer game elements in gamification Int. J. of Human-Computer Studies 127 pp 150-68 doi: 10.1016/j.ijhcs.2018.05.006
[16] Demenkova T A, Tomashevskaya V S and Shirinkin I S 2018 Mobile applications for tasks of distance learning Russ. Technological J. (in Russ) 6(1) 5-19 doi: 10.32362/2500-316X-2018-6-1-5-19
[17] Kamalidinova E R and Sardak L V 2017 Features of electronic educational resources to be used in mobile learning Pedagogical Education in Russia (in Russ) 6 53-9
[18] Lavrenov A N 2020 Proctoring as a learning tool *Management in social and economic systems* (in Russ) 9 40-2

[19] Verbitsky A A 2019 Digital learning: problems, risks and prospects *Homo Cyberus* (in Russ) 1(6) url: http://journal.homocyperus.ru/Verbitskiy_AA_1_2019

[20] Kudzh S A and Golovanova N B 2020 On improving training mechanisms teaching staff and prospects for targeted learning in the interests of universities *Russ. Technological J.* (in Russ) 8(4) 112-28 doi: 10.32362/2500-316X-2020-8-4-112-128