Innovative Technologies Against the COVID-19's Challenge: Education Issues

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Abstract

The paper intends to consider the role of technologies to overcome the COVID-19's challenges in higher education. On investigating, it has been found that the digital strategies utilizing innovative technologies help students to adapt to pandemic consequences. This study enlightens the various technologies that assist education in diverse aspects to outlive against COVID-19. The technological shift that happened during the pandemic and its influence on society is discussed. Besides the considered innovation technologies, this paper also deals with changes that have taken place in the education system of Kazakhstan in pandemic circumstances. Alongside our suggested solution for further educational process issues is also presented. A detailed review of the literature is done on COVID-19, digital technologies in education, blended learning using appropriate keywords on SCOPUS, Springer, Science Direct, and Google Scholar. Some relevant sites and blogs are also taken into account to get insights. We have identified technologies used in Kazakhstan that play an important role now. There have been chosen exploratory and conclusive research design. Fifty-nine students provided qualitative responses; ninety-eight students and graduates participated in the quantitative survey. The results of the study have shown students' increased awareness concerning blended learning. The scientific novelty lies in the description of the experience gained by higher schools during the quarantine. We believe that in the

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future, blended learning should be used largely. The innovations in the learning process cover two areas. The first is related to the software used. It is like the creation of a virtual university that facilitates communication between students and teachers. The second area correlates with content, without which any innovation will fail.

Keywords: Artificial Intelligence (AI), Digital technology, COVID-19, blended learning, tertiary institutions.

Introduction

The problem of innovative development is reflected in the works of many economists. Austrian economist Josef Schumpeter (1934), in his book 'Theory of Economic Development' viewed innovation as changes in technology and management and the use of resources. The German scientist G. Mensch tried to show a correlation between the economic growth rate and the cycles of essential innovations (Mensch, 1983). A turn towards a strategy of increasing the competitiveness and sustainability in all systems by using a new type of resources, namely the results of intellectual activity, has taken place against a growing shortage of material resources, an extensive path of development, and deterioration in the environmental situation. Not coincidentally, in recent years, service companies have emerged among the world's leaders, and the volume of sales of science-intensive products in the world market has exceeded trillions of dollars. It is important to note that science, education, and defense in highly developed countries belong to state budgets' strategic part. According to Vida, I., Spaller, E., & Vasa, L. (2020) digital solutions help entrepreneurs and businesses to "reconsider their business models which can be more competitive, sustainable, and better connected to other sectors of the economy".

Innovation is a self-regulated process, and its driving forces are the desire to get super-profits. The only concern is a risk degree. The process will proceed spontaneously only when the first reason is stronger than the second one. That is

why in the USA, Germany, France, Japan, and other developed countries, innovative activity is encouraged by preferential funding, venture capital, taxation, and depreciation politics.

Digitization and Industry 4.0 approaches increase companies' level of competitiveness if it is used to create new levers of competitive advantage and "technological advancement make people rethink the present and future activities" (Brauweiler et al., 2020).

One of the critical problems is to organize interaction between science and production. International experience of innovative activity testifies to the variety of forms and methods used in the R&D field. The peculiarity of the present moment is that the quarantine measures do not allow doing business in the old way. Even absolute skeptics decide to digitalize, urgently rebuild processes, products, and communications. Innovative solutions help to adapt to new realities. Yerimpasheva & Balgabayeva state that "reality is transformed under the influence of global megatrends" as urbanization, digital technologies, and customer behaviors (Yerimpasheva & Balgabayeva, 2020).

However, the COVID-19 pandemic "has severely disrupted the education and training" of all students (Upadhyaya, Jain, Iyengar, Patralekh & AbhishekVaish, 2020). In higher education, where distance learning, in most cases, took the form of translation of recorded lectures and working with online platforms, some universities have been suspended due to the lack of IT infrastructure for both students and teachers (UN | Education during Covid-19, 2021).

There has been a "sudden shift of the educational, economic, business, clinical care, and many other activities to the online domain" (Haghani, Bliemer, Goerlandt & Li, 2020). The new "antivirus-enabled paradigm" requires "advanced technology" and "a tool to quicken the pace of digital transformation" (Megahed & Ghoneim, 2020). Digital transformation is "a process that aims to improve an entity by triggering significant changes to its properties through combinations of

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information, computing, communication, and connectivity technologies" (Vial, 2019).

In a short time, governments had to respond to shocks in education systems and find new ways to tackle the education crisis, and develop a set of solutions. The UN recommended focusing efforts on the following points:

- Tackling knowledge loss, preventing dropout, and developing skills;
- Removing barriers to the Internet;
- Improving the quality of data and monitoring tools in the field of education;

Increasing the level of consistency and flexibility concerning different levels and types of education and training (UN | Education during Covid-19, 2021).

During the COVID-19 crisis, higher education is undergoing an incredible transformation. On the other hand, online learning sharply identifies problem areas, so-called 'bottlenecks,' exacerbating social inequality, uneven access to the Internet, and the lack of a sufficient number of qualified professionals who can teach at a distance. At the same time, there are optimistic reports on distance education in China and other Asian countries (Altbach & de Wit, 2020). The article describes the case of Kazakhstan, in particular, how the al Farabi Kazakh National University (KazNU) faced the higher education crisis.

Literature Review

The COVID-19 pandemic poses enormous challenges to humanity. In the 20th century, the impetus for scientific and technological progress was the Second World War; now, the coronavirus gives an impetus to development (Kurenev, 2020). The "digital revolution that has developed in recent years may be accelerated as a consequence of the COVID-19" (Poch et al., 2020).

The coronavirus pandemic has changed all areas of our lives. We all have to rebuild it, find new non-standard solutions, and learn to exist in new realities. It is needed

to link different types of technologies properly. Companies, universities, governments, and people are increasingly using digital technology (DT) to cope with the pandemic's effects. These are mobile technologies, the Internet of Things, telecommunication networks (5G), big data analytics, artificial intelligence (AI), blockchain technology. Many authors are inclined to believe that the digital technologies adopted in the strategic decisions making process can lead to increased competitiveness and can help to overcome the consequences of pandemic (Papadopoulos, Baltas & Balta, 2020; Nadikattu, 2020; Chettri, Debnath & Devi, 2020; Agosto & Giudici, 2020). Technological advancements in AI "can prove beneficial in the COVID-19 scenario" (Mohanty, Harun AI Rashid, Mridul, Mohanty & Swayamsiddha, 2020).

Singh et al. (2020) have described the innovative technology of the Internet of Things (IoT) used during the quarantine. The fourth industrial revolution has started with the applications of advanced manufacturing and digital information technologies (Javaid et al., 2020). Industry 4.0 as an intelligent system includes a flexible production line, AI, IoT, and other digital technologies. According to Iivari, Sharma & Ventä-Olkkonen (2020), the COVID-19 pandemic has forced education "suddenly and abruptly" to engage in new Information and Communication Technologies (ICTs).

Vaishya, Javaid, Khan & Haleem (2020) have proved that "the involvement of AI reduces complexity and time taken." Many authors agree that AI is used to reduce workers' workload (Allam et al., 2020; Pirouz et al., 2020; Vigil Martín, 2020; Mulenga & Marbán, 2020; Ting et al., 2020).

Madurai Elavarasan & Pugazhendhi (2020) have conceptualized the aspects of technology utilization "to provide a helping hand in an epidemic state of affairs." Besides, they state that the "government should deploy tech-based solutions" because the technology is a "weapon in this war against the unexpected" and "technologies, management and governance are key factors" in facing pandemic consequences (Madurai Elavarasan & Pugazhendhi, 2020).

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Digital health systems are "well suited to provide novel solutions" to the "public health emergency" (Kapoor et al., 2020). New technologies and telemedicine have come to aid doctors and have been used in the advanced stage. COVID-19 response in East Asia has shown extensive use of emerging technologies (Big data, AI, drone, 5G, robotics, automated vehicle, blockchain) linked to medical ones (Shaw, Kim & Hua, 2020). On the other hand, it has been initiated a "different work culture" in many countries: teleworking, online meetings, and classes, online education for schoolchildren is becoming evident. Thus, a life-style change takes place, "which may have relatively longer socio-psychological and behavioral implications" (Shaw, Kim & Hua, 2020). However, the pandemic only sped up the change, as blended learning started in international educational programs long ago (Klenner et al., 2017). The pandemic also seems to be a "constructive disruptor, giving an opportunity for restructuring the present conventional, classroom-based educational system" (Rajhans, Memon, Patil & Goyal, 2020). Although using "technologies like AI and blockchain may be financially challenging for small retail stores" (Kumar, Raut, Narwane & Narkhede, 2020).

Beaunoyer, Dupéré & Guitton have investigated how the pandemic can "potentiate digital inequalities and how digital inequalities potentiate vulnerability to COVID-19" (Beaunoyer et al., 2020). Because children of today "are not equally equipped for their technology" so schools and education "should undergo an extensive digital transformation to be able to meet the needs of the young generation and their digitalized future" (Iivari, Sharma & Ventä-Olkkonen, 2020). Blended learning in the context of pandemic COVID-19 is "suddenly paramount to education," and internationally, there is a "move towards blended learning in major tertiary institutions" (Jowsey, Foster, Cooper-Ioelu & Jacobs, 2020). Farahani, Laeer, Farahani, Schwender & Laven, (2020) demonstrated that a "blended learning approach with e-learning can improve students'… consultations and communication skills".

Methodology

A detailed review of the literature has been done on COVID-19 and digital technology using appropriate keywords on SCOPUS, Springer, Science Direct, and Google Scholar. We have carried out qualitative and quantitative methods of research. Students of al Farabi Kazakh National University were surveyed who faced quarantine consequences, which affected the learning process. The spring semester of 2019-2020 academic year consisted of the following elements: five weeks of offline and ten weeks of online learning, exams, final attestation, and defense of a thesis. The online surveys were organized via Google forms. Surveys were administered as exploratory and conclusive research and included open-ended and close-ended questions. Fifty-nine students provided open-ended responses that then were analyzed. Such topics have been identified from the open-ended responses: (i) Satisfaction from online semester; (ii) Used software/technologies; (iii) quality of Internet provided; and (iv) Academic honesty. The raised topics helped to identify students' perceptions concerning learning design. The number of respondents who participated in quantitative research was ninety-eight students and graduates. The study has shown that students increased their skills in using new software and awareness of the importance of blended learning in the studying process.

Findings and Discussion

Digital technologies in the 21st century are developing at a crazy pace, creating a genuinely new world. The modern world is as new as it is unpredictable, and the situation with the COVID-19 pandemic is the best confirmation of this. Things that seemed not very important one year ago are now playing a crucial role.

In the first survey among 59 respondents, we used open-ended questions. Students from the fifth week of the spring semester of the 2019-2020 academic year began to study remotely from home. The main programs for use were Zoom, Google Meet, and Microsoft Teams. Passing exams at KazNU was carried out depending

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on the educational program and faculty. Simultaneously, communication outside the classroom was carried out through the university's Intranet, WhatsApp, E-mail, and phone. The final exams were organized via Zoom, Microsoft Teams, Univer system (university's platform), LSD Moodle, and Oqylyq.kz. Sixty-three percent of respondents consider the exams passed without problems. Thirty-seven percent of the respondents faced difficulties such as unstable Internet connection, lack of Internet, and problems with the software chosen for the exam. At the same time, 91% of respondents are satisfied with the learning outcomes, while 57% answered that they are ready to continue their studies in the same format, 20% prefer traditional offline format, and 23% find it challenging to answer. It is interesting to note that 85% of the respondents said they are ready to switch to blended learning. Of these, 62% prioritize the spare time that they might have.

The study results provided by Jowsey et al. (2020) suggest that "blended learning can positively influence and impact the achievements of students, especially when utilized to manage and support distance education". They have highlighted conditions for successful blended learning. They are:

- Active engagement,
- Valuing students' feeling,
- Learning supports (phone/internet, hardware, and software),
- Family support, and
- Teacher communication.

We decided to take advantage of this study's results and use the listed conditions for successful blended learning to compile a questionnaire to survey students of KazNU. Additional criteria for successful blended learning have been added to the questionnaire. The survey's purpose was to determine what conditions matter to be a successful student, whether they differ from the listed ones. Also, we wanted to know whether students consider blended learning as an excellent educational opportunity. The results of the survey are presented in exhibit 1.
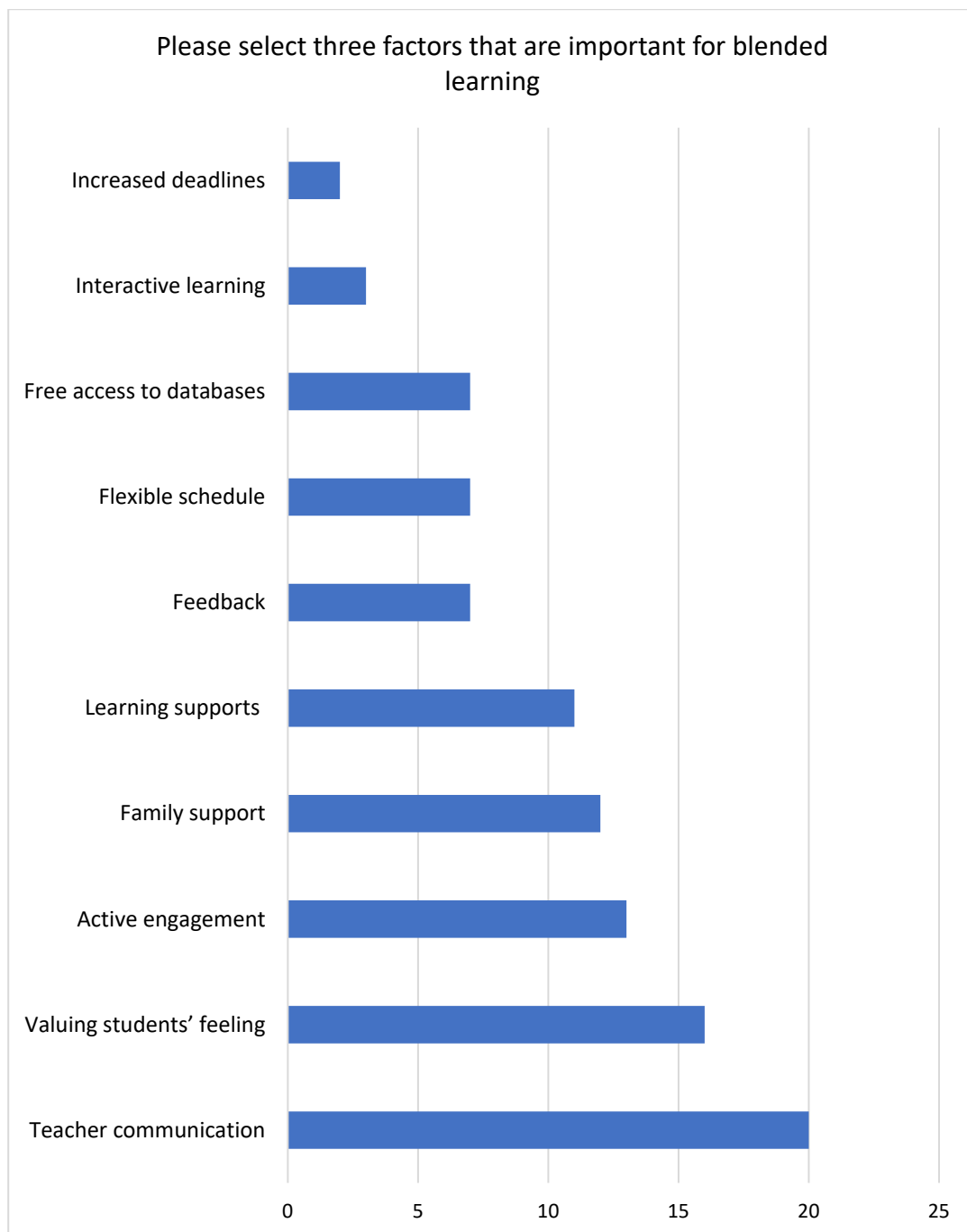
Figure 1. Conditions for successful blended learning

The highest preferences of respondents were distributed between such criteria as Teacher communication (20%), Valuing students' feelings (16%), and Active engagement (13%).
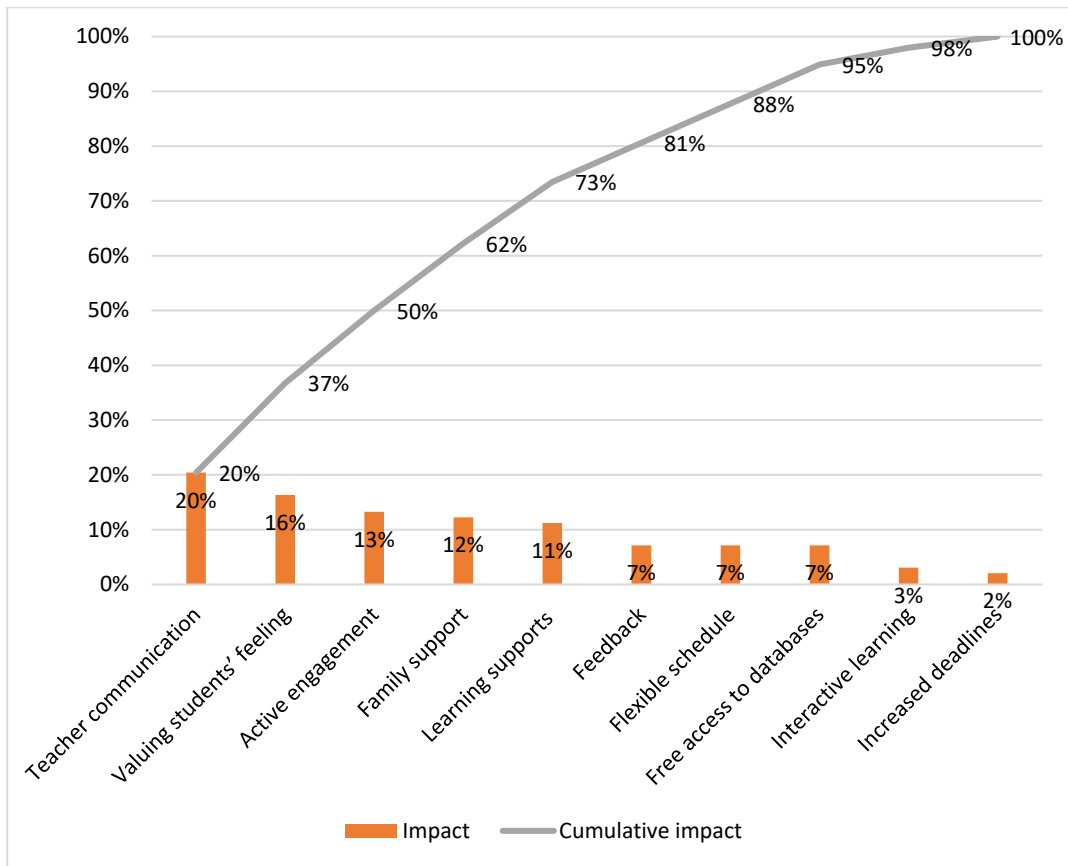
Figure 2. Pareto diagram based on the results of a survey of 98 KazNU students

According to the 80/20 Rule, the following criteria are required for successful blended learning:

- Teacher communication
- Valuing students' feeling
- Active engagement
- Family support
- Learning supports
- Feedback.

As can be seen from the diagram, KazNU students' preferences are somewhat different from those listed in the study by Jowsey et al. (2020).

The coronavirus pandemic has changed the world forever. Experts note that the politics and state structure of countries, their economies, and all other spheres of people's life will change. It is also about the education system. The latter, like other industries, was not ready to operate under quarantine conditions and now has to adapt to new realities and challenges in a short time.

The Professor Stephen Lamb, a director of the Centre for International Research on Education Systems at Victoria University in Melbourne who led the study on online learning because of the COVID-19 pandemic stated "Unequal internet access and access to a computer are just the tip of the iceberg of the challenges some students face" (Maslen, 2020). IT specialists at universities around the world "have been in crisis mode and have generally done a remarkable job migrating many courses and programmes online" (Altbach & de Wit, 2020).

The COVID-19 pandemic has launched a widespread digital transformation in society. The pandemic has forced people to make an incredible digital leap in everyday life. Traditional education has turned to distance learning. The coronavirus pandemic has had a significant impact on education around the world. To date, educational institutions, students, and teachers have been forced to turn to distance learning in a short time. In mid-March 2020, the Ministry of Education and Science, together with IT companies and educational institutions, carried out a colossal work. A project office was created, where the world experience (USA, Mongolia, Russia, and other neighboring countries) was studied. To switch to a new studying format, online pieces of training and webinars were conducted. Around a hundred civil universities have been transferred to the distance learning system. Higher educational institutions switched to online education on March 16. The universities turned out to be the most prepared since they had the entire necessary infrastructure.

The advantages of using new technologies in education are apparent. Distance learning problems have always been of interest to Kazakhstani universities. Some courses have already been organized in an online format, as in Al Farabi KazNU. Experts point out the importance of blended learning, which consists of learning

elements provided offline and online. This type of education will be prevalent because of its flexibility and changing epidemiological situation.

The Oqylyq.kz distance learning and proctoring system include a large amount of necessary functionality when organizing distance learning.

The startup «Oqylyq.kz» have been represented by three young Kazakhstani entrepreneurs - Ersultan Yermanov, Eduard Zaukarnaev, and Anuar Kagarov. Oqylyq.kz provides a flexible set of tools for testing knowledge using a proctoring system. There is a certainty that principles of academic integrity are not violated. Thanks to proctoring, control is carried out using a microphone, webcam, screen recording, machine vision, and the automated algorithm that recognizes suspicious patterns of a student's behavior and signals the teacher.

Another undoubted advantage of the Oqylyq.kz project is that the system entirely operates on servers located on the territory of the Republic of Kazakhstan, which gives additional data security. The Oqylyq.kz team has implemented several projects with a total value of more than 20 million tenges, including final exams at KazNU, entrance exams to physics and mathematics schools in Almaty, and math Olympiads, which is more than 30,000 online exams.

Implications

The COVID-19 pandemic has negatively affected all systems, and the situation requires extraordinary measures, primarily related to the digitalization of all areas. According to experts, the coronavirus pandemic has exacerbated existing problems in education. However, those institutions that had paid sufficient attention to new technologies and innovations before the pandemic were less affected. Sufficient digitalization of universities' educational process makes it possible to overcome the pandemic's consequences and stay afloat painlessly.

Conclusion

- Digital solutions help to "reconsider … business models which can be more competitive, sustainable, and better connected to other sectors of the economy" (Vida, Spaller, Vasa, 2020).

- The COVID-19 pandemic "has severely disrupted the education and training" of all students (Upadhyaya et al., 2020). There has been a "sudden shift of the educational, economic, business, clinical care, and many other activities to the online domain" (Haghani et al., 2020).

- The new "antivirus-enabled paradigm" requires "advanced technology" and "a tool to quicken the pace of digital transformation" (Megahed & Ghoneim, 2020).

- The "digital revolution that has developed in recent years may be accelerated as a consequence of the COVID-19" (Poch et al., 2020).

- The coronavirus pandemic has changed all areas of our lives. We all have to rebuild it, find new non-standard solutions, and learn to exist in new realities. It is needed to link different types of technologies appropriately. Companies, universities, governments, and people are increasingly using digital technology (DT) to cope with the pandemic's effects.

- Many authors are inclined to believe that the digital technologies adopted in the strategic decisions making process can lead to increased competitiveness and can help to overcome the consequences of pandemic (Papadopoulos, Baltas & Balta, 2020; Nadikattu, 2020; Chettri, Debnath & Devi, 2020; Agosto & Giudici, 2020; Nadikattu, 2020).

- AI is used to reduce the workload of healthcare workers (Allam et al., 2020; Pirouz et al., 2020; Vigil Martín, 2020; Mulenga & Marbán, 2020; Ting et al., 2020) and technologies are one of the crucial factors in facing pandemic consequences (Madurai Elavarasan & Pugazhendhi, 2020).

- New technologies and telemedicine have come to aid doctors and have been used in the advanced stage. COVID-19 response in East Asia has shown extensive use of emerging technologies (Big data, AI, drone, 5G, robotics, automated vehicle, blockchain) linked to medical ones (Shaw, Kim & Hua, 2020).

- It has been initiated a "different work culture" in many countries: Tele-working,

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online meetings, and classes, online education for schoolchildren are becoming evident. Thus, a life-style change takes place, "which may have relatively longer socio-psychological and behavioral implications" (Shaw, Kim & Hua, 2020).

- The pandemic seems to be a "constructive disruptor," allowing restructuring the present conventional, classroom-based educational system" (Rajhans et al., 2020).
- The pandemic can "potentiate digital inequalities and how digital inequalities potentiate vulnerability to COVID-19" (Beaunoyer et al., 2020).
- Blended learning in the context of pandemic COVID-19 is "suddenly paramount to education" and internationally, there is "move towards blended learning in major tertiary institutions" (Jowsey et al., 2020).
- "Blended learning approach with e-learning can improve students'… consultations and communication skills" (Farahani et al.,2020).
- Two online surveys were administered as exploratory and conclusive research and included open-ended and close-ended questions. The study has shown that students have increased awareness of the importance of blended learning in the studying process.
- The results of study have highlighted conditions for successful blended learning. They are Teacher communication, Valuing students' feelings, Active engagement, Family support, Learning supports, and Feedback. The results are almost overlapping with the study results provided by Jowsey et al. (2020).
- The platforms as Zoom, Google Meet, and Microsoft Teams have become very popular among students and teachers. Startup Oqylyq.kz has proved its worth.
- Thirty-seven percent of the respondents faced difficulties such as unstable internet connection, lack of internet, problems with the software chosen for the exam. Furthermore, here, questions arise for Internet providers.

Limitations / Further Research.

Further research on effectively used learning tools is needed based on the 2020-2021 academic year results.

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