



## Modernization of higher vocational education on the example of medical universities: Features of it implementation

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### Abstract

The need to assess the possibilities and prospects of IT in medical education has determined the relevance of the study, the purpose of which was to consider the experience of introducing information technologies into the educational process of medical universities. A total of 322 students and 169 teachers took part in an anonymous online survey. The research design involved two major research units, namely the theoretical and experimental ones, which consisted of several successive stages. The psychological consequences of introducing information technologies into the educational process were studied using valid psychodiagnostic methods. As a result of the study it was found that possible obstacles to the expansion of the use of IT to teach medical students clinical disciplines are inadequate technological infrastructure, lack of adequate curricula, and students' lack of independent work and self-discipline skills. The distance learning experience was generally assessed as positive with an average level of satisfaction. The main positive aspects of introducing information technology and distance

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learning in medical education are timesaving and flexibility of classes. The limitations of the study were related to the problem of conducting the study in a pandemic environment, so it was conducted online.

Keywords: Education; higher education; information technology; medical education; medical universities.

## 1. Introduction

### 1.1. Conceptual and Theoretical Foundations

Virtual reality cannot completely replace traditional practice despite the availability of the most advanced technologies; this primarily refers to medical specialties. Functional diagnostics, surgical and dental manipulations, obstetrics and many other medical skills require direct clinical practice. Therefore, the expansion of the use of information technologies in medical education will always be carried out within the unity of theory and practice based on the acquisition of clinical experience in the process of direct patient supervision. However, the COVID-19 pandemic has become a challenge to both health care systems on a global scale revealing their weaknesses and to medical education systems due to the forced and sudden transition to predominantly distance learning. Medical higher educational institutions had to very quickly make changes to their curricula; the teachers had to improve computer literacy and the students were expected to develop skills of independent work. At the same time, there was a reduction in the number of clinical facilities of medical universities due to the re-profiling of hospitals to treat coronavirus patients. There were no similar cases; therefore, the study of the features of the use of information technologies in medical education in modern conditions is a relevant issue.

The COVID-19 pandemic, being a global challenge to healthcare systems and medical education, simultaneously became a catalyst for positive changes contributing to the transformation of medical education taking into account not only the traditional competencies of professionalism, patient care and personal responsibility, but also the new and relevant competencies, which include the ability to solve population and public health problems, design and continually improve health care systems, use data and technology for patient care, research and education, and eliminate health disparities and discrimination in medicine (Lucey & Johnston, 2020). These changes required a revision of the curriculum both in terms of the content of courses and the balance of study time (Lucey & Johnston, 2020). It is noteworthy that American medical higher educational institutions quickly responded to the need for innovative changes having managed to ensure the annual graduation of well-trained doctors on time and without lowering standards in the context of the constraints associated with the pandemic (Lucey & Johnston, 2020). The biggest challenge faced by medical educational institutions in the United States, which is also typical of other countries, has been the restriction on the traditional model of medical education related to clinical training in the workplace. Senior students used to be actively involved in practical work as physician assistants, for example, during a flu epidemic; however, in contrast to this, during the COVID-19 pandemic, medical educational institutions have been reluctant to involve students in coronavirus patient care primarily due to the shortage of personal protective equipment, limited COVID-19 testing capabilities and uncertainty about the transmission routes and the rate of the spread of the virus (Lucey & Johnston, 2020). The problem of the quality of education was also aggravated by the fact that many teachers being involved in patient care were less concentrated on teaching students. Therefore, the whole educational process has been quickly restructured, and distance learning strategies under the guidance of teachers have been introduced; these include both didactics and thematic conferences, as well as videoconferences of inpatient and

outpatient appointments, which ensures the mastery of relevant clinical competencies (Lucey & Johnston, 2020).

The educational process has shifted to remote learning on digital platforms, students were involved in information and research work related to COVID-19, which allowed them to acquire relevant educational and clinical experience in the field of public health services. It is important to emphasize the contribution of government agencies, professional organizations, accreditation bodies, and licensing commissions as effective partners of medical educational institutions in the response to the pandemic, which involved normative support for medical education during the pandemic; this US experience (Lucey & Johnston, 2020) can serve as a good example for reforming medical education in other countries. The Association of American Medical Colleges is making a great contribution to the development of medical education distance learning; it has published guidelines for educating students during the coronavirus pandemic and provided all-round support for the medical community to develop appropriate educational strategies and ensure safe and effective clinical education. In addition, another guidebook on the voluntary participation of medical students in direct patient care during the COVID-19 outbreak has been released. Currently, there are two types of e-learning: remote access to learning for those who are geographically distant from the teacher, and computer-assisted interaction, which is an interactive technique that provides educational material through a computer, and student progress is monitored and evaluated during this process (Al-Balas et al., 2020). The virtual environment is seen as a cost-effective alternative to physical laboratories and can be quickly set up for both hands-on laboratories and scientific e-learning applications (Khan & Salah, 2020).

However, it cannot be argued that the pandemic has disrupted the traditional system of medical education and exacerbated the need for fast and high-quality training of doctors in the current global emergency. Distance learning can disrupt professional identity formation, which is dependent on learning and role modeling, which teach students to prioritize patients and strive for altruism. An important consequence of the pandemic is the transformation of medicine and medical education involving the maximum use of IT, the development of telemedicine, and the transformation of curricula (Rose, 2020). The introduction of e-learning, the use of the Internet, information and communication technologies to improve teaching in medical higher educational institutions have great potential. However, in low- and middle-income countries there is a problem of the availability of appropriate resources. Jordan, where distance learning in medical education was not used before the COVID-19 pandemic, has shown that e-learning in medical education aimed at individual experience, practices, and knowledge of students, can become a good alternative to traditional learning to provide high quality education (Al-Balas et al., 2020).

Distance learning is assessed as an effective way to increase student activity in the educational process. Among its advantages, students note timesaving, flexibility of classes, and improved interaction with teachers and classmates; however, they also note a serious problem related to the acquisition of adequate clinical skills. The emergence of ICTs has led to a paradigm shift in medical education and practice (Karsenti & Charlin, 2008), and the need and readiness of medical students for online education is increasing (Karsenti & Charlin, 2008). One of the major obstacles to the introduction of information technologies in medical education is the rejection of new technologies by teachers due to their limited knowledge and lack of proper training (Al-Balas et al., 2020). The conflict between the dominant face-to-face learning and non-dominant distance learning is an obstacle to the development of distance learning by medical teachers (Pettersson & Olofsson, 2015).

The use of information technology allows the transition from traditional synchronous learning based on the simultaneous interaction of students and teachers to asynchronous learning which is not scheduled and does not require simultaneous interaction between students or between students and the teacher. At the same time, the results of online education are not only comparable but also exceed the indicators of student performance in the traditional learning environment, which is a good argument for overcoming skepticism (Kay & Pasarica, 2019).

### 1.2. Related Research

The modern world is characterized by two specific and interrelated features, namely: globalization processes and the rapid development of information technology, which can be observed in all spheres of social life and has a serious impact on the transformation of higher vocational education. The introduction of information technologies in the educational process expands the access of students and teachers to educational information on a global scale and has a generally positive effect on the quality of education (Ryabov et al., 2019, 2020). For example, in recent years, videos have been increasingly used in medical education, and they have been proved effective both for ensuring cognitive learning and acquiring clinical skills (Taslibeyaz et al., 2017).

Related research by British scientists reflects the significant need for fundamental implementation of IT technologies in the context of distance learning in medical specialties (Goh & Sandars, 2020). Consequently, the use of new technologies for education, such as artificial intelligence for adaptive learning and virtual reality, is likely to be an important component of transformative change and the future of medical education.

### 1.3. Purpose of the Study

Thus, *the object of the study* is the process of higher vocational medical education and *the subject of the study* is the features of the use of information technologies (IT) in teaching medical students.

*The purpose of the study* is to examine the experience of introducing information technologies into the educational process of medical universities in the Russian Federation.

*The research objectives are as follows:*

1. To study the implementation of information technologies in the educational process of medical universities based on the analysis of scientific, legal, educational and methodological sources of literature.
2. To study the features of the use of IT in Russian medical universities in modern conditions.
3. To develop guidelines for the use of IT when teaching medical students.

*The research hypothesis:* the expansion of the use of IT when teaching medical students has a positive effect on their theoretical and practical skills, and also contributes to the improvement of academic performance.

The article intends to investigate the necessity of introducing information technologies into distance learning for medical university students in the region under study, and to identify trends in respondents' attitudes toward the digital transformation of education.

## 2. Methods and materials

### 2.1. Research design and sample

The research design involved two major research units, namely the theoretical and experimental ones, which consisted of several successive stages. At the first stage, the relevance of the research topic, its goals and objectives were determined; then, an analytical review of the relevant sources of scientific literature was carried out. A research hypothesis was formulated, and, in accordance with it, a questionnaire was developed in order to study the use of information technology to teach medical students. A randomized sample of respondents involving students and teachers of leading medical higher educational institutions in the Russian Federation was formed; the study participants were surveyed in order to obtain a subjective assessment of the implementation of IT in the educational process and its prospects with due regard to the pandemic. The personal attitude of respondents to innovations was also examined. Conclusions based on the obtained results were made and the practical recommendations were developed.

### 2.2. Participants

The study took place at Pirogov Russian National Research Medical University, which is one of the oldest medical universities in the Russian Federation. The educational institution actively participates in medical activities and the health care system development by constantly supporting scientific research and the introduction of innovations, which allows it to maintain a leading position in medical education in the Russian Federation. A total of 322 students and 169 teachers (491 respondents in total) took part in an anonymous online survey. There were 500 questionnaires; 9 of them were found to be irrelevant.

### 2.3. Data Collection Tools

The study of the psychological implications of the implementation of information technologies in the learning process was carried out based on valid psychodiagnostic techniques (the Scale of self-assessment of innovative personality traits (Lebedeva & Tatarko, 2009), the Real World Problems Test by Sternberg and the Questionnaire of tolerance to uncertainty (modified by Kornilova, 2010).

The Scale of self-assessment of innovative personality traits identifies the qualities and characteristics of a person striving for innovation (Lebedeva & Tatarko, 2009) on the basis of assessing 15 characteristics of a person who has a positive attitude to innovation: 1) the desire to engage in creative activities; 2) independence; 3) a constructive attitude towards mistakes; 4) passion for research, curiosity; 5) encouraging creativity of other people; 6) willingness to invest in innovation; 7) the ability to operate in an unstable environment; 8) confidence that change is the path to success; 9) focus on the future; 10) willingness to take risks; 11) creativity; 12) openness to everything new; 13) striving for diversity; 14) a bold attitude towards the unknown; 15) an active search for new opportunities.

The Uncertainty tolerance and intolerance questionnaire (Kornilova, 2010) includes three scales: Uncertainty Tolerance (UT), Uncertainty Intolerance (UIT), and Interpersonal Intolerance to Uncertainty (IITU) associated with other personality traits, such as willingness to take risks, the use of intuition, and readiness to make decisions (Kornilova, 2010). At the same time, tolerance involves the readiness for a parity dialogue, for the cognition of new alien things while not excluding the possibility of changing the system of views and ideas of the individual. Intolerance to uncertainty is defined as a

person's tendency to make black-and-white or hasty decisions often without taking into account the real state of affairs and to strive for obvious and unconditional acceptance or rejection in relationships with other people. Intolerant individuals view the future as a source of discomfort and respond to the emergence of a situation of uncertainty with a set of cognitive, emotional and behavioral inferences. Tolerance to contradictions, as well as flexible thinking, are the characteristics that are opposite to rigid thinking that rejects new, changeable, and contradictory things (Kornilova, 2010).

The concept of subjective uncertainty associated with the peculiarities of event attribution and control is used as a factor of the psychological regulation of decision-making that determines the nature of information collection in a situation of uncertainty. Individuals who are intolerant to subjective uncertainty view a future negative event as unacceptable even if it is very unlikely to happen. The quality measured by the Tolerance to uncertainty questionnaires is not reduced to personality traits and is understood as the latent acceptance of uncertainty, which manifests itself at the level of other personal traits associated, first of all, with the personal regulation of decisions and actions in the face of uncertainty, namely readiness for risk and preference for an intuitive style in the regulation of choice.

#### 2.4. Data Analysis

The automatic interpretation of test results with the help of an online integral calculator is based on numerical percentage values with a zero reference point (Lebedeva & Tatarko, 2009): 0-20% - low, 21-40% - reduced, 41-60% - average, 61-80% - increased, 81-100% - high. The innovativeness index is calculated as the arithmetic mean of the values of the three scales (Creativity, Risk for Success, Focus on the Future).

In our study, we used the Uncertainty tolerance and intolerance questionnaire, which included three well-known scales: O'Connor's Scale (Reasonable actions; Acceptance of alternatives; Conservative points of view), Rydell and Rosen's Scale (Readiness to make decisions; Anxiety arising from undefined stimuli; Desire to completely define problems; Risk appetite; Uncertain search; Problem fragmentation), and Budner's Scale (Prediction; Diversity and originality; Clarity, transparency; Correctness, regularity) (Kornilova, 2010). At the same time, the tolerance to uncertainty factor is understood as a generalized personality trait that characterizes the desire for change, novelty and originality, the willingness to follow unbeaten tracks, the preference for more complex tasks, the ability to be independent and go beyond the accepted limitations.

The UIT factor focuses on the pursuit of clarity, orderliness, the rejection of uncertainty, the assumption of the dominant role of rules and principles, the dichotomy between right and wrong ways, opinions, and values. The IITU factor is interpreted as interpersonal intolerance to uncertainty and involves the pursuance for clarity and control, as well as instability and variability of interpersonal relationships and discomfort in the event of their uncertainty. The average rates are as follows: UT = 36-60, UIT = 39-65, IITU = 24-40 (Kornilova, 2010).

The creativity of an innovative personality is based on the ability to rethink, generate and implement new ideas, which is based on openness, tolerance and flexibility of thinking (Bykova, 2011). The Real World Problems test contains life situations and the types of behavior in them: adaptation to current conditions; choice of the environment, which is the rejection of the current environment in favor of the environment that is more suitable for a given personality; shaping the environment, which involves the desire to change the environment, and not just adapt to what seems unshakable.

*The limitations of the study* were associated with the problem of conducting the study in the context of the pandemic, and therefore it took place online.

*Ethical issues* were related to anonymity, which was guaranteed by the fact that the questionnaires did not contain any personal data of the respondents.

### 3. Results and discussion

Information technologies have been used in medical education for a long time; they are a familiar and important component of the educational process, which was confirmed by the survey. However, the active introduction of distance learning in medical education took place only in connection with the COVID-19 pandemic. As for the use of multimedia, webinars and 3D modeling, these technologies are more or less familiar to both teachers and students, and fit into the traditional format of classroom activities, while remote forms before the pandemic developed to a greater extent in system of postgraduate medical education. The COVID-19 pandemic has become a challenge to medical higher educational institutions.

However, universities of other profiles quickly and without detriment to the quality of education managed to adapt their curricula and switch to online mode while the need for clinical practice directly at the patient bedside caused a serious discussion about whether diagnostic and therapeutic procedures can be taught remotely. No matter how perfect the technologies are, they will never be able to replace a real patient, and the sensations and emotions when watching an educational video will always be different from those experienced during medical practice.

In our study, two directions can be distinguished: the study of the subjective assessment of medical students and teachers of the use of information technologies in the learning process, as well as the identification of the personal characteristics of the respondents, which make it possible to characterize their attitude to innovative changes. The questionnaire was developed based on scientific literature data, which allowed us to formulate the key questions reflecting the main aspects of the IT implementation in medical education, as well as the problems and prejudices that arise in this case. Tables 1-4 describe the results of the questionnaires and psychological tests.

Table 1. Subjective student and teacher assessment of the practice and prospects of the IT implementation in higher medical educational institutions

Question	Teachers		Students		Student's t-test	p	
	absolute value	%	absolute value	%			
At your university, the introduction of information technologies in the educational process began	More than 5 years ago	142	84.0	208	64.6	137.18	<0.05
	1-5 years ago	27	16.0	114	35.4	137.18	<0.05
	In 2020 in connection with the pandemic	0	0	0	0	0	
At your university, the introduction of distance learning began	More than 5 years ago	0	0	0	0	0	
	1-5 years ago	16	9.5	12	3.7	41.01	<0.05
	In 2020 in connection with the pandemic	153	90.5	310	96.3	41.01	<0.05
Teacher participation in	Actively participate	139	90.5	223	69.3	149.91	<0.05
	Online classes constitute a	115	68.0	279	86.6	131.52	<0.05

online classes	good part of the learning process						
	Use multimedia	158	93.5	316	98.1	32.53	<0.05
	Uses synchronous live streaming sessions (Internet)	97	57.4	201	62.4	35.36	>0.05
Technical resources and facilities of the university	Updated and high-quality	25	14.8	18	5.6	65.05	<0.05
	Rather good	79	46.7	185	57.5	76.37	<0.05
	Not good enough (lack of resources and facilities)	65	38.5	119	37.0	10.61	<0.05
Distance learning is used	To study theoretical general subjects and languages	163	96.4	312	96.9	3.54	<0.05
	To study theoretical medical subjects	134	79.3	290	90.1	76.37	<0.05
	To study clinical disciplines	98	58.0	205	63.7	40.31	<0.05
	To conduct research	21	12.4	17	5.3	50.20	<0.05
	To conduct webinars and online conferences	145	85.8	211	65.5	143.54	<0.05
What device do you use to study remotely	Computer	136	80.5	105	32.6	338.70	<0.05
	Laptop	159	94.1	216	67.1	190.92	<0.05
	Smartphone	101	59.8	304	94.4	244.66	<0.05
What are the advantages of distance learning in medical education compared to the traditional educational process?	Timesaving and flexibility of classes	85	50.3	212	65.8	109.60	<0.05
	Academic performance improvement	76	45.0	190	59.0	98.99	<0.05
	More efficient interaction with the teacher	84	49.7	201	62.4	89.80	<0.05
	More efficient interaction with fellow students	31	18.3	57	17.7	4.24	<0.05
	No advantages	36	21.3	58	18.0	23.33	<0.05
What are the disadvantages of distance learning in medical education?	Decrease in the quality of education	74	43.8	115	35.7	57.28	<0.05
	Less efficient interaction with the teacher and/or fellow students	72	42.6	104	32.3	72.83	<0.05
	Lack of time	79	46.7	65	20.2	187.38	<0.05
General satisfaction of medical students with distance learning	High	8	4.3	51	15.8	81.32	<0.05
	Average	135	79.9	233	72.4	53.03	<0.05
	Low	26	15.4	38	11.8	25.46	<0.05
What form of medical education is the most effective	Traditional (classroom learning and learning in hospital)	48	28.4	57	17.7	75.66	<0.05
	Distance	3	1.8	19	5.9	28.99	<0.05
	Blended	118	69.8	246	76.4	46.67	<0.05
What does the problem of the IT	Poor training and stereotypical thinking of teachers	44	26.0	212	65.8	213.55	<0.05

implementation in medical education refer to?	Student dissatisfaction due to lack of direct contact	39	23.1	118	36.6	108.19	<0.05
	Poor self-organization and independent work skills of students	116	68.6	153	47.5	149.20	<0.05
	Inadequate technological infrastructure	62	18.9	120	37.2	129.40	<0.05
	Lack of access to the Internet/bad Internet connection	26	15.4	114	35.4	141.42	<0.05
	Distance learning in medical education cannot be implemented due to the need for clinical practice	37	21.9	96	29.8	55.86	<0.05
	IT technologies can be effective for gaining clinical experience, but this requires further development	61	36.1	137	42.5	45.25	<0.05
	Lack of adequate curricula	93	55.0	152	47.2	55.15	<0.05
	Problems related to the lack of technological infrastructure	45	26.6	110	34.2	53.74	<0.05
	TOTAL	169	100	322	100		
	Correlation coefficient		0.857				<0.05

One of the consequences of the global quarantine was the realization that the traditional model of medical care is being replaced by a new paradigm, which is transforming the concept of both the professional activity of doctors and medical education while maintaining basic values. In this case, IT plays a key role in ensuring the quality of medical education.

The experience of different countries (Al-Balas et al., 2020; Lucey & Johnston, 2020) indicates the effectiveness of distance medical education and its great potential, as well as the presence of a number of serious problems and obstacles, among which the main ones are the availability of high-quality Internet and computers, as well as the psychological rejection of innovations by teachers. When comparing the results of the student and teacher survey conducted at one of the leading medical universities in the Russian Federation with the data of scientific literature on similar studies that took place in other countries, we can note the active participation of teachers in the implementation of information technologies. It should also be noted that teachers mainly use computers and laptops while students prefer smartphones. Information technologies are widely used to theoretically study general and specialized disciplines and conduct webinars in contrast to the study of clinical disciplines.

Potential obstacles to the increased use of IT to teach medical students clinical disciplines are inadequate technological infrastructure, as indicated by about a third of respondents, and a lack of adequate curricula, as noted by half of the respondents in both groups. However, it should also be highlighted that more than half of the students indicated the lack of training and stereotypical thinking of teachers as the major problem, which is confirmed by less than a third of the teachers participating in the study. At the same time, according to most teachers, a serious problem is student motivation and readiness for independent work, as well as the lack of self-discipline skills. In addition, about one

fifth of the respondents in both groups believe that the complete transition to distance learning in medical education is impossible due to the need for clinical practice; however, the number of those who see IT prospects in this area and believe that they should be developed and improved is much bigger. What calls attention to itself is the fact that information technologies are not often used in scientific research, which may be associated with the inadequate use of such Internet resources as virtual laboratories, and also indirectly note the unpopularity of scientific activities among modern students.

In any case, this aspect requires further study and the development of effective measures to increase the motivation of both students and teachers to conduct medical research using information technologies. While many students and teachers consider distance medical education to be of lower quality and do not see its benefits, most respondents described the online learning experience as positive while noting the improved academic performance of medical students.

Generally, the distance learning experience was assessed as positive with an average level of satisfaction. This indicates that there is a gradual process of overcoming stereotypes and prejudices regarding the prospects of information technologies and distance learning in medical universities. The expansion of the use of IT and the introduction of distance learning in medical education largely depend on psychological factors, one of which is the readiness to accept innovations. Innovation and creativity are important components of the involvement of all educational process participants which determine the characteristics of their professional behavior. Table 2-4 present the results of the study of the indicators of innovative qualities of students and teachers carried out based on valid psychodiagnostic techniques.

It is interesting that the indicators of student creativity and risk for the sake of success were slightly higher than those of teachers, which also affected the indicator of the general index of innovativeness (Table 2). That is, students, primarily due to their age, are more ready to perceive new things and less resistant to innovations. In general, the majority of students and teachers showed a high and increased level of creativity, which indicates their readiness to accept new ideas that do not fit into the usual thinking patterns.

Although both groups were characterized by the average level of risk appetite (half of the respondents), the willingness to take a risk for the sake of success was noted by many respondents. It can be assumed that both creativity and risk appetite are important professional characteristics, and some differences in the student and teacher indicators are associated with their age and achievements. This is also confirmed by the greater student focus on the future compared to teachers who demonstrated average indicators on this scale. However, almost half of teachers and more than half of students demonstrated a high or increased level of their focus on the future, which indicates the readiness to actively search for opportunities and lack of fear to make mistakes.

Table 2. The results of self-assessment of the innovative personality traits by medical students and teachers

Test indicators	Interpretation	Teachers		Students		Student's t-test	p
		absolute value	%	absolute value	%		
Creativity	Low	4	2.4	9	2.8	2.83	<0.05
	Reduced	11	6.5	28	8.7	15.56	<0.05
	Average	67	39.6	102	31.7	55.86	<0.05
	High	53	31.4	132	41.0	67.88	<0.05
	Increased	34	20.1	51	15.8	30.41	<0.05

Risk appetite for the sake of success	Low	5	3.0	4	1.2	12.73	<0.05
	Reduced	7	4.1	10	3.1	7.07	<0.05
	Average	88	52.1	155	48.1	28.28	<0.05
	High	41	24.3	92	28.6	30.41	<0.05
Focus on the future	Increased	28	16.6	61	18.9	16.26	<0.05
	Low	2	1.2	3	0.9	2.12	<0.05
	reduced	6	3.6	3	0.9	19.09	<0.05
	average	78	46.1	112	34.7	80.61	<0.05
	high	47	27.8	109	33.9	43.13	<0.05
	increased	36	21.3	95	29.5	57.98	<0.05
TOTAL		169	100	322	100		
Innovativeness index		62.7		63.00		2.12	<0.05
Correlation coefficient						0.949	<0.05

At the same time, the results of the study of uncertainty tolerance (Table 3) showed that it is much higher among students than among teachers who, due to their age, are more curious and prone to generate and implement new ideas, strive to changes, novelty, and originality; they are ready to solve more complex problems, follow unbeaten tracks, and go beyond the accepted limitations. Teachers in this case turn out to be more cautious and conservative; they tend to strive for clarity and rejection of uncertainty, which causes a feeling of discomfort.

Table 3. Results of the study of tolerance to uncertainty of students and teachers of a medical university

Scale	Average indicators		Student's t-test	p
	Teachers	Students		
UT	38	52	98.99	<0.05
UIT	74	44	212.13	<0.05
IITU	46	32	98.99	<0.05
Correlation coefficient	-0.500			<0.05

Paradoxically, an innovative personality, according to the research (Bykova, 2011), is expected to actively interact with the environment and shape it. In our case, students, being more innovative thinkers compared to teachers, prefer to choose an environment and adapt to it while teachers shape the environment; however, about a third of students prefer to adapt to the current conditions and not to actively change anything (Table 4).

Table 4. The results of the study of medical students and teachers according to the Sternberg method

Scale	Teachers		Students		Student's t-test	p
	absolute value	%	absolute value	%		
Choice of the environment	26	15.4	126	39.1	167.58	<0.05
Adaptation to the environment	65	38.5	175	54.3	111.72	<0.05
Shaping of the environment	78	46.2	21	6.5	280.72	<0.05
TOTAL	169	100	322	100		
Correlation coefficient	-0.500					<0.05

Thus, in addition to the pursuance of development and transformation, it is necessary to develop student volition to be innovative as an important professional quality of self-development. As for teachers, it is necessary to increase their motivation to constantly improve qualifications, master new technologies and introduce information technologies into the educational process and medical practice.

In general, before the COVID-19 pandemic, in medical education, information technologies were used as an extra technical tool to support classroom learning; however, the need to ensure the continuity and quality of vocational training in the conditions of quarantine restrictions led to the revision of the attitude towards distance learning in medical education and the emergence of a new paradigm of medical education with a focus on the introduction of information technologies and online learning to study both theoretical and clinical disciplines. The advantages of distance learning contributing to the more active involvement of students and teachers in the educational process and the effective construction of a system of theoretical and practical knowledge of students suggest that in the near future it will become one of the major forms of higher education which will also include the study of clinical disciplines. Before the pandemic there was a tendency of a gradual transition to the active use of simulation technologies when teaching subjects such as anatomy, physiology, and propaedeutics of internal diseases; thus, the quarantine has revolutionized this process and extrapolated it on both theoretical and clinical disciplines.

The practice, which turned out to be quite positive, contributed to overcoming organizational barriers and psychological stereotypes about the introduction of IT into the programs of theoretical and practical training of doctors. Nevertheless, there is still a number of important professional competencies that students can acquire only through direct contact with patients in a clinic, in particular, the ability to perform auscultation, palpation, dental, gynecological and surgical manipulations, examine psychoneurological patients, diagnose and treat children and newborns, and much more, which involves the formation of empathy, clinical thinking, and the acquisition of practical skills. In connection with the above, some of the respondents demonstrated a negative attitude towards distance learning in medical education; however, the majority of respondents positively assessing the experience of distance learning opted for blended learning that combines online learning with clinical practice.

#### **4. Conclusions and Recommendations**

The COVID-19 pandemic has become a challenge to both health care systems and medical education systems due to the forced and sudden transition to predominantly distance learning. When comparing the results of the student and teacher survey conducted at one of the leading medical universities in the Russian Federation with the data of scientific literature on similar studies that took place in other countries, we can note the active participation of teachers in the implementation of information technologies. The positive aspects of the introduction of IT and distance learning in medical education are timesaving, the flexibility of classes, better academic performance of students, and a more effective interaction with teachers. Possible obstacles to the expansion of the use of IT to teach medical students clinical disciplines are inadequate technological infrastructure, lack of adequate curricula, poor training and stereotypical thinking of teachers, and students' lack of independent work and self-discipline skills. Despite the fact that a number of students and teachers consider distance medical education to be of lower quality and do not see its benefits, the distance learning experience was generally assessed as positive with an average level of satisfaction. This indicates that there is a gradual process of overcoming stereotypes and prejudices regarding the prospects of information technologies and distance learning in medical universities. Our research has shown the need to develop student volition to be innovative as an important professional quality of self-development, as well as to increase the motivation of teachers to constantly improve their qualifications, master new technologies and introduce IT into the educational process and medical practice.

The results of current and related research indicate the creation of global requirements for distance learning in medical specialties to implement a digital transformation of their educational process to form future qualified doctors.

### List of abbreviations

IT - information technologies

UT - Uncertainty Tolerance

UIT - Uncertainty Intolerance

IITU - Interpersonal Intolerance to Uncertainty

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