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Assessing the effectiveness and adequacy of medical student examinations in the context of distance learning

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Abstract

The problem of assessing students' knowledge is gaining particular importance and relevance. The purpose of the study is to clarify the effectiveness and adequacy of examinations and the assessment of the knowledge of medical students with the help of an online platform through studying the opinions of teachers and students who participated in this process. The students and teachers took part in a hospital therapy exam on the Moodle platform and were subsequently interviewed to reveal their experience. The results of the study showed that according to 67% of students, the level of exam organization was acceptable. Thus, 59% of students positively assessed the process and structure of the exam and found them to be clear and convenient. The research describes a model for the exam organization and assessment in an online learning environment, which consists of two parts: theoretical and practical.

Keywords: academic performance, distance learning, medical skills, online exams, testing students' knowledge.

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1. Introduction

Student knowledge assessment is an important aspect of the educational process in all educational institutions, including medical universities. Adequate assessment and its use as a tool for improving students' knowledge is the basis for building a quality learning process and training good specialists in the field of medicine (Bushmina, 2021).

The outbreak of the COVID-19 pandemic has affected the lives of students and triggered an unprecedented emergency (Reuge et al., 2021). There have been serious changes in the education sector. For the first time ever, the learning process took place remotely (online) and both students and teachers faced a number of difficulties in this regard. One of the most significant problems has become the issue of assessing students' knowledge. This is important not only for the proper assessment of the knowledge gained but also for the overall assessment of the level of students' knowledge.

On the other hand, Desai et al. (2020) indicate that conducting online classes nationwide may be a challenge in developing countries due to poor Internet connectivity and insufficient access to high-speed broadband services. However, the mainstreaming of online education among medical students during the current health crisis suggests that it is a very pragmatic and affordable learning option that can certainly complement traditional classroom learning (Grigorkevich et al., 2022).

The teachers faced difficulties in both the final and intermediate assessments of student progress. Final assessment shows what students have learned at the end of a unit, course, or period. It also checks whether the learning goals have been achieved. Intermediate assessment is usually used in higher education as a source of constant feedback in order to improve the teaching and learning processes. It has been found that intermediate assessment can be effective in an online learning environment and can also help increase student engagement. Fundamental assessment problems include validity, reliability, and dishonesty (Gikandi et al., 2011). In online learning, there are additional difficulties associated with assessment.

Technological progress helps teachers and students of medical universities, as well as the representatives of other spheres who have faced problems due to the pandemic. In particular, mobile technology helps support learning and communication. Mobile technologies are increasingly being used by physicians to obtain up-to-date information on patient care. This provides medical students with learning opportunities; however, appropriate pedagogical approaches to teaching and assessment are not clear yet (Davies et al., 2012).

Accordingly, the issue of assessing the practical knowledge of medical students in the context of online learning remains relevant and needs to be addressed by scientists and practitioners. This study aims to test the effectiveness and adequacy of examinations and assessments of medical students online, to obtain opinions of both students and teachers on this issue, to identify existing problems and provide recommendations for optimizing the assessment process.

2. Literature review

Medical education is a complex process that requires significant economic costs and time expenditure. It also requires a number of practical skills and knowledge. Therefore, the possibilities of online education and assessment in this context are limited (Bushmina, 2021).

The quality of education is assessed in order to clarify the dynamics and level of student knowledge and to determine the weak and strong aspects of the competencies of students (Zinkevich, 2012). Student knowledge assessment should not be reduced to an exclusively formal procedure of assigning

marks and filling in documents. In education, students' knowledge should also be assessed to encourage them to study (Schuwirth & Van der Vleuten, 2011).

2.1. Online training and assessment of students' knowledge

Online learning is an effective approach for mastering both theory and practical skills. It is necessary to consider what kind of practical skills need to be taught. More complex practical skills that require tactile sensation are best taught face-to-face so that the teacher can provide instant feedback (Dolan et al., 2015).

It should be borne in mind that online learning may be suitable for some students but not for others. In particular, this may depend on the learning style of the individual. Obviously, different students have different learning styles (visual, auditory, reading/writing, tactile). Research has found that learning styles are not determined by the gender of students and their previous performance (Urval et al., 2014).

Online learning provides good opportunities to complement the face-to-face learning process. The results obtained by the Indonesian researchers showed that the use of archived videos and online learning have a very positive effect on students' acquisition of knowledge and a range of skills (Indrawati, 2021).

At the onset of the COVID-19 pandemic, it was a suitable option to allow students to use reference materials when taking exams, as well as to virtually supervise this process. In order to avoid student problems and frustration, research recommends exams with virtual supervision (Prigoff et al., 2021).

In order to effectively teach students practical skills online, it is necessary to follow 4 key rules: (1) activation (remembering and demonstrating the knowledge gained); (2) demonstration and explanation (usually done by the teacher); (3) application of skills and knowledge followed by feedback; (4) implementation of the skills and knowledge gained into practice (Alekseeva & Balkizov, 2020).

The effectiveness of online learning depends on (1) well-developed course content, motivated interaction between teachers and students, the level of training and support of the curators; (2) creation of a sense of community in online learning; (3) rapid technology improvement (Sun & Chen, 2016).

Numerous studies show that students usually have a positive attitude towards online learning and assessment. For example, at Chitwan Medical College in Nepal, more than half (53.5%) of students were satisfied with online learning, and 29.7% had a neutral attitude (Sharma et al., 2020). However, some studies show that students prefer traditional learning and assessment. Medical college students in India took an online exam that was followed by a survey. More than 60% of students reported that they prefer traditional knowledge assessment methods to the new online approaches. According to the authors, the result was expected. However, in the current context of the Covid-19 pandemic and the rapid development of digital technologies, the approaches to student knowledge assessment need to be revised (Sadeesh et al., 2021).

2.2. The formation of community in online learning

In the process of online learning, students should feel that they are part of a team, have an opportunity to communicate with peers, and also ask teachers questions and receive feedback. The recommendations of American scientists for building a learning community in the context of online medical education are as follows: (1) community building efforts should be introduced at the

beginning of the course and continue until its completion; (2) both teachers and students should be involved; (3) both synchronous and asynchronous technologies should be used to create space where teachers and students interact; (4) a variety of strategies should be implemented for productive discussion; (5) student assignments should be focused on collaboration (Sun & Chen, 2016).

2.3. Modern approaches in medical education and assessment of students' knowledge

2.3.1. Competency-based medical education

A competency-based approach to medical education should be consistent and comprehensive and develop assessment and feedback systems. Ideally, the bulk of the assessment process should take place in the context of clinical practice. Assessment facilitates the development of competencies. There are many assessment methods but the focus should be placed on their effective application. The formation of new competencies (e.g. teamwork) requires the development of new assessment systems (Holmboe et al., 2010).

The US researchers suggest that medical educators should use the situation created by the Covid-19 pandemic to make changes in 3 areas related to competency-based medical education: focusing on results, expanding assessment tools and improving the transition from undergraduate medical education (UME) to graduate medical education (GME) (Hauer et al., 2021).

2.3.2. Problem-based learning in medical education

Problem-based learning was first implemented in medical education in 1969 at McMasters University. Since then, it has been an important part of the curriculum of most medical universities. Today there is a need to find ways to implement it in the online learning environment. Blended learning is a relatively new trend in education. It complements face-to-face learning with eLearning modules (Woltering et al., 2009).

2.3.3. Flipped classroom

According to students, continuous self-learning skills can be improved through the flipped classroom approach. Medical students were satisfied with this learning approach and generally preferred it to the traditional lecture-based approach (Ramnanan & Pound, 2017).

Developers have created many online platforms that can be used to teach students. The Kahoot survey platform is a high-potential mid-term assessment tool as it is transparent, practical, and fun to learn. It can be used to motivate students to learn. However, Kahoot is not the best tool for making difficult subjects easier, as many students might think (Ismail & Mohammad, 2017).

The literature review shows that despite considerable technological progress and the adoption of online education by a wide range of students and teachers, today the majority of medical university teachers do not clearly understand how to organize the processes of teaching and assessing students online and prefer the traditional approach.

2.4. Setting objectives

The new conditions caused by the Covid-19 pandemic and the introduction of distance learning in secondary and higher education have set many new challenges to educators, software developers, and scientists. Many educational institutions have already adapted to online learning and teachers have learned to deliver classes through the Internet. Another more difficult task is to assess the practical knowledge of students in this context. In particular, this refers to medical universities, where the ability to touch is fundamentally important.

Note that a considerable number of modern studies are devoted to online education and its effectiveness compared to traditional learning. However, most of them focus on personal and professional qualities of students, while their academic performance and mechanisms of grading and examination in distance learning are often ignored. The present study aims to clarify the effectiveness and adequacy of examinations and the assessment of the knowledge of medical students with the help of an online platform through studying the opinions of teachers and students who participated in this process.

The objectives of the research include studying the opinions of medical university students and teachers on the assessment of practical knowledge online, clarifying the problems and prospects associated with this, as well as finding possible ways to improve this process.

3. Methods and materials

3.1. Research design and sample

The research is based on the questionnaires and interviews. A similar method was used by Woltering et al. (2009).

3.2. Survey

The study involved 215 students and 63 teachers from Sechenov First Moscow State Medical University (Sechenov University) (Table 1).

Table 1. Demographic information

Students	Gender	Male	118
		Female	97
	Age	19-20	136
		21-22	79
Teachers	Gender	Male	34
		Female	29
	Age	27-35	16
		36-45	29
		46-58	18

The students studied "Hospital therapy" and took the final exam on the Moodle platform. After the exam, the students were asked to fill in a questionnaire that contained 10 closed-ended questions related to their opinion on this format of training (Figure 1).

The student questionnaire contained the following questions:

1. Was the online learning process well-organized? (Yes/No)
2. Did you understand the structure and process of training? (Yes/No)
3. Are you satisfied with the quality of the audio material? (Yes/No)
4. Are you satisfied with the quality of the video material? (Yes/No)
5. Are you satisfied with the quality of the images? (Yes/No)
6. Was there technical support in the course of training and taking the exam? (Yes/No)
7. Do you think that it is better to study this discipline and take the final exam in the online learning environment rather than in the traditional format? (Yes/No)

8. Do you think that it is better to study this discipline and take the final exam in the traditional learning environment rather than in the online format? (Yes/No)

9. Do you think that knowledge of specialized medical subjects can be assessed online? (Yes/No)

10. Do you think that your exam result reflects your real level of knowledge? (Yes/No)

The teachers who delivered classes and conducted the exam and/or watched it were asked to participate in an interview to share their opinion on the exam format.

The key interview questions were as follows:

1. Do you think that online learning, online exams, and online student knowledge assessment are applicable in higher medical education?

2. Is it possible to use the online examination format in the context of all specialized medical subjects?

3. Are the tools provided by online platforms sufficient to assess student knowledge within the framework of higher medical education?

4. How objective is the online exam score?

5. Which format is more suitable for conducting classes and exams and assessing students' knowledge in higher medical education: online or traditional?

The reliability of the student questionnaire was verified using Cronbach's alpha. The Cronbach's alpha values are as follows: $\alpha > 0.9$, Excellent; > 0.8, Good; > 0.7, Acceptable; > 0.6, Questionable; > 0.5, Poor (Gliem, J.A. & Gliem, R.R., 2003). The value of Cronbach's alpha is 0.92. Hence, the questionnaire is reliable and can be used for the survey purposes.

3.3. Data analysis and statistical processing

The results of the student survey and teacher interviews were entered into Excel and analyzed. The reliability of the student questionnaire was verified using Cronbach alpha.

3.4. Ethical issues

All study participants were informed about the procedure and objectives of the study in advance. They were handed out the copies of research rules. Each participant gave their written consent to take part in the study.

3.5. Research limitations

The research results are reliable. No irrelevant results were obtained. However, it should be borne in mind that this research is a pilot study and involved only one university in the Russian Federation; therefore, the number of participants was limited.

4. Results

Student questionnaire results are shown in Figure 1.

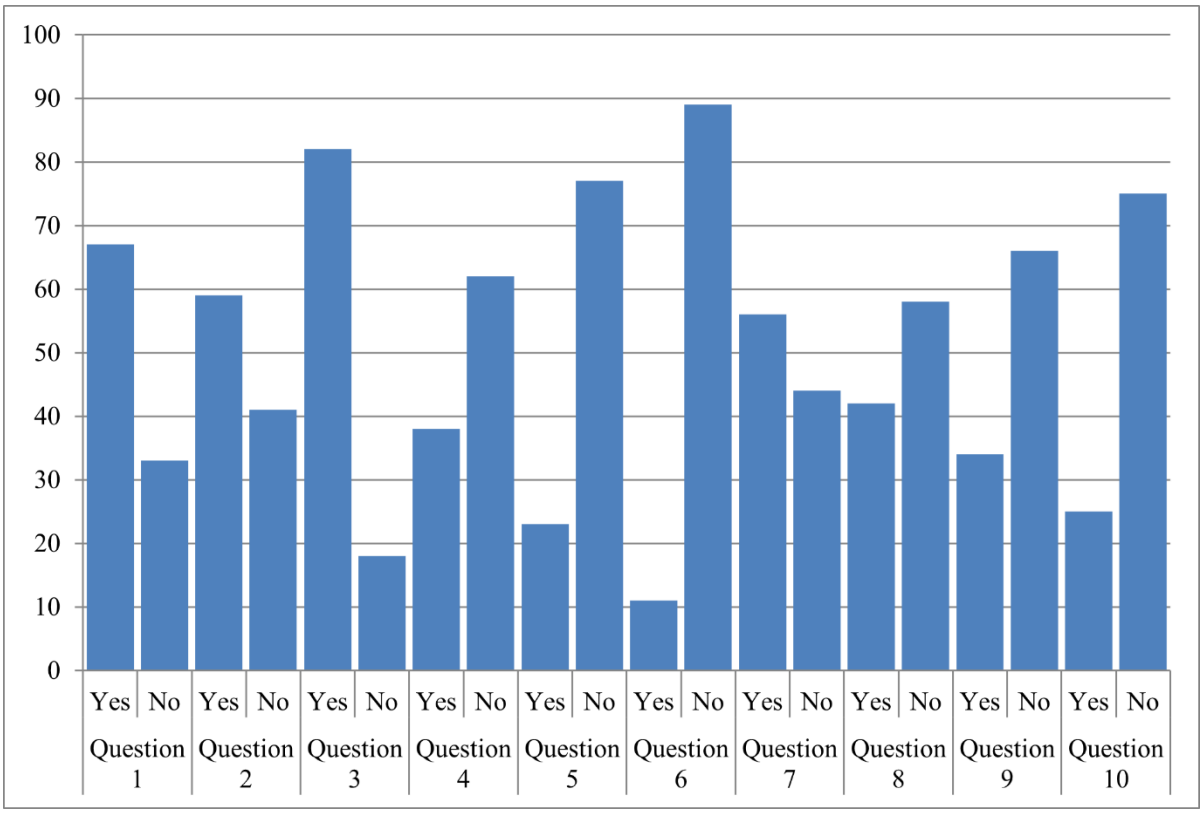

Figure 1. The percentage of positive and negative responses to the student questionnaire

1. Was the online learning process well-organized? (Yes/No)

According to 67% of students, the process was well-organized; 33% of respondents did not share this opinion. The result suggests that the online exam was organized quite well. However, based on the results of other questions, the online examination process still needs to be improved.

2. Did you understand the structure and process of training? (Yes/No)

Thus, 59% of students noted the clear structure and process of training; 41% did not agree with this. This result suggests that the structure and the process of training were clear to most students.

3. Are you satisfied with the quality of the audio material? (Yes/No)

Eighty-two percent of students answered this question in the affirmative and 18% in the negative. This result suggests that most students did not have problems with audio materials in the course of the exam.

4. Are you satisfied with the quality of the video material? (Yes/No)

Thirty-eight percent of students answered “yes” and 62% of respondents selected the “no” option. This result shows that most students had problems watching videos during the exam. This problem can be solved, for example, by choosing a different video format or using a different platform for examinations.

5. Are you satisfied with the quality of the images? (Yes/No)

Twenty-three percent of respondents noted their satisfaction with the quality of the images while 77% indicated their bad quality. Obviously, most students were dissatisfied with the quality of the images used in the exam. This is of particular importance in the case of anatomy. To address this problem, it is necessary to choose a different image file format, a different platform, or create better quality images.

6. Was there technical support in the course of training and taking the exam? (Yes/No)

Eleven percent of students answered this question in the affirmative and 89% in the negative. This suggests that students had little support during the exam and they had to solve all technical problems on their own. The problem can be eliminated by assigning one or more technicians to support students during the exam.

7. Do you think that it is better to study this discipline and take the final exam in the online learning environment rather than in the traditional format? (Yes/No)

Fifty-six percent of students answered the question in the affirmative and 18% in the negative. Thus, just over half of the students prefer the online assessment format to the traditional one. This gives reason to believe that the online format of exams can be effectively applied in medical education.

8. Do you think that it is better to study this discipline and take the final exam in the traditional learning environment rather than in the online format? (Yes/No)

Forty-two percent of students opted for traditional learning and 58% noted the online format. Obviously, the majority of students prefer the online format. This suggests that some of the traditional exams can be implemented online.

9. Do you think that knowledge of specialized medical subjects can be assessed online? (Yes/No)

Thirty-four percent of respondents noted answered in the affirmative and 66% of students gave a negative answer. Despite the fact that many students like the online exam format, many of them still feel that it is not suitable for most specialized disciplines in higher medical education. This may be due to the lack of a tactile aspect within the framework of studying such disciplines.

10. Do you think that your exam result reflects your real level of knowledge? (Yes/No)

Twenty-five percent of respondents believe that their exam scores reflect their real knowledge and 75% of students do not think so. In addition, the students reported that in the offline environment, they could have demonstrated better practical skills, which would have undoubtedly increased their final grades. This was taken into account when making conclusions on the final results of the course. This result suggests that the online exam format does not always provide an adequate assessment of students' knowledge. This issue can be solved by improving the online exam procedure or by using the traditional assessment format.

4.1. Teacher interview results

Examples of teachers' answers:

Respondent 1: The platform is good and provides many tools for the successful completion of training and exams. Students also like this format. However, there are some difficulties in understanding the real level of student knowledge when using this approach.

Respondent 2: This is a good idea to be used for assessing students' knowledge in the context of non-core subjects. I believe that in the case of anatomy, this is not the most suitable option. I would give preference to the traditional format of training and examinations in the case of specialized disciplines.

Respondent 3: I am not a supporter of distance learning and, moreover, distance examinations. It seems to me that this poses a challenge to both the students themselves and those who evaluate them. In addition, after such training and assessment, it will be difficult for young professionals to apply their knowledge in practice.

Respondent 4: The system is well-designed and it seems that there is almost no difference between the online exam and the face-to-face procedure. However, there is a lack of live communication between the teacher and the student and it is difficult to understand how well the student has mastered the material. In addition, the traditional exam environment is more transparent as it is more obvious whether the student is cheating or not.

According to the interview results, the majority of teachers give preference to the traditional format of examinations and student assessment (Figure 2).

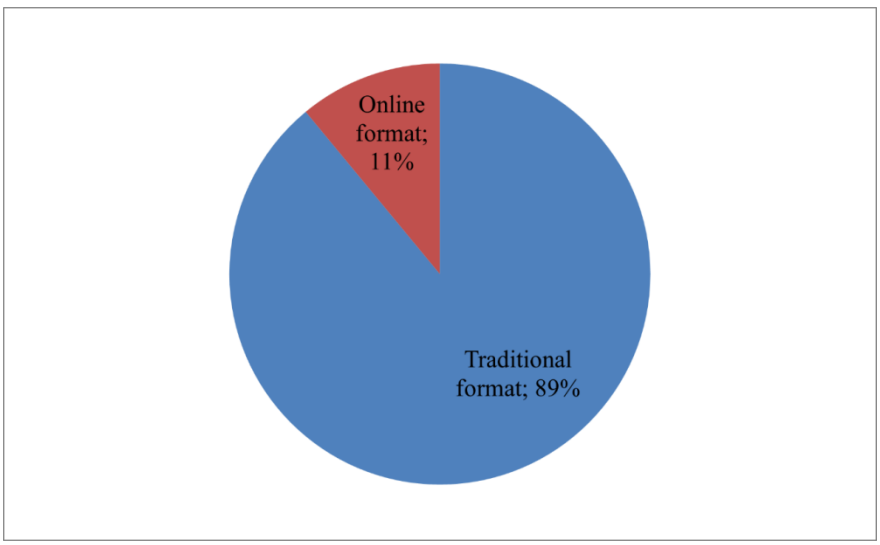

Figure 2. Preferred format of students' knowledge assessment (teachers)

The results of the student survey and teacher interviews show that the online format of conducting practical classes and assessing student knowledge in higher medical education needs significant improvements. The format has its advantages and disadvantages; however, most respondents believe that it should be used within the framework of the traditional format but not instead of it.

Based on the study results and their analysis, a model of a possible approach to assessing the knowledge of medical students in the context of online learning has been constructed (Figure 3).

Figure 3. Model of a possible approach to assessing the practical knowledge of medical students in an online learning environment

This model involves two stages of the exam: theoretical and practical. The theoretical stage can be implemented online. The practical stage requires the physical presence of students and teachers (examiners) in the classroom, but due to the Covid-19 pandemic, it also requires some organizational measures to be taken to minimize the risk of Covid-19 infection. The theoretical and practical stages can be carried out on different days. The theoretical stage (written exam) involved a considerable number of preparatory steps, the most important of which was to select a platform where the assessment would take place. The effectiveness of exam preparation depends on the availability of technical resources and on the procedure whereby the examination tasks are taken online. For that reason, it is vital to optimize the online examination paradigm. The practical exam, on the other hand, was designed in a way that minimizes interpersonal contacts between participants in order to minimize the risk of Covid-19 infection. To be more specific, students were divided into small groups of 5 and less. Teachers were obligated to monitor compliance with anti-epidemiological safety measures during the exam.

5. Discussion

The research results have shown that in the context of online learning in connection with the Covid19 pandemic, teachers and students have faced a number of difficulties related to the implementation of the learning process and student knowledge assessment, in particular in the context of medical education, where the ability to touch is crucial.

For the online assessment of students during the COVID-19 pandemic, Russian scientists have created a special “assessment dial” model (Alekseeva & Balkizov, 2020). The watch face has 5 digits that correspond to 5 principles in the utility formula: reliability, validity, acceptability, educational contribution, and feasibility. Each indicator has its own weighting factor (Alekseeva & Balkizov, 2020). In addition, it is necessary to remember that the assessment of students' knowledge should also contribute to their more effective studies. Based on the research results, a model of the exam implementation in an online format has been proposed.

Online platforms provide an opportunity to assess mainly theoretical knowledge. However, medical education is not reduced to the mastery of theoretical information. According to the researchers from Saudi Arabia, knowledge assessment, for example, in the field of anatomy, is a complex task that requires the assessment of several areas: theory, practice, and clinical knowledge (Yaqinuddin et al., 2013). In general, theoretical knowledge is tested with the help of a written exam consisting of multiple-choice and short answer questions. The assessment of practical knowledge (3D anatomical concepts) includes oral, selective, and objective structured clinical examinations. The application of anatomical knowledge to patients is tested primarily through objective structured clinical exams (Yaqinuddin et al., 2013).

The model described in the study offers optimal conditions for an objective assessment of students' knowledge. Previously, in order to adequately assess the performance of a student, teachers took into account many different factors, for example, attendance, activity in the classroom, practical activities, initiative, etc. In the context of online learning, all these aspects are difficult to track. According to research, the student assessment system should involve the development of the following relations: each aspect of the competency must be informed from various sources of assessment while each source of assessment should be used to inform about several aspects of the competencies (Schuwirth & Van der Vleuten, 2011). In addition, to ensure the effective assessment of student learning outcomes, existing psychometric approaches should be expanded; the role of human judgment in assessment must be studied and reconsidered (Schuwirth & Van der Vleuten, 2011).

The results of the study conducted by Omani researchers are in line with the results obtained in our research indicating that students have a more positive attitude to online examinations compared to teachers. More than half of the Omani students who took the Moodle exam expressed a clear preference for the online exam environment (Inuwa et al., 2011). This trend prevailed among senior students. It was also more popular with male students. The key advantages of the online exam include image quality, time management, and seating arrangement (Inuwa et al., 2011).

Based on the results of the study, in medical education, it is more feasible to conduct the main part of practical classes and examinations in the traditional format. In particular, it is important for special disciplines such as anatomy, internal medicine and surgery. Surgical skills and the ability to examine the patient (auscultation, palpation) are required in a wide range of medical specialties (Kneebone, 2003). Simulators can provide a safe and realistic learning environment for ongoing practice. Simulation (with the use of physical models, computer software, or a combination of the two) offers the opportunity to learn and evaluate skills. However, effective training cannot be ensured by simulation alone. It can be used to complement the educational process (Kneebone, 2003). Simulation can be used in the course of the practical exam stage.

American researchers emphasize that assessment in medical education (which is based on competencies) differs from the assessment in other fields and has a number of features (Holmboe et al., 2010). Competency-based medical education definitely requires a robust and multifaceted assessment system. It is necessary to focus on the clinical training context. Both qualitative and quantitative methods of assessing student knowledge should be applied (Holmboe et al., 2010).

Generally, the results obtained in the study show that the traditional format of examinations and assessment of students' knowledge is the most suitable for medical universities. However, the pandemic and the challenges associated with it make it necessary to look for the opportunities to conduct these processes online. Today, it is better to combine face-to-face and online approaches to learning.

6. Conclusions

Based on the study results, it can be concluded that both students and teachers positively assess the capabilities of online platforms and are happy to use them. However, in the current realities of a medical university, the traditional format of teaching and assessing the knowledge of medical students should prevail.

The results obtained showed that according to 67% of students, the level of exam organization was acceptable; 59% of students positively assessed the process and structure of the exam and found them to be clear and convenient. There were 82% of students who were satisfied with the quality of the audio materials used in the course of training and the final exam. However, only 38% of students positively assessed the quality of the video materials and 23% were satisfied with the quality of the images. The majority of students (89%) reported that there was virtually no technical support during their training and the exam; 56% of students generally approve of the online format of exams and assessment. However, 28% believe that the traditional format is still better. Also, 66% of students noted that the online format is not always suitable for assessing knowledge in specialized disciplines in the context of medical education. According to 75% of the surveyed students, their exam scores do not reflect their real knowledge level. The result obtained made it possible to promptly take measures and provide students with additional tasks, during which they demonstrated really better performance in the mastery of practical skills.

As for the results of teacher interviews, many educators spoke positively about the possibilities of the online system in the context of examinations. However, the majority of teachers expressed doubts that this approach to assessing students' knowledge is suitable for the medical education realities. It was difficult for the teachers to evaluate the real level of students' knowledge based on the online exam results. Most of them believe that the traditional approach to assessing student knowledge is more appropriate for their university. At the same time, the majority of teachers were also positive about the use of online systems in the learning process and students' knowledge assessment.

Based on the results of this study, a model for the exam organization and student knowledge assessment in an online learning environment in the context of medical education was described. It consists of two parts: theoretical and practical. In this case, the theoretical stage must be implemented online and the practical one should be carried out in person in compliance with a number of anti-epidemic rules.

This research is a contribution to the study of the issue of assessing medical students in the context of distance learning and the use of online platforms. The study may be of interest to students, teachers, parents, university administrations and all those who are interested in modern education trends. Future research can focus more on the examination procedures for senior medical students, which require a thoughtful assessment of practical skills, as the pandemic has hindered the practical examination process.

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