



# The Learning Experience of Romanian Medical Students During the Online Teaching Imposed by the COVID-19 Pandemic

Dumitru Sutoi <sup>1,2</sup>, Catalina Oana Bazavan<sup>1</sup>, Maria Sutoi<sup>1,2</sup>, Alina Petrica<sup>1,3</sup>, Adina Maria Marza <sup>1,4,5</sup>, Cosmin Iosif Trebuan<sup>1,6</sup>, Cosmin Librimir<sup>1,6</sup>, Octavian Constantin Neagoe<sup>5,7,8</sup>, Mihaela Ionica<sup>5,7,8</sup>, Florina Nicoleta Buleu<sup>9</sup>, Ovidiu Alexandru Mederle<sup>1,4,10</sup>

<sup>1</sup>Department of Surgery, Emergency Discipline, “Victor Babes” University of Medicine and Pharmacy, Timisoara, 300041, Romania; <sup>2</sup>Clinic of Anaesthesia and Intensive Care, “Pius Brinzeu” Emergency Clinical County Hospital, Timisoara, 300736, Romania; <sup>3</sup>Emergency Department, “Pius Brinzeu” Emergency Clinical County Hospital, Timisoara, 300736, Romania; <sup>4</sup>Emergency Department, Emergency Clinical Municipal Hospital, Timisoara, 300079, Romania; <sup>5</sup>First Department of Surgery, “Victor Babes” University of Medicine and Pharmacy, Timisoara, Romania; <sup>6</sup>Emergency Department, Emergency County Hospital, Reşita, Romania; <sup>7</sup>Second Clinic of General Surgery and Surgical Oncology, Emergency Clinical Municipal Hospital, Timisoara, Romania; <sup>8</sup>First Department of Surgery, Breast Surgery Research Center, “Victor Babes” University of Medicine and Pharmacy, Timisoara, Romania; <sup>9</sup>Department of Cardiology, “Victor Babes” University of Medicine and Pharmacy, Timisoara, 300041, Romania; <sup>10</sup>Department of Surgery, Multidisciplinary Center for Research, Evaluation, Diagnosis and Therapies in Oral Medicine, “Victor Babes” University of Medicine and Pharmacy Timisoara, Eftimie Murgu Square 2, Timisoara, 300041, Romania

Correspondence: Mihaela Ionica, Tel +40748904915, Email ionica.mihaela@umft.ro

**Introduction:** The COVID-19 pandemic has disrupted many aspects of society, including medical education. In response to the pandemic, Romanian medical schools and universities have turned to online learning as a means of continuing instruction while maintaining social distancing protocols. While online learning in medical education was utilized prior to the pandemic, its widespread adoption has brought both challenges and opportunities to the field. The purpose of this study was to assess medical students’ perception towards implementing E-learning during COVID 19 pandemic.

**Material and Methods:** This cross-sectional multicentric study comprised 611 medical students from several medical university centers from Romania. A self-developed questionnaire was online applied between January and March 2021 and used for the evaluation and analysis of perceived changes in teaching before and during the COVID-19 pandemic.

**Results:** Most students (n = 71.5%) considered that the pandemic had an overall negative impact on their professional development. A significant negative correlation (p < 0.01, for all), was observed between during COVID-19 pandemic and the level of medical training, motivation to learn, and level of self-confidence.

**Conclusion:** The shift to online learning during the pandemic decreased the psychological and professional development of medical students, resulting in a low perception of self-confidence, motivation, and practical involvement. However, there are many benefits brought by the use of electronic technologies for medical education both in Romania and in the world. These benefits should be systematically evaluated, and effective strategies should be developed to permanently improve the e-learning methods of these students.

**Keywords:** medical education, COVID-19 pandemic, online medical education, medical training

## Introduction

The COVID-19 pandemic has disrupted many aspects of society, including medical education. In response to the pandemic, many medical schools and universities have turned to online learning as a means of continuing instruction while maintaining social distancing protocols. While online learning in medical education was also utilized prior to the pandemic, its widespread adoption has brought both challenges and opportunities to the field. Online learning has emerged as a viable alternative to traditional in-person education, offering a flexible and accessible way to deliver

medical education and training. The use of various digital platforms and technologies has allowed medical institutions to continue to provide high-quality education while ensuring the safety of their students, faculty, and staff.<sup>1-3</sup>

The shift to online learning in medical education during the pandemic has had significant implications for students, educators, and the broader healthcare system. As medical students have been unable to participate in in-person clinical experiences, there has been an increased need for innovative and effective online learning strategies to ensure that students continue to receive the training and experience they need to become competent healthcare professionals.<sup>3,4</sup>

During the COVID-19 pandemic, attempts have been made to use different technologies to help different universities on a global scale to ensure the continuity of learning processes, either by introducing mobile learning (M-learning) systems<sup>5,6</sup> or by use of the Internet of Things (IoT),<sup>7</sup> but it was observed that they could also be affected by other external variables related to social factors, such as learning motivation.

In Romania, both universities and medical institutions have utilized online learning platforms to provide medical students, residents, and fellows with didactic lectures, case discussions, and simulation exercises, allowing for the exchange of knowledge and ideas in a safe and accessible manner.<sup>8-10</sup>

However, the adoption of online learning in the medical field also comes with its challenges. The lack of hands-on experience and in-person interactions with faculty and colleagues can be a barrier to effective learning and training. Additionally, not all medical professionals have access to reliable internet connectivity or the necessary technology to participate in online learning activities.<sup>11-13</sup>

The main purpose of this study was to assess medical students' perception from Romania regarding on-line learning during the COVID-19 pandemic. We believe that, by examining the experiences of medical students we can gain a better understanding of the opportunities and challenges presented by online learning in medical education and work towards creating a more effective and accessible educational system for all.

## Materials and Methods

### Study Design and Participants Selection

To this cross-sectional, multicentric study, data were prospectively collected from ten medical universities from Romania. A total of 713 medical students were invited to take part in the study. All students were studying general medicine, from all medical study years (Ist-VIth). Students attended the following medical universities (in order of number of participants): "Victor Babes" University of Medicine and Pharmacy Timisoara; "Dunarea de Jos" University of Galati; Lucian Blaga University of Sibiu-Faculty of Medicine; Oradea University-Faculty of Medicine and Pharmacy; "Iuliu Hațieganu" University of Medicine and Pharmacy Cluj; "Grigore T. Popa" University of Medicine and Pharmacy Iasi; University of Medicine, Pharmacy, Sciences and Technology (UMFST) "George Emil Palade" Targu Mures; "Carol Davila" University of Medicine and Pharmacy Bucuresti; "Vasile Goldiș" Western University of Arad-Faculty of Medicine; University of Medicine and Pharmacy of Craiova; "Ovidius" University Constanta-Faculty of Medicine.

Informed consent was obtained prior to the acquisition of data from all participants.

### Self-Developed Questionnaire Design

Evaluation of impact of the COVID-19 pandemic on the psychological and professional development of medical students was performed through an original questionnaire comprising multiple items that allowed for the self-evaluation of both subjective and objective parameters. A structured, self-developed questionnaire with 58 items was created to evaluate the perception of medical online learning among general medicine students based on a review of the literature and expert opinions. The questionnaire was designed to assess the following areas: (1) demographic information of the participants, (2) experiences with online learning during the pandemic (self-confidence, motivation to learn), (3) challenges faced by students during online learning (practical/clinical abilities, interdisciplinary thinking, teaching abilities of professors and temptation to cheat on exams) and (4) effectiveness of online learning (self-assessment of level of preparation, average grades before and during the pandemic).

Survey questions were presented as single-choice answers, as scale-based answers: 1 to 5 (5 being considered in full agreement with the presented statements) and 1 to 10 (1 is lowest and 10 is the highest score) or as free answers. The

questionnaire was designed to be self-administered by medical students through an online form. Incomplete forms were excluded from the present study ( $n = 102$ ). The questionnaire was pilot tested with a small sample of medical students and educators to ensure its validity and reliability. Construct validity was assessed using exploratory factor analysis. To assess the reliability of the questionnaire, it was administered to the same sample of students from the pilot-study two weeks after the initial administration. Internal consistency was assessed using Cronbach's alpha (0.822), and test-retest reliability was assessed using the intraclass correlation coefficient.

## Statistical Analysis

Statistical data processing was performed using SPSS software for Windows version 20 (Armonk, NY: IBM Corp.) and Excel Microsoft Office 2003 (Microsoft Corporation). The database was created in Microsoft Excel, based on individual student answers, comprising demographic data and values for each question. Depending on the type and characteristics of the parameters followed, the data obtained were attributed to quantitative, categorical, or ordinal variables.

Confidence interval was 95% ( $n = 611$ ). Minimum number of sample size for 95% confidence interval was 377, and for 99% confidence interval was 643. Population size has been set at 20,000, and response distribution was 50%. With a sample size of 611, margin of error accepted is 3.90%.

Descriptive analysis was used to characterize the participant group, as well as to describe the subgroups according to the following variables. Descriptive analysis of quantitative variables was expressed as mean or median according to type of distribution, range, maximum and minimum values. Variability of measured values in a group was expressed as standard deviation (SD). Nominal and ordinal data were presented as proportions and percentages.

Normal distribution of the studied data set was performed using the Shapiro-Wilk and Kolmogorov-Smirnoff tests. In this study, for subgroups with  $n < 20$  observations, for testing the normality of the distribution of variables, both tests were used.

Parametric tests were performed for continuous variables adapted to type of distribution and type of measurement (independent or repeated), comprising paired and unpaired Student's *t*-test. Welch's correction was applied when comparing groups with unequal variance. One-way ANOVA was used for the assessment of differences between the means of 3 or more samples. Homogeneity of variance was done using Levene's test.

Linear association between quantitative variables was computed with Pearson correlation coefficient ( $r$ ). The strength of correlation was considered moderate for  $r$  values between 0.3 and 0.39, strong for  $r$  values between 0.4 and 0.69, and very strong for  $r$  values of 0.7 and above, respectively. The type of correlation was determined by a positive or negative  $r$  value. Non-parametric tests comprised Chi-square test for the analysis of correlation between categorical/ordinal data. A  $p$  value less than 0.05 was considered statistically significant, with  $p$  values lower than 0.01 being marked as highly significant.

Data collected from free-answer questions were quantified by query search. To estimate the relative frequency of each parameter, we calculated the total number of mentions for each variable divided by the total number of recordings.

## Results

### Demographic Distribution

Of the total of 611 students included in the final sample of this study, 19.8% ( $n = 121$ ) are first-year students, 19.5% ( $n = 119$ ) are second-year students, 11.9% ( $n = 73$ ) are in the third year of study, 21.4% ( $n = 134$ ) are forth-year students, 15.2% ( $n = 93$ ) are students in the fifth year of study and 11.6% (71) are in the last year of study. From all students, 56.8% ( $n = 347$ ) participants being enrolled from the "Victor Babes" University of Medicine and Pharmacy Timisoara. Demographic data can be found in [Table 1](#).

### Perception of e-Learning During COVID-19 Pandemic on Teaching

Analyzing the items that addressed teaching exclusively online, it was observed that the most important advantage of e-learning, for the majority of students, was gaining more free time (54.8%,  $n = 335$ ), by saving the hours spent arriving

**Table I** Distribution of Study Group by Year and University of Study

Demographic Variable	No. of Students N (%)
<b>Years of study</b>	
<b>I</b>	121 (19.8)
<b>II</b>	119 (19.5)
<b>III</b>	73 (11.9)
<b>IV</b>	134 (21.9)
<b>V</b>	93 (15.2)
<b>VI</b>	71 (11.6)
<b>University of study</b>	
UMFT	347 (56.8)
UDJ-GALATI	132 (21.6)
ORADEA UNIVERSITY	40 (6.5)
ULBS	25 (4.1)
UMF Cluj	24 (3.9)
UMF Iasi	17 (2.8)
UMFST	12 (2)
UMFCD	7 (1.1)
UVVG	4 (0.7)
UMFCV	1 (0.2)
UOC	1 (0.2)

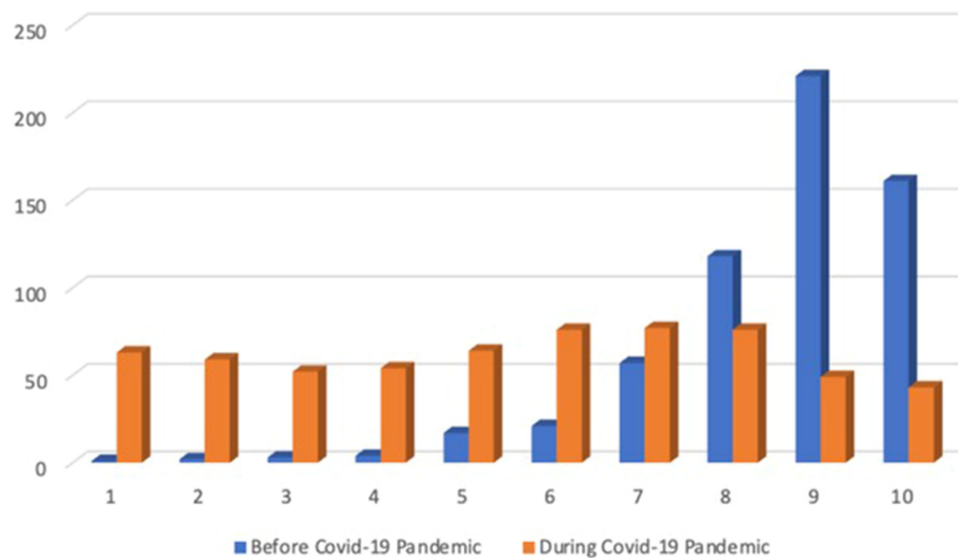
**Notes:** UMFT – “Victor Babes” University of Medicine and Pharmacy Timisoara; UDJ-GALATI – “Dunarea de Jos” University of Galati; ULBS – Lucian Blaga University of Sibiu-Faculty of Medicine; UMF Cluj – “Iuliu Hațieganu” University of Medicine and Pharmacy Cluj; UMF Iasi – “Grigore T. Popa” University of Medicine and Pharmacy Iasi; UMFST –University of Medicine, Pharmacy, Sciences and Technology (UMFST) “George Emil Palade” Targu Mures ; UMFCD – “Carol Davila” University of Medicine and Pharmacy Bucuresti; UVVG – “Vasile Goldiș” Western University of Arad-Faculty of Medicine; UMFCV – University of Medicine and Pharmacy of Craiova ; UOC – “Ovidius” University Constanta-Faculty of Medicine.

with different means of transport in classes. The second advantage for online teaching as stated by students was comfort and convenience (31.4%, n = 192). Another frequently mentioned advantage was financial savings (12.8%, n = 78).

The lack of interaction between students and other colleagues, teachers, doctors, and patients were the most important disadvantage highlighted in this group of students (n = 59.2%, n = 362), followed by lack of practice (51.1%, n = 312). Loss of motivation ranked as the third main disadvantage (n = 17.5%, n = 107).

Evaluated by scale of 1 to 5 (with 5 being in total agreement), 58.3% of students considered that the change from the classical method to e-learning affected the quality of medical teaching, at a theoretical and a practical level, with a mean value of item evaluation of  $4.1 \pm 1.3$ . Furthermore, 55.8% of students were in total agreement with the fact that the teaching staff would have sustained the lectures and hospital training in a more interesting way if they had not been online. With a mean value of  $3.2 \pm 1.2$ , students were neutral in their opinion on how well teachers adapted to the online transition. However, evaluated at a mean value of  $4 \pm 1.2$ , students considered that teaching staff could use the technology to a higher level, such that they could offer an experience as good as it was before lockdown.

Level of motivation to learn was evaluated using a scale from 1 to 10, with 10 being considered as maximum motivation. A significant difference was recorded between these levels before and during the pandemic ( $p < 0.001$ ). Level of motivation decreased from an average of  $8.5 \pm 1.5$  to an average of only  $5.4 \pm 2.7$ . Before the pandemic, 26.4% and 36.2% of students evaluated their level of motivation at 10 and 9, respectively. During the pandemic a dramatic decrease was observed, with only 7% and 7.5% of students considering having a high degree of motivation to learn, attributing a value of 10 and 9, respectively. A significant negative correlation ( $r = -0.573$ ) was noted between the level



**Figure 1** Level of motivation to learn before and during COVID-19 pandemic on a scales from 1 to 10 (1 being the lowest and 10 the highest score).

of motivation and the specific period ( $p < 0.01$ ). About 43.7% of students considered that online teaching did not determine them to study as much as before the pandemic (Figure 1).

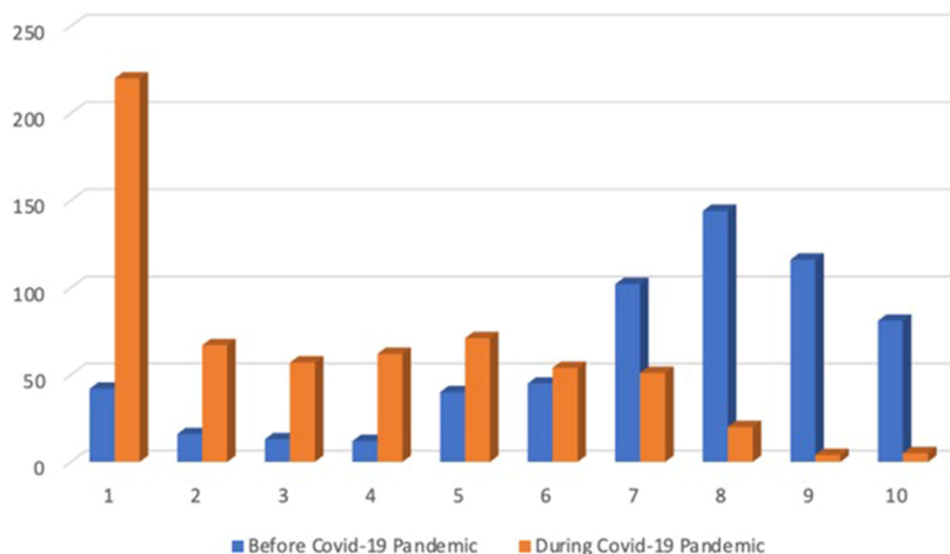
The bigger opportunity for students to cheat during an online exam is an important aspect that teachers should be aware of. We analyzed the level of temptation to cheat during an exam, before and during the pandemic, using a scale from 1 to 10 (where 1 was the lowest level and 10 the greatest). During the classic examination sessions, before COVID-19, the average level of temptation to cheat on exams was  $2.8 \pm 2.1$ . During the pandemic, the level of temptation to cheat increased significantly, recording a mean of  $7 \pm 3$  ( $p < 0.001$ ). Before the pandemic, 41.9% of students considered that temptation was at its lowest value. On the other hand, when the exams became online, 31.1% of students had a maximum level of temptation. A significant positive correlation was observed not only between time and temptation to cheat ( $r = 0.645$ ,  $p < 0.001$ ) but also between the level of motivation and temptation to cheat ( $r = 0.180$ ,  $p < 0.001$ ) although to a lesser extent. Moreover, 59.4% of students ( $n = 363$ ) completely agree that there are more opportunities to cheat during online exams.

## Perception of e-Learning During COVID-19 Pandemic on Medical Training

Analysis of the perceived level of training before and after several months of online teaching was assessed by using a scale from 1 to 10 (1 being the lowest and 10 the highest score).

Before COVID-19, the average recorded score for the perceived level of training was  $8 \pm 1.4$ . During the pandemic, a significant decrease in perceived level of medical training was observed, with a mean of  $6.2 \pm 2$ . A significant reduction in the number of students that perceived a high level of training was observed before and during the pandemic, with 6.1% evaluating at 10 and 33.2% at 9 before COVID-19 and only 1.6% evaluating at 10 and 10% at 9, respectively, following the onset of the pandemic ( $p < 0.001$ ). A significant negative correlation ( $r = -0.460$ ,  $p < 0.001$ ) was observed between the specific period and the perceived level of medical training (Figure 2).

Interestingly, the mean value of exam grades did not present a significant difference between the two evaluated periods, with an average of  $8.7 \pm 2.4$  and  $8.1 \pm 2.7$  before and after the pandemic, respectively. However, 36.5% of students considered to have issues regarding their medical knowledge. One of the highlighted issues regarded clinical practice. Based on evaluation scales from 1 to 5 (5 being considered in full agreement with the presented statements), 80.5% of students selected a score of 5, considering that during the pandemic they experienced a lack of practical internships. Moreover, 48.3% stated that they are afraid of not being able to compensate for the lost period and wish to somehow regain the loss of practical training after the medical crisis disappears. About 60.1% of students did not agree when being asked if the practical experience accumulated during the COVID-19 pandemic was like the one gained



**Figure 2** Level of training of students before COVID-19 pandemic and during COVID-19 pandemic on a scales from 1 to 10 (1 being the lowest and 10 the highest score).

previously. Furthermore, 45.5% fully agreed that the global pandemic affected in a negative way interdisciplinary thinking, an important aspect of medical training.

In the same line, 69.4% of students deeply felt the absence of the in-hospital internships. This comprised of a lack of interaction with patients and acknowledging that during online classes they were not able to gain indispensable qualities for a future doctor, such as the ability to properly communicate and empathize with their patients.

As a global assessment, 75.9% ( $n = 463$ ) of students considered that the COVID-19 pandemic had a negative influence on their professional development.

## Perception of e-Learning During COVID-19 Pandemic on Self-Confidence

Self-confidence was evaluated using a scale from 1 to 10, where 1 is lowest and 10 is the highest score. Before the COVID-19 pandemic, the average level of self-confidence was  $8.2 \pm 1.6$ . These values recorded a significant decrease following the onset of the pandemic, with an observed level of  $6.2 \pm 2.4$  ( $p < 0.001$ ). Level of self-confidence presented a significant negative correlation ( $r = -0.447$ ,  $p < 0.001$ ) with the specific period.

About 37.2% of students consider that during the online period was a major causing factor when it comes to the gaps accumulated in their medical knowledge and are afraid that because of the insufficient time spent among medical staff, patients, without the real connection with the hospital environment, their interdisciplinary thinking will not ever be as good, or as evolved as their colleges from terminal years that were able to experience this kind of medical training. Moreover, 43.7% of students fully agreed that online teaching during the pandemic period represented a dejecting factor for them.

Furthermore, 11.3% of students stated that due to the COVID-19 pandemic and the lack of human interaction, not only with patients but also with their teachers and colleagues, they had moments when they thought of the possibility of quitting medical school. In 2.9% of evaluated cases decided to give up on studying in the medical field.

## Discussion

The COVID-19 pandemic has had a significant impact on the medical education landscape, with many institutions turning to online learning as a means of continuing instruction while maintaining social distancing protocols. While online learning in medical education has been utilized prior to the pandemic, its widespread adoption has brought both challenges and opportunities to the field.<sup>3,14,15</sup> The present study aim was to assess medical students' perception towards implementing E-learning during COVID 19 pandemic in Romania.

In our study, the most important advantage of e-learning, for the majority of students, was gaining more free time (54.8%,  $n = 335$ ), by saving the hours spent arriving with different types of transport in university classes. The second advantage for online teaching as stated by students was comfort and convenience (31.4%,  $n = 192$ ). Another frequently mentioned advantage was financial savings (12.8%,  $n = 78$ ).

However, online learning has also presented significant challenges to medical education during the pandemic. One of the main challenges has been the difficulty of providing hands-on, experiential learning opportunities for students. This has been particularly challenging for students in clinical fields, who may require significant hands-on experience to develop the necessary skills and competencies. Another challenge of e-learning has been the potential for decreased student engagement and motivation in online learning environments. This can be particularly challenging in medical education, where student engagement and motivation are essential for success.<sup>16-19</sup>

As we observed in the present study, the results show that the level of student's medical practice significantly decreased during the COVID-19 pandemic, resulting in a negative correlation between online teaching and its unfavorable change ( $p < 0.01$ ). Moreover, the same fact is highlighted in the self-confidence and level of motivation analysis, both having a downward evolution and associating a negative correlation. In accordance with our results, in 3 studies conducted by Büssing et al, they report that online teaching during the pandemic had a negative impact on students' stress perception, psychological well-being, and work satisfaction, especially in the first part of the pandemic, when all the social restrictions were implemented.<sup>20-22</sup>

Various studies<sup>3,14,16,17</sup> have examined students' attitudes towards online learning, and the results have been mixed. Some students have reported positive experiences with online learning, citing the convenience and flexibility it provides. For example, online learning allows students to study at their own pace and access course materials from any location with internet connectivity. Additionally, online learning can reduce the time and costs associated with commuting to and from class. However, other students have expressed concerns about the quality of online learning and the lack of in-person interactions with faculty and peers. These students believe that the absence of face-to-face communication and hands-on learning experiences can lead to decreased motivation, disengagement, and reduced learning outcomes. In another study, Gismalla et al analyze the perception of e-learning for medical students during COVID-19 pandemic, and observed that the students found that the lack of face-to-face communication with lecturers and other students during e-learning sessions had a significant contribution to a poor environment for professional communication and the exchange of learning experiences.<sup>23</sup> By analyzing medical students' attitudes toward e-learning during the COVID-19 pandemic, it was found that many students declared e-learning's usefulness and confirmed its complementary role in medical education, but some announced that it could not replace in-person training.<sup>24</sup>

Regarding e-learning psychological point of view, the COVID-19 pandemic, according to our study participants added to decreasing self-confidence and motivation, also influencing the level of involvement. This aspect was a contributing factor in the decision of approximately 3% of the evaluated students to drop out of medical studies. All of those causing factors lead to 72% of students stating that overall, the pandemic had a major negative impact on their professional life.<sup>25</sup> In agreement with our findings, Lollobrigida et al consider that distance learning can represent a demotivational factor for students because values such as equality, human interaction and clinical experience cannot be offered by online teaching in the long term.<sup>26</sup>

As a global assessment, 75.9% ( $n = 463$ ) of students from this study considered that the COVID-19 pandemic had a negative influence on their professional development.

Opposite to our findings, a study that also included medical students found that 65.5% of the respondents thought that e-learning is more or equally effective for meeting individual learning needs than traditional teaching methods.<sup>27</sup> According to Thapa et al, only about 34% ( $n = 470$ ) of the students found e-learning as effective as traditional face-to-face learning during the COVID-19 pandemic in Nepal. Overall, 58.9% had a favorable attitude toward e-learning.<sup>28</sup>

Furthermore, the participants in this study achieved better results during the pandemic than before, results confirmed also in the study by Lungeanu et al.<sup>29</sup> Better results can be correlated with better preparation, but in the case of online learning the possibility of cheating must be taken into consideration. In line with this issue, an interesting and concerning aspect has been observed in the present study, namely a positive correlation between

the level of temptation to cheat on exams during the pandemic. This represents a serious ethical issue that has significant implications for patient care and the integrity of the medical profession. Medical professionals who cheat on exams may lack the necessary knowledge and skills to provide high-quality patient care, which can lead to misdiagnosis, inappropriate treatment, and even patient harm. It is essential that medical universities and professional organizations take a strong stance against cheating and work to promote a culture of academic honesty and integrity in the medical profession. These findings highlight the need to acknowledge the possibility of an increased cheating attempt during online examinations and the need to adapt examination methods to prevent such attempts.

Even if Romania is in Eastern Europe in an area with weaker economic power and less access to technology, online teaching during the pandemic might have had a less negative impact if there had been an attempt to gradually implement online teaching in the teaching curriculum. The adaptability process would have been smoother, easier, and more efficient.<sup>30,31</sup>

Almaiah et al investigated between February 20 and June 15, 2022, by applying online questionnaires whether there is a difference between social anxiety and computer anxiety that could influence the perception of e-learning and observed that cooperative learning environments have a remarkable impact on anxiety, as learners feel more relaxed and comfortable when sharing information collaboratively, although other previous studies have shown that traditional classrooms can increase anxiety levels compared to e-learning environments.<sup>32</sup> Moreover, we are aware of the usefulness of different e-learning methods in the education of students in different fields, as studies in the specialized literature have shown,<sup>33</sup> but we believe that for a quality medical education and a more correct choice of the medical specialty at the end of the faculty and for greater learning efficiency, a compromise method consisting of online courses and on-site hands-on training might be a better alternative.

## Study Limitations

The highly subjective nature of the study represents that main limitation, as perception of changes in the educational process varies greatly on the individual that experiences these changes. Most of the parameters evaluated through the questionnaire were of subjective nature, and therefore open to a various array of bias, such as flawed self-assessment and social adaptation of negativity. Self-assessment may determine a poor reflection of personal abilities and achievements, as some students may under- or over-appreciate themselves. As this study collected data anonymously, we consider that the risk for social adaptation of negativity bias was low. Another limitation of the present study lies with the limited generalization of the results, although we have observed a good internal reliability, the questionnaire was specifically constructed to fit the medical students from Romania.

## Conclusions

This study demonstrates the views of the perception of e-learning among medical students during COVID-19 pandemic. The majority of medical students had a negative perception (75.9%) of e-learning. However, there are many benefits brought by the use of electronic technologies for medical education both in Romania and in the world. These benefits should be systematically evaluated, and effective strategies should be developed to permanently improve the e-learning methods of these students.

## Institutional Review Board Statement

Ethical review and approval were waived for this study due to the anonymized data collection for this non-interventional study.

## Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.



## Data Sharing Statement

Data and materials can be provided upon reasonable request to the corresponding author.

## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

## Funding

This research received no external funding.

## Disclosure

The authors declare no conflicts of interest in this work.

## References

1. Sleiwah A, Mughal M, Hachach-Haram N, et al. COVID-19 lockdown learning: the uprising of virtual teaching. *J Plast Reconstr Aesthet Surg.* 2020;73(8):1575–1592. doi:10.1016/j.bjps.2020.05.032
2. Abbasi MS, Ahmed N, Sajjad B, et al. E-Learning perception and satisfaction among health sciences students amid the COVID-19 pandemic. *Work.* 2020;67(3):549–556. doi:10.3233/WOR-203308
3. Naciri A, Radid M, Kharbach A, et al. E-learning in health professions education during the COVID-19 pandemic: a systematic review. *J Educ Eval Health Prof.* 2021;18:27. doi:10.3352/jeehp.2021.18.27
4. Choi B, Jegatheeswaran L, Minocha A, et al. The impact of the COVID-19 pandemic on final year medical students in the United Kingdom: a national survey. *BMC Med Educ.* 2020;20(1):206. doi:10.1186/s12909-020-02117-1
5. Almaiah MA, Ayouni S, Hajjej F, et al. Smart mobile learning success model for higher educational institutions in the context of the COVID-19 pandemic. *Electronics.* 2022;11(8):1278. doi:10.3390/electronics11081278
6. Almaiah MA, Hajjej F, Shishakly R, et al. The role of quality measurements in enhancing the usability of mobile learning applications during COVID-19. *Electronics.* 2022;11(13):1951. doi:10.3390/electronics11131951
7. Almaiah MA, Alfaisal R, Salloum S, et al. Integrating Teachers' TPACK levels and students' learning motivation, technology innovativeness, and optimism in an IoT acceptance model. *Electronics.* 2022;11(19):3197. doi:10.3390/electronics11193197
8. Al-Balas M, Al-Balas HI, Jaber HM, et al. Distance learning in clinical medical education amid COVID-19 pandemic in Jordan: current situation, challenges, and perspectives. *BMC Med Educ.* 2020;20(1):341. doi:10.1186/s12909-020-02257-4
9. Alsoufi A, Alsuyhili A, Msherghi A, et al. Impact of the COVID-19 pandemic on medical education: medical students' knowledge, attitudes, and practices regarding electronic learning. *PLoS One.* 2020;15(11):e0242905. doi:10.1371/journal.pone.0242905
10. Chick RC, Clifton GT, Peace KM, et al. Using technology to maintain the education of residents during the COVID-19 pandemic. *J Surg Educ.* 2020;77(4):729–732. doi:10.1016/j.jsurg.2020.03.018
11. Harries AJ, Lee C, Jones L, et al. Effects of the COVID-19 pandemic on medical students: a multicenter quantitative study. *BMC Med Educ.* 2021;21(1):14. doi:10.1186/s12909-020-02462-1
12. De Ponti R, Marazzato J, Maresca AM, et al. Pre-graduation medical training including virtual reality during COVID-19 pandemic: a report on students' perception. *BMC Med Educ.* 2020;20(1):332. doi:10.1186/s12909-020-02245-8
13. Ahmad AR, Murad HR. The impact of social media on panic during the COVID-19 pandemic in Iraqi Kurdistan: online questionnaire study. *J Med Internet Res.* 2020;22(5):e19556. doi:10.2196/19556
14. Dost S, Hossain A, Shehab M, et al. Perceptions of medical students towards online teaching during the COVID-19 pandemic: a national cross-sectional survey of 2721 UK medical students. *BMJ Open.* 2020;10(11):e042378. doi:10.1136/bmjopen-2020-042378
15. Cho S, Jang SJ. Nursing students' motivational and self-regulated learning during the COVID-19 pandemic: a cross-sectional study. *Nurs Health Sci.* 2022;24(3):699–707. doi:10.1111/nhs.12968
16. Erfannia L, Sharifian R, Yazdani A, et al. Students' satisfaction and e-learning courses in covid-19 pandemic era: a case study. *Stud Health Technol Inform.* 2022;289:180–183. doi:10.3233/SHTI210889
17. Potu BK, Atwa H, Nasr El-Din WA, et al. Learning anatomy before and during COVID-19 pandemic: students' perceptions and exam performance. *Morphologie.* 2022;106(354):188–194. doi:10.1016/j.morpho.2021.07.003
18. Mukhtar K, Javed K, Arooj M, et al. Advantages, limitations and recommendations for online learning during COVID-19 pandemic era. *Pak J Med Sci.* 2020;36(COVID19–S4):S27–S31. doi:10.12669/pjms.36.COVID19-S4.2785
19. Baczek M, Zagańczyk-Bączek M, Szpringer M, et al. Students' perception of online learning during the COVID-19 pandemic: a survey study of Polish medical students. *Medicine.* 2021;100(7):e24821. doi:10.1097/MD.00000000000024821
20. Bussing A, Zupanec M, Ehlers JP, et al. Mental stress in medical students during the pandemic and their relation to digital and hybrid semester-cross-sectional data from three recruitment waves in Germany. *Int J Environ Res Public Health.* 2022;19(17):11098. doi:10.3390/ijerph191711098
21. Büssing A, Rodrigues Recchia D, Dienberg T, et al. Dynamics of perceived positive changes and indicators of wellbeing within different phases of the COVID-19 pandemic. *Front Psychiatry.* 2021;12:685975. doi:10.3389/fpsy.2021.685975

22. Bussing A, Lindeberg A, Stock-Schröer B, et al. Motivations and experiences of volunteering medical students in the COVID-19 pandemic-results of a survey in Germany. *Front Psychiatry*. 2021;12:768341. doi:10.3389/fpsy.2021.768341
23. Gismalla MD-A, Mohamed MS, Ibrahim OSO, et al. Medical students' perception towards E-learning during COVID 19 pandemic in a high burden developing country. *BMC Med Educ*. 2021;21(1):377. doi:10.1186/s12909-021-02811-8
24. Niroumand S, Mastour H, Moodi Ghalibaf A, et al. Medical Students' Attitude Toward E-learning During the COVID-19 Pandemic. *Shiraz E-Med J*. 2022;23(9):e121340. doi:10.5812/semj-121340
25. Desai D, Sen S, Desai S, et al. Assessment of online teaching as an adjunct to medical education in the backdrop of COVID-19 lockdown in a developing country - An online survey. *Indian J Ophthalmol*. 2020;68(11):2399–2403. doi:10.4103/ijo.IJO\_2049\_20
26. Lollobrigida M, Ottolenghi L, Corridore D, et al. Student evaluation of distance learning during the COVID-19 pandemic: a cross-sectional survey on medical, dental, and healthcare students at Sapienza University of Rome. *Int J Environ Res Public Health*. 2022;19(16):10351. doi:10.3390/ijerph191610351
27. AlQhtani A, AlSwedan N, Almulhim A, et al. Online versus classroom teaching for medical students during COVID-19: measuring effectiveness and satisfaction. *BMC Med Educ*. 2021;21(1):452. doi:10.1186/s12909-021-02888-1
28. Thapa P, Bhandari SL, Pathak S, Wilkinson J. Nursing students' attitude on the practice of e-learning: a cross-sectional survey amid COVID-19 in Nepal. *PLoS One*. 2021;16(6):e0253651. doi:10.1371/journal.pone.0253651
29. Lungeanu D, Petrica A, Lupusoru R, et al. Beyond the digital competencies of medical students: concerns over integrating data science basics into the medical curriculum. *Int J Environ Res Public Health*. 2022;19(21):15958. doi:10.3390/ijerph192315958
30. Liang S, Chai CS, Lee VWY. Surveying and modelling 21st century online learning patterns of medical students. *Int J Environ Res Public Health*. 2022;19(19):12648. doi:10.3390/ijerph191912648
31. Chai CS, Hwee Ling Koh J, Teo YH. Enhancing and modeling teachers' design beliefs and efficacy of technological pedagogical content knowledge for 21st century quality learning. *J Educ Comput Res*. 2019;57:360–384. doi:10.1177/0735633117752453
32. Almaiah MA, Alfaisal R, Salloum SA, et al. Examining the impact of artificial intelligence and social and computer anxiety in e-learning settings: students' perceptions at the university level. *Electronics*. 2022;11(22):3662. doi:10.3390/electronics11223662
33. Almaiah MA, Alfaisal R, Salloum S, et al. Determinants influencing the continuous intention to use digital technologies in higher education. *Electronics*. 2022;11(18):2827. doi:10.3390/electronics11182827

## Advances in Medical Education and Practice

Dovepress

### Publish your work in this journal

Advances in Medical Education and Practice is an international, peer-reviewed, open access journal that aims to present and publish research on Medical Education covering medical, dental, nursing and allied health care professional education. The journal covers undergraduate education, postgraduate training and continuing medical education including emerging trends and innovative models linking education, research, and health care services. The manuscript management system is completely online and includes a very quick and fair peer-review system. Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

Submit your manuscript here: <http://www.dovepress.com/advances-in-medical-education-and-practice-journal>