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DOI: 10.2478/rjom-2021-0005

Original papers

E-learning during the COVID-19 pandemic: the impact on medical students' perceived academic progress

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Abstract

The Covid-19 pandemic created one of the most stressful situations all around the world and affected almost all activity sectors, including medical education. Sudden restrictions on social interactions forced an abrupt transition from amphitheatres and physical examinations to online lectures and, despite difficulties, the academic community rallied to continue teaching. The swift transition left academia with no time to design custom platforms and confined the university to choose among a set of readily available tools: Google Classroom and Google Meet, Zoom and Moodle, which offer a basic framework for substituting the students' needs. In some countries, ours included, most of the summer term took place online.

Although pandemics are, hopefully, rare events, the experience with online classes should be used to improve and expand current teaching models, since this improvement could be a means to a general improvement of the medical teaching system. On the other hand, the COVID-19 pandemic is not finished yet and many restrictions continue, affecting at least 20% of the total undergraduate training of several generations of doctors.

The study aims to identify – within the medical students' community - transferable aspects of online classes to the post-pandemic teaching in the perspective of blended learning. We deliberately chose to omit the examination part of the educational process in order to set the focus on the delivery of teaching.

In this first analysis of the results, the degree of progress in reaching a high professionalism level was analyzed starting from the self-assessment of professional growth, that was previously found to be in good agreement with the actual achievements as derived from the traditional formative examination. [1]

Keywords: *medical students, students' perceived progress, preferences, e-learning, COVID-19 pandemic, lockdown, online classes, medical education*

Methods

This is part of a cross-sectional study conducted to investigate the lockdown impact on the medical students of the Faculty of Medicine, in Carol Davila University of Medicine and Pharmacy from Bucharest. In our country, the lockdown period started on the 21st of March (3 weeks after the start of the second semester); it lasted until the 14th of May 2020, but the remote training was continued until the end of the second semester. Learning strategies such as lectures, case conferences, role playing, personal or group assignments, and in few cases existing video materials (already published on YouTube) were mainly used in a schedule adjusted around the one planned for this second semester.

The study was started in May 2020 by an academic team from the Faculty of Medicine. Five focus groups (small groups of 8-10 people) were formed with students enrolled in the preclinical classes to assess the advantages and disadvantages of e-learning, as well as the personal compromises imposed by the pandemic. The input from a smaller group (4 students) from the clinical classes was added.

Subsequently, with the contribution of 2 other instructors and 4 students from the clinical years, a 31-item survey was developed and revised based on feedback and personal insights. In brief, the survey focused on five major areas: (1) the personal perceptions of students regarding professional progression during the time of using e-learning as the primary educational procedure compared to the traditional medical education; (2) the personal changes the lockdown imposed; (3) the time management; (4) the adherence to the university schedule; (5) the students' opinions and suggestions for enhancing the experience of e-learning in the case of another semester taking place in a similar manner.

This first report aims to distinguish what influenced the students' satisfaction and personal growth perception most. For the purpose of this analysis, we divided the students in groups according to the answer selected to the question: "what is the self-assessment of your progress in medical education during the e-learning period compared to the progress you had presumed to obtain without the lockdown?" The three groups: "progressed as expected" (PAE), "progressed better than expected" (PBE), "progressed less than expected" (PLE) were compared from different perspectives: year of study, gender, the perceived quality of the teaching, the changes in the scheduling imposed by the university, the personal time management, and the answers to the question "what did you dislike most during the e-learning period?". This last question gave the possibility to mark multiple answers from a predetermined list of 7 and the possibility to add items in their own wording. These answers were re-classified in additional 6 answers, covering the main topic mentioned by the responders.

The questionnaire was disseminated in the communication groups of the students from first to final years. A total of 536 medical students responded. The mean age was 22.25 years and, among them, 25% were males and 75% females.

The representation from each study year was: 69 students from year 1; 75 students from year 2; 98 students from year 3; 156 students from year 4; 56 students from year 5 and 82 students from year 6. Because of the similarities in the scope of training (fundamental, basic science) and experience, the students from the first and second year of study were analyzed together; they represent the preclinical group. The students from year 3 and 4 formed the early clinical group, as in the 3rd year hospital training is started and in the 4th year the first clinical modules are completed. The students in the last 2 years of training (advanced clinical group) were considered separately, as they are more mature, they have already fully accustomed to the hospital practice, and their main objective is the admission to a residency program.

Results

The main results of the study are presented in Table 1. The e-learning program was largely accepted, being followed by more than 50% of its schedule by 86.8% of the respondents, as following: 285 students participated between 75%-100% of the schedule and 175 students between 50-75% of the schedule. There were only 9.51% (51 students) that followed the program between 25-50% of the schedule and very few (4.66%) below 25%.

Overall, few students would like to continue exclusively online and only 16/536 would like to transfer all the medical training online. Their impression is driven in more than one third of the responders by the class they attended and the way the training was delivered.

The gender distribution accords to the overall gender structure in the medical program of the university; there was an unequal representation according to the GPA.

The largest number of students (264, representing 49.06%) considered that their progress was less than expected; 215 students (40,11%) performed as expected and only 10.63% appreciated their performance as better than expected (Table 1). There were no differences in gender between these 3 groups. However, the perceived level of achievement was significantly lower in the 3rd and 4th year of study compared to others: 60.23% of the total felt into the PLE category in the early clinical group, while in the preclinical and in the advanced clinical groups, the percentage was much lower and almost equal (20.45% and 21.59%, respectively) ($\chi 2 = 23.86$, $p=0.0009$).

No student in the PLE group considered the e-learning experience as totally positive and a significant number (58/264) of them considered it unacceptable; on the opposite, no student from the PBE group considered the e-learning as unacceptable.

Even in this group only 9/54 would like to continue exclusively online. Excepting the response "Good or bad, depending on the organization of the class", that had proportionally more respondents than the PBE, the PAE group positioned its responses between the PLE and PBE groups. Concerning this particular answer there were no statistically significant differences in opinion between the PLE and the PBE students ($\chi 2 = 0.57$, $p=0.48$).

Table 1. Comparison between students who perceived

		Progress less than expected		Progress as expected		Progress better than expected	
		No	% of total in category	No	% of total in category	No	% of total in category
Gender	Female	200	75.75%	162	75.34%	41	71.93%
	Male	64	24.24%	53	24.65%	16	28.07%
Year of study**	1st year	29	10.98%	31	14.41%	9	15.79%
	2nd year	25	9.47%	40	18.60%	10	17.54%
	3rd year	54	20.45%	31	14.41%	13	22.80%
	4th year	99	37.50%	50	23.25%	7	12.28%
	5th year	24	9.09%	26	12.09%	6	10.52%
	6th year	33	12.50%	37	17.20%	12	21.05%
How would you describe the e-learning experience**	Very good, it should continue the in the same way	0	0.00%	7	3.25%	9	15.79%
	Good, some activity should continue this way	12	4.54%	57	26.51%	20	35.08%
	Good or bad, depending on the organization of the class	88	33.33%	87	40.46%	22	38.60%
	Acceptable, but only a small part of the activity should continue online	106	40.15%	59	27.44%	6	10.52%
	Unacceptable, nothing should continue online	58	21.97%	5	2.32%	0	0.00%
How did you organize yourself during the lockdown	I have reorganised my house/apartment/room into a workspace and a leisure space*	45	17.11%	50	23.25%	18	31.57%
	I had to live in the same place as before, but with more people (family members, friends)	69	26.23%	54	25.23%	11	19.29%
	I've moved to another city	40	15.20%	23	10.70%	6	10.52%
	I had to buy additional devices/services in order to better communicate online	39	14.82%	32	14.88%	2	3.50%
	I didn't change anything	110	41.82%	101	46.97%	27	47.36%
	I started an online job	2	0.76%	3	1.39%	0	0.00%
	Negative comment (the adjustments to the personal living space didn't assure an efficient learning activity)	1	0.38%	0	0.00%	0	0.00%
	I temporarily interrupted my job	1	0.38%	0	0.00%	0	0.00%
Did not having to commute to different locations for the university allowed you to study more?**	Yes	79	29.92%	116	53.95%	50	87.71%
	No	93	35.22%	25	11.62%	2	3.50%
	I can't tell, my whole schedule was different	22	34.84%	74	34.41%	5	8.77%
Do you consider you have organised your schedule according to your needs (both professional and social) during lockdown?**	I have organised my schedule very well	10	3.78%	29	13.48%	17	29.82%
	I have organised my schedule better than before	42	15.90%	79	36.74%	28	49.12%
	I have organised my schedule same as before	91	34.46%	63	29.30%	10	17.54%
	I have organised my schedule worse than before	121	45.83%	44	20.46%	2	3.50%

Table 1 (continued). Comparison between students who perceived

		Progress less than expected		Progress as expected		Progress better than expected	
		No	% of total in category	No	% of total in category	No	% of total in category
Did the schedule imposed by the university give you the feeling of having a better control over your life?**	Yes, a lot	5	1.89%	20	9.30%	6	10.52%
	Yes, somehow	45	17.04%	58	26.97%	13	22.80%
	Yes, but very little	32	12.12%	33	15.34%	8	14.03%
	Not at all	120	45.45%	70	32.55%	21	36.82%
	No, on the contrary, it interrupted my plans	62	23.48%	34	15.81%	9	15.78%
How frequently did you use online activities during lockdown?	Rarely, <25% of the time	1	1.75%	7	3.25%	17	6.44%
	Sometimes, between 25 and 50% of the time	6	10.52%	17	7.90%	28	10.60%
	Rather frequently, between 50 and 75% of the time	19	33.33%	71	33.03%	85	32.20%
	Very frequently, >75% of the time	31	54.38%	120	55.81%	134	50.75%
How frequently were you NOT actually active in the online classes, although you were connected?**	Rarely, <25% of the time	113	42.80%	120	55.81%	33	57.89%
	Sometimes, between 25 and 50% of the time	88	33.33%	71	33.02%	20	35.08%
	Rather frequently, between 50 and 75% of the time	39	14.77%	18	8.37%	3	5.26%
	Very frequently, >75% of the time	24	9.09%	6	2.79%	1	1.75%
What did you dislike the most during the e-learning training?	I disliked the absence of direct interaction with the patients**	205	77.65%	133	61.86%	31	54.38%
	I disliked the absence of the daily habit of going to the hospital**	130	49.24%	69	32.09%	11	19.29%
	I dislike the absence of direct interaction with the teachers	173	68.37%	88	45.83%	19	35.84%
	I disliked the large quantity of information presented in an online class/case presentation/lab**	111	42.04%	80	37.20%	11	19.29%
	I disliked the insufficient explanations during an online class/case presentation/lab**	115	43.56%	51	23.72%	3	5.26%
	I disliked the absence of possibility of real time participation (answering questions, drawing graphs) because of technical limitations of the elearning app**	100	37.87%	51	23.72%	7	12.28%
	I disliked the technical issues of online classes (poor internet connexion, microphonics, limited non-responsive interface)*	158	59.84%	103	47.90%	32	56.14%

* p<0.05; **p<0.001

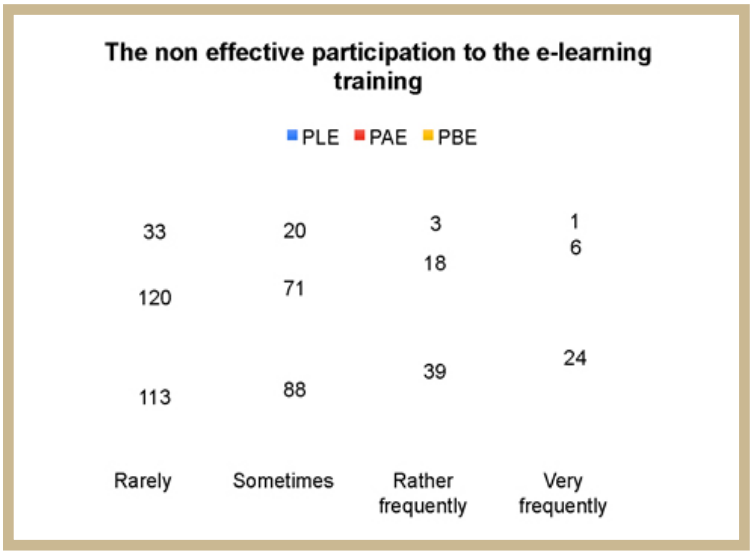
More students among those who performed better or as expected than the PLE ones considered to organize their workspace and to separate it from the rest of the house/room. This was particularly significant for students in the early clinical group ($\chi2$= 14.29, p=.0.0009), as for the preclinical and the advanced clinical students the difference was non-significant ($\chi2$=0.67, p=0.72 and $\chi2$=0.46, p=0.79, respectively).

Time was also remarkably better managed in the PBE than in the PLE groups, with the PAE ranking between them. Students who performed better were able to harness the time gained from not having to commute, in order to study more. The difference was maintained in all 3 categories of years of study.

Moreover, the PBE responders organised their schedules better than previously and adapted better to the scheduling imposed by the university, while almost half of the PLE group (45.83%) had a more disorganised schedule than before; for a majority of them (68.62%) the class program either did not help or interrupted the planned activities.

Despite a similar rate of participation to the online classes, the effective participation (where the students were actively using the platforms, not just signing in and leaving it running in the background) was significantly different between the PLE, PEA and PBE groups (Fig 1). From the total 91 students that attended rarely or very rarely the classes, 69.23% were in the PLE group and only 4.40% in the PBE group.

Figure 1. The non effective participation during the online classes



Legend:
- Rarely = < 25% of the time;
- Sometimes = between 25-50% of the time;
- Rather frequently = 50-75% of the time;
- Very frequently = >75% of the time.

Overall, the main complaint regarding the online training was the absence of the interaction with the patients (369 students), followed by the technical issues (293 students) and the lack of direct interaction with the instructors (280 students). Missing the routine of going daily to the hospital was mentioned by 210 students. The excessive amount of information presented during the online classes was commented by 202 students. Less than a third of the students indicated the insufficient explanations during the online classes (169) or the lack of direct interaction in class (158).

The content of the open answer was filled in by 48 students. The most frequent element of discontent was the online teaching abilities of the professors (mentioned by 22 of them), followed by the inconsistent scheduling and improper set up of the activities (13 students); 8 students reinforced the need for more practical training, 3 noticed the lack of interaction with their colleagues during the online training and 2 recognized their difficulty to focus for the whole duration of the sessions.

The PAE, PBE and PLE students had statistically significant different answers to all the items initially included in the questionnaire and the significance was maintained when comparison was restricted to the PBE and PLE groups.

The analysis by years of study groups revealed significant differences between the PLE, PBE, PAE for the responses 1 (I disliked the absence of direct interaction with the patients) and 3 (I disliked the absence of direct interaction with the teachers) in all groups. The early and advanced clinical students differentiate from the preclinical one by the response 2 (I disliked the absence of the daily habit of going to the hospital) that was significantly different only for the preclinical group. The advanced clinical group showed no difference in the selection of the answers 4 (I disliked the large quantity of information presented in an online class/case presentation/lab), 5 (I disliked the insufficient explanations during an online class/case presentation/lab), 6 (I disliked the absence of possibility of real time participation (answering questions, drawing graphs) because of technical limitations of the e-learning app) while in preclinical and early clinical years groups the overall difference maintained its statistical significance (Table 2).

Figure 2. Perceived limitations of the e-learning classes

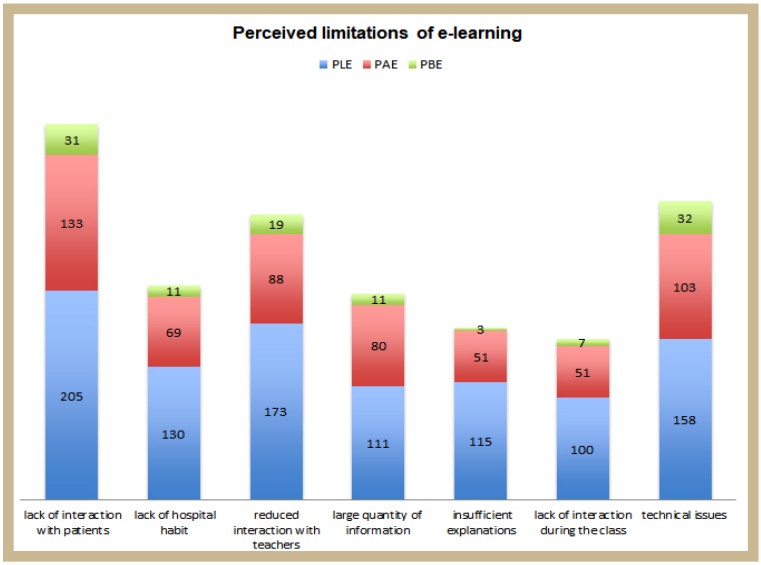


Table 2. Differences according to the years of study

		Progress less than expected		Progress as expected		Progress better than expected	
		No	% of total in category	No	% of total in category	No	% of total in category
Did the schedule imposed by the university give you the feeling of having a better control over your life?**	Yes, a lot	5	1.89%	20	9.30%	6	10.52%
	Yes, somehow	45	17.04%	58	26.97%	13	22.80%
	Yes, but very little	32	12.12%	33	15.34%	8	14.03%
	Not at all	120	45.45%	70	32.55%	21	36.82%
	No, on the contrary, it interrupted my plans	62	23.48%	34	15.81%	9	15.78%
How frequently did you use online activities during lockdown?	Rarely, <25% of the time	1	1.75%	7	3.25%	17	6.44%
	Sometimes, between 25 and 50% of the time	6	10.52%	17	7.90%	28	10.60%
	Rather frequently, between 50 and 75% of the time	19	33.33%	71	33.03%	85	32.20%
	Very frequently, >75% of the time	31	54.38%	120	55.81%	134	50.75%
How frequently were you NOT actually active in the online classes, although you were connected?**	Rarely, <25% of the time	113	42.80%	120	55.81%	33	57.89%
	Sometimes, between 25 and 50% of the time	88	33.33%	71	33.02%	20	35.08%
	Rather frequently, between 50 and 75% of the time	39	14.77%	18	8.37%	3	5.26%
	Very frequently, >75% of the time	24	9.09%	6	2.79%	1	1.75%
What did you dislike the most during the e-learning training?	I disliked the absence of direct interaction with the patients**	205	77.65%	133	61.86%	31	54.38%
	I disliked the absence of the daily habit of going to the hospital**	130	49.24%	69	32.09%	11	19.29%
	I dislike the absence of direct interaction with the teachers	173	68.37%	88	45.83%	19	35.84%
	I disliked the large quantity of information presented in an online class/case presentation/lab**	111	42.04%	80	37.20%	11	19.29%
	I disliked the insufficient explanations during an online class/case presentation/lab**	115	43.56%	51	23.72%	3	5.26%
	I disliked the absence of possibility of real time participation (answering questions, drawing graphs) because of technical limitations of the elearning app**	100	37.87%	51	23.72%	7	12.28%
	I disliked the technical issues of online classes (poor internet connexion, microphonics, limited non-responsive interface)*	158	59.84%	103	47.90%	32	56.14%

Discussions

A major result of this study is that, overall, the largest number (almost half) of students considered their progress was less than expected; together with the ones that perceived their progress to be as expected, they form a majority (89.37%), with only a minority standing for a better progress during the last e-learning semester. Even for those that fit in this new learning environment, many voices asked for improvements and very few were willing to continue as such. Despite this apparent rejection of e-learning, a certain refinement comes from the fact that implementing online classes in less than 2 weeks is not an easy task and experience was probably not enough for all the members of the academic staff before this rapid switch to an exclusive e-learning teaching. The previous disinterest and the limited knowledge of the advantages of e-learning inside the teaching community were found as main obstacles to the implementation of an efficient process [2]. In our study, the characterization of the online experience as "good or bad, depending on the class" was mentioned by more than one third of the students with no difference between the PLE and PBE ones. This emphasizes the heterogeneity of the training that was delivered and the critical role of the educator in the learning experience. Thus, one direction to improve is the sharing of knowledge inside the academic community in order to develop appropriate instruments for each discipline from learning the good practice from other colleagues.

Adapting to the online academic curricula takes time not only for the faculty but also for the students, as suggested by a study claiming that not all students manage to adapt in due time to such change [3]. Despite a similar rate of participation to the online classes, the effective participation was significantly lower for the PLE compared to the PBE groups. The medical students enrolled in our university did not have a great amount of experience with the e-learning activities, the usage of the online medical training resources and platforms, despite a good exposure to the internet. As expected, some students better adapted their already developed digital skills (acquired by navigating the various social media platforms which are popular nowadays), this adaptation leading to some of the students optimising their e-learning behavior. Thus, a direction to improve the online attractiveness is to help students adapt their experience in using social media and other online platforms and websites to academic apps and learning platforms. In this respect, we also underline that the **technical issues** were mentioned by all groups, particularly by the PBE and PLE ones. Students might have felt overwhelmed by the amount of online activity they were suddenly required to attend and their lacking computer commanding skills could have become an obstacle. Literature confirms that the technical barrier is a serious obstacle in assimilating medical information [4] and that the university support is very important for an efficient e-learning experience, as it is the one offered by the main provider of software licences and platforms [5,6].

The main complaint about e-learning was the **lack of patient interaction** and the percentage was the highest (77.65%) inside the PLE group, with some significant differences between the preclinical and the clinical years. In the preclinical years, in which the curriculum includes few contacts with the patients, the lack of bedside training was underlined by students from the PBE and PAE groups. These students were closer to their desirable professional achievement status and in a better position to anticipate obstacles in the next year with the possible extension of the exclusive online training. There might also be an anticipation of what was proved as a difficult context for the summer mandatory hospital training or, it might just reflect the typical juvenile enthusiasm for entering into the medical practice.

In the early and the advanced clinical years, the PLE (89,76% and 78,98%, respectively) perceived the lack of patient interaction as the downside of outmost importance. The preferences for abstract conceptualization versus concrete experience [7] applied to undergraduate medical training, shows that the bedside teaching is a learning tool of critical importance. Nothing can replace seeing a patient because clinical experience and human interaction are extremely important for the practice of medicine [8]. Case-based learning, which was adopted by some of the teachers, was probably useful but not a perfect substitute, even if the majority of medical students find it essential for acquiring the needed skills for practicing medicine [9] and for increasing their performance [10]. Although bedside teaching has been reclining in recent years worldwide [11], in Romania it remains one of the most valuable resources for learning medicine. From our data, the PLE group missed this interaction the most. That leads us to conclude that those who considered their progress to be insufficient might have a preferred learning style more practice-oriented such as the learning-by-doing learning style.

Another challenge was the l**ack of a proper and direct interaction between students and**

teachers, both during the scheduled online classes; in this respect, there were also differences between the PBE and PLE groups. A possible explanation would be a more goal-oriented profile in PBE than more process-oriented and social interaction profile in PLE. The need for a genuine connection was also displayed in relation to teaching, since **real time participation during lectures** was an issue that affected 33,33% of all students, regardless of their performance, but affecting more the PLE group compared to the PBE one (37.87% and 12.28% respectively). The PBE group was more prepared to learn on their own, very few of them needing **further explanations** (1.77%) compared to 68.04% of PLE. Feedback and extra explanations, some of which might be more difficult to obtain in the online framework, without audio and visual interaction are also important tools for raising the efficiency of the online training [5]. Furthermore, the answer "**excessive quantity of information**" selected by 19.3% of PBE, compared to 54.95% of PLE suggests that PBE were either less intimidated by the abundance of study materials or more proactive in the search for supplementary information. These allow us to look at the two profiles of students in matters of grit, a combination of perseverance with passion in achieving a specific long-term goal. As possible improvements to the learning experience, particularly for the less confident and independent students, would be planning for an immediate feedback after the online classes [4].

Students in the PBE category managed to better organize themselves. The PBE were the ones to have re-organized their learning space, had better time management and knew how to take advantage of the schedule provided by the university. The time saved from not having to commute every day was less frequently appreciated by the preclinical group. This stems from the fact that they are not yet fully accustomed to self-teaching, but also from an objective matter, as preclinical students attend their courses mainly in the classrooms in the faculty location, so less time is spent in traffic. Thus, one direction to improve the online attractiveness, at least for the clinical years, is to raise awareness about the time efficiency it offers and to provide some time management and even organization skills trainings.

There are also additional significant **differences between the preclinical, early clinical and advanced clinical groups** that need to be highlighted. Although the first 2 years of undergraduate education have a great impact over the lives and coping strategies of the students, the members of the preclinical group are undoubtedly the most enthusiastic and energetic, eager to prove themselves and others that they deserve a top place in the university ranking. This might explain the big number of students who felt the lack of direct interaction with their teachers, the absence of real-time participation and the fact that they find their schedule far worse organised during the lockdown. Moreover, the disapproval regarding the amount of information and lack of appropriate explications highlighted in the first 2 groups of students count as another argument for their fervour. Special support in organizing resources should be provided for the preclinical students.

The juniors deal primarily with the basic sciences relevant to a further understanding of the medical training, so these years are mainly dedicated to theoretical education. Consequently, only a few students found the online classes unacceptable and the majority benefited from this type of teaching.

For the next years though, medical education turns into a balanced mixture of theoretical and practical training [12] and apparently becomes more stressful [13]. Thus, providing context is essential for medical students and for their perceived performance, but it seemed to be true only for the early clinical students. For the advanced clinical group, the lack of going to hospital training everyday was not influencing the affiliation to the PBE or to the PLE group. This finding suggests that advanced clinical students have already assimilated the fundamental clinical maneuvers and count more on their independent study. Alongside the bigger percentage of the students in year 5 and 6 (34.78%) who were able to organize their schedule more efficiently during the lockdown, this highlights a tendency of the medical students to grow in their students' abilities, over the years, and to be more independent. Individual learning proves to be an efficient process. Another reason might be the prospect of the residency exam which is an important stressing factor encouraging them to devote to the theoretical study. Our results echo other research which noted the link between national licensing exams and the increasing habit of skipping classes to learn at twice the speed, with some following along with classes remotely in the final year of medical training [14].

Conclusion

The study underlines the perspective of students and emphasizes that the only acceptable compromise for medical education is blended learning, since the practical aspect of the medical training is essential. From the self-perceived professional growth, the

online training seems to be more effective for students with a high level of grit, who are more goal-oriented than social-oriented and more capable to self-manage their time.

Two main weaknesses were mainly noted by the ones who found difficulties to adapt and to benefit from e-learning: the improper management and the inconsistent delivery of the training. Solutions would include the enlargement of knowledge and the development of the e-learning tools and abilities for both the academics and the medical students. Furthermore, the provision of time management and organization skills guidelines and support, sustained feedback from their teachers, particularly for the preclinical students and for the less independent and more social-oriented ones would benefit their progress.

This study led us to discover also some advantages for the e-learning approach, such as the time efficiency, more autonomy and flexibility of the learning process. However, these advantages might not be obvious for every student, so it is paramount that these benefits be highlighted in order to improve the overall learning program's efficiency.

The COVID-19 pandemic contributed to more rapid achievements in many areas; it should be upsetting to miss the chance of improving medical education from the lessons learnt during this arduous experience.

List of abbreviations

PAE = progress according to expectations
PBE = progress below expectations
PLE = progress lower than expectations

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