

Learning in Clinical Research: Hybrid Teaching Experience with Medical Students

María F. Grande Ratti¹, Valentina Kiblsky Elizalde¹, Mariana A. Burgos², María P. Russo¹ and Bernardo J. Martínez³

1. Servicio de Clínica Médica, Hospital Italiano de Buenos Aires, Argentina

2. Área de Investigación en Medicina Interna, Servicio de Clínica Médica, Hospital Italiano de Buenos Aires, Buenos Aires, Argentina

3. Central de Emergencias de Adultos, Hospital Italiano de Buenos Aires, Buenos Aires, Argentina

ABSTRACT

Introduction: the COVID-19 pandemic brought about a change in our health and education system. Training programs also had to adapt and required rapid change.

Objectives: to describe an educational experience of virtual/hybrid teaching in clinical research between teachers of the Clinical Service of a university hospital and medical students of a private institution who participated in the ESIN Program (Students in Research).

Methodology: the contents and educational strategies included audio or videotaped lectures (asynchronous and self-administered), project-based learning, practical workshops (virtual and group synchronous meetings) by adopting learning models such as the inverted classroom, and individual tutoring between teacher and student. We gathered the data through observation in academic contexts and based on elements of anonymous satisfaction surveys, with prior informed consent of participants.

Results: fourteen students participated, six in 2021 and eight in 2022. All were women and medical students (50% fourth year, 35% sixth year, and 15% fifth year). The techniques implemented favored participation and promoted active, project-based learning. They mentioned positive aspects such as the practical academic approach, the availability of the teaching team for any doubts, the time and enthusiasm for teaching, and encouraging participation. The theory videos were a valuable review tool, and team meetings received high praise even if the one-on-one meetings received much attention as help and support before the scientific congresses. In general, they stated that it was an enriching experience that showed that you can achieve what you thought impossible. All of them actively participated in at least one scientific congress, and 50% were co-authors of an academic publication.

Conclusion: the students assumed commitments and responsibilities and incorporated competencies and skills in project implementation and dissemination. This educational experience helped to optimize class time for exchange, discussion, and doubts. The resources produced, the activities developed, and the contents addressed are now available at the institutional level.

Key word: education, medical, undergraduate, research personnel, problem-based learning, information science, congresses as topic, peer review, research

Author for correspondence: maria.grande@hospitalitaliano.org.ar, Grande Ratti MF.

Received: 05/29/23 Accepted: 11/03/23 Online: 12/29/2023

DOI: <http://doi.org/10.51987/revhospitalbares.v43i4.277>

How to cite: Grande Ratti MF, Kiblsky Elizalde V, Burgos MA, Russo MP, Martínez BJ. Learning in Clinical Research: Hybrid Teaching Experience with Medical Students. *Rev. Hosp. Ital. B.Aires.* 2023;43(4):191-199.

Aprendizaje en investigación clínica: experiencia de enseñanza híbrida con estudiantes de medicina

RESUMEN

Introducción: la pandemia de COVID-19 indujo un cambio en nuestro sistema de salud y de educación. Los programas formativos también tuvieron que adaptarse y exigieron un cambio rápido.

Objetivos: describir una experiencia educativa de enseñanza virtual/híbrida en investigación clínica, entre docentes del Servicio de Clínica de un hospital universitario y estudiantes de Medicina de una institución privada, que participaron del Programa ESIN (Estudiantes en Investigación).

Metodología: los contenidos y las estrategias educativas incluyeron las clases teóricas audiograbadas o videograbadas (asincrónicas y autoadministradas), el aprendizaje basado en proyectos, los talleres prácticos (encuentros sincrónicos virtuales y grupales), mediante la adopción de modelos de aprendizaje como el aula invertida, y la tutoría individual entre docente-estudiante. Los datos se recopilaban mediante la observación en contextos académicos, y basándonos en elementos de encuestas anónimas de satisfacción, previo consentimiento informado de los participantes.

Resultados: participaron 14 estudiantes, 6 durante el año 2021 y 8 durante 2022. Todas mujeres y estudiantes de medicina (50% de cuarto año, 35% de sexto año y 15% de quinto año). Las técnicas implementadas favorecieron la participación y promovieron el aprendizaje activo, basado en proyectos. Mencionaron aspectos positivos como el enfoque académico práctico, la disponibilidad del equipo docente para atender cualquier duda, el tiempo y el entusiasmo por enseñar y fomentar la participación. Los videos teóricos resultaron útiles como herramientas de repaso, y los encuentros grupales fueron especialmente valorados, si bien los encuentros individuales fueron destacados como ayuda y apoyo previo a los congresos científicos. En general, manifestaron que fue una experiencia enriquecedora que demostró que se puede lograr lo que se creía imposible. Todas participaron activamente de al menos un congreso científico, y el 50% resultó coautora de una publicación académica.

Conclusión: los estudiantes asumieron compromisos y responsabilidades, e incorporaron competencias y habilidades en la implementación y en la difusión de los proyectos. Esta experiencia educativa facilitó que el tiempo de clase pudiera optimizarse para intercambio, discusión y dudas. Los recursos producidos, las actividades desarrolladas y los contenidos abordados quedan disponibles a nivel institución.

Palabras clave: educación de pregrado en medicina, investigadores, aprendizaje basado en problemas, ciencia de la información, congresos como asunto, revisión de la investigación por pares

INTRODUCTION

Technology-based learning methods for undergraduate, graduate, and continuing medical education have become increasingly prevalent¹. Progressive implementation has been considered crucial to continuing curricular changes by providing new challenges and opportunities for educators².

These reforms can lead to unimaginable innovation in traditional learning³. However, the COVID-19 pandemic has ushered in a hyper-technological era, exposing us to “emergency virtualization,” unlike preparing a university with time for virtual education⁴. While there have been unique challenges in adapting medical education⁵, it has allowed us to advance virtual teaching methods because the resources produced, the activities developed, and the content addressed remain available as institutional resources⁶.

Likewise, teaching skills for all healthcare personnel are now increasingly recognized as a fundamental professional skill, with expectations to teach and share

with colleagues (e.g., academic continuing education meetings, athenaeums, and or scientific congresses), as well as with patients through the role of educator during the practice of care⁷.

Therefore, nowadays, we have digital competencies in teaching, understood as those educators need to leverage digital technologies in their work⁸. Learning models such as the flipped classroom, where students must complete a task before teaching sessions, facilitate the optimization of class time for analysis and the application of higher-order knowledge⁹. This technique enhances virtual medical education by encouraging student engagement and promoting active learning¹⁰.

On the other hand, clinical research education is essential for medical students for several reasons: it provides tools for reading and critically assessing biomedical literature (which helps develop skills to analyze and even question scientific evidence), contributes to establishing connections between theory and practice (a deeper understanding of

diseases and treatments), offers the opportunity to work alongside experienced researchers and as part of a team, and includes an insight into research ethics and the regulations governing clinical studies (e.g., protection of personal data, informed consent, among others).

The objective of this account was to describe an educational experience in a virtual environment created to encourage and document research activities among undergraduate students.

METHODS

This educational experience involved a consecutive sample of two groups of undergraduate students from a private university institution, participants in the ESIN Program (Students in Research) during the years 2021 and 2022, with teaching professionals from a private hospital in the Autonomous City of Buenos Aires. The private university was established in 2001, offering various undergraduate programs (Nursing, Medicine, Biochemistry, Pharmacy, Surgical Instrumentation, and Biomedical Engineering) and also postgraduate programs (including master's degrees, doctorate, specialization programs, and continuous education courses).

The program involves the active collaboration of undergraduate students within a research protocol/project approved by the institutional Ethics Committee and under the coordination and supervision of a responsible investigator (whose role is to lead the project and take responsibility for assigned training activities). There was an open call (with internal dissemination inviting all students) through which the teaching team submitted the protocol, its ethical approval, requirements (e.g., major, year, previous experiences), and the maximum number of candidates per project. Subsequently, we conducted individual interviews with interested applicants, and the final ranking of selected candidates was published. In both years, there were more candidates than available positions, making the selection challenging, with a preference for students with previous experience or more advanced students.

In this case, the experiential account is limited to the students who were part of the agreement with professionals from the Research Area in Internal Medicine (section of the Medical Clinic Service), which includes portfolios (defined as a set of projects or programs and other works grouped for effective management) of strategic lines, with a long history and experience. Therefore, the projects they participated in related to themes of the Adult Emergency Center, Venous Thromboembolic Disease, and or Diabetes.

Through an initial agreement with the institution, the students committed to fulfilling agreed-upon timelines, schedules, and responsibilities as an extracurricular and elective activity.

Educational activities and pedagogical strategies were planned using a virtual teaching model to provide clinical research skills and competencies. The planning included theoretical-practical and applied sessions, meaning

learning was project-specific. The format was hybrid, with in-person teaching restricted to simulation and the practice of communication at a scientific congress, and oral presentations within it. The congress took place virtually in 2021 and in-person in 2022.

During the two-year duration of the experience, all academic activities were recorded (and attendance was taken for longitudinal monitoring of the students). Additional efforts included searching for a bibliography for supplementary reading (which was user-friendly and in Spanish), recording theoretical audiovisual classes to generate a repository for public access (available asynchronously and self-administered), which could be shared with the rest of the team (Fig. 1).

Data were collected through observation in academic meeting spaces, practical activities in pairs and or small groups of students (depending on the number of participants) that promoted discussion and peer exchange, and self-produced deliverables associated with the tasks (e.g., writing a scientific summary with a maximum of 300 words, creating a PowerPoint presentation for a national conference, among others).

Additionally, through an anonymous survey using GoogleForm®, with prior consent, we inquired about the opinion of the students on the self-perception, feelings, and feedback of the teachers involved in the support or supervision of this educational experience.

RESULTS

In total, 14 students participated in this experience, six in 2021 and eight in 2022 (Table 1). All participants were female and belonged to the advanced years of the medicine program (50% in the fourth year, 35% in the sixth year, and 15% in the fifth year).

Initially, they received training in Good Clinical Practices, defined as an international standard of ethical and scientific quality for the design, conduct, execution, monitoring, auditing, recording, analysis, and reporting of clinical research and also for the protection of the rights, integrity, and confidentiality of health data. They completed a self-managed virtual course that provides the necessary tools for conducting and evaluating ethical and quality research. This course includes modules with video-recorded classes that facilitate understanding of the most relevant aspects and a supplementary reading bibliography. Each module contains a multiple-choice exam, requiring a correct response of 60% to pass, and a final exam that awards the corresponding certificate with the possibility of repeating the exam up to 3 times (2 recovery instances) when the established goal is not reached.

In the second stage, we employed practical activities based on real cases (related to ongoing research protocols). We designed guidelines and tasks to be solved asynchronously in pairs to promote discussion and exchange. Additionally, group activities were conducted, including a monthly synchronous meeting between students and the Professor with an Assistant/Tutor for the presentation and group feedback on asynchronous

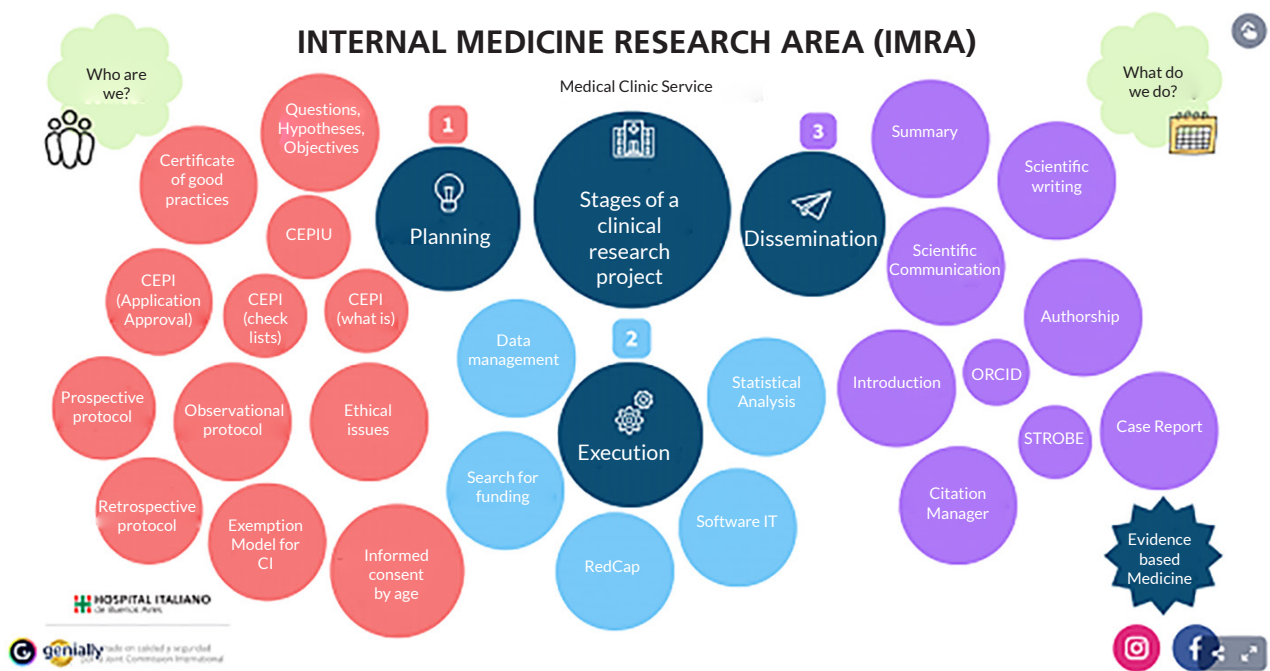


Figure 1. Repository in Genially, self-crafted. (LINK, valid until 05/29/2023)

Table 1. Characteristics of the students included in the 2021-2022 experience

	Year	Gender	Career	Year	Attendance	National Congress	International Congress	Publication
1	2021	Female	Medicine	4.º	9 months	1	1	NO
2	2021	Female	Medicine	6.º	9 months	1	1	YES
3	2021	Female	Medicine	5.º	9 months	1	1	YES
4	2021	Female	Medicine	4.º	9 months	1	1	YES
5	2021	Female	Medicine	5.º	9 months	1	1	YES
6	2021	Female	Medicine	4.º	9 months	1	1	YES
7	2022	Female	Medicine	6.º	12 months	2	0	NO
8	2022	Female	Medicine	4.º	12 months	2	0	NO
9	2022	Female	Medicine	6.º	9 months	2	0	NO
10	2022	Female	Medicine	4.º	10 months	2	0	YES
11	2022	Female	Medicine	4.º	10 months	2	0	YES
12	2022	Female	Medicine	4.º	10 months	2	0	NO
13	2022	Female	Medicine	6.º	10 months	2	0	NO
14	2022	Female	Medicine	6.º	10 months	2	0	NO

enrolling in the activity, and there was unanimity (100%) in considering co-authorship in a National Congress as extremely productive/useful.

Table 4 includes some verbatims from the open-text response question. From the students' perspective, they

expressed gratitude for the time and willingness to teach, highlighting the utility and support provided by the teaching team, which resulted in an enriching experience.

They mentioned that they incorporated many new and valuable tools for their future professional endeavors

tasks. As shown in Table 2, throughout the year, there were seven virtual meetings (via GoogleMeet®, each lasting 1 hour) and two in-person meetings (2-hour workshops), resulting in an approximately monthly gathering. Furthermore, there were some on-demand tutorials (virtual, lasting 30 minutes) for review sessions or pre-conference speech practice conducted individually (one student and one teacher).

The assessment methods implemented were diverse, including written exams (e.g., good practices

course), written deliverables (e.g., summary elaboration), oral presentations (during practical sessions and at the scientific congress), and class discussions. Constructive and project-based feedback was also a fundamental tool throughout the learning process for assessing the acquired competencies.

Regarding feedback on teachers and proposed academic activities, the satisfaction form had a response rate of 93% (13/14). As evidenced by Table 3, all participants expressed having met the initial expectations when

Table 2. Contents and educational strategies

Meeting	Modality	Contents	Asynchronous assignment
1	Sincrónico Virtual	Activity of presentation and consensus of work modality	Theoretical reading on criteria for a good research topic and FINER. Practical assignment (in pairs), based on the project protocol in which they are participating
2	Synchronous virtual	Descriptive vs. analytical research questions FINER-P attributes SMART objectives and attributes Hypothesis: what it is and when it applies	Video 1 Practical assignment (in pairs), based on the project protocol in which they are participating
3	Synchronous virtual	Ethical considerations in clinical research of observational studies	Video 2 Course on Good Ethical Practices in Research (individual)
4	Synchronous virtual	Theoretical-practical workshop on how to write an abstract for a scientific congress (and specific requirements	Video 3 Practical assignment (in pairs), based on the project protocol in which they are participating
5	Synchronous virtual	Theoretical-practical workshop on scientific presentations. IMRaD structure of manuscripts, basic rules for visual aids, the 5 Cs of communication	Video 4 Practical assignment (individual), based on the project protocol in which they are participating
6	Synchronous virtual	Presentation for oral communication. Recommendations: timing, simplicity, audience, intonation, practice	Video 5 Practical assignment (individual), based on the project protocol in which they are participating
7	On-site	Simulation of oral communication Space for feedback on scientific presentations	N/A
8	On-site	Oral presentation at Scientific Congress	N/A
9	Synchronous virtual	Closing activity and feedback on final report	N/A

FINER-P: acronym for Feasible, Interesting, Novel, Ethical and Relevant, plus Biological Plausibility

IMRaD: Introduction, Methods, Results and Discussion

5 Cs of Communication: correct, concise, clear, coherent, controlled

SMART: acronym for Specific, Measurable, Assignable, Realistic and Time-related, referring to the fact that objectives should be specific, measurable, achievable, realistic and time-limited.

Table 3. Student satisfaction with the educational proposal

Questions	2021 (n: 6)	2022 (n: 7)
I found the group synchronous meeting to be (*)		
1 (Not at all productive/useful)	0	0
2	0	0
3	0	0
4	2 (33.33%)	2 (28.6%)
5 (Extremadamente productivos/útiles)	4 (66.67%)	5 (71.4%)
I found the individual synchronous meetings to be (*)		
1	0	0
2	0	0
3	0	0
4	0	1 (14.3%)
5	6 (100%)	6 (85.7%)
I found Video 1 (questions, objectives, hypotheses) to be (*)		
1	0	0
2	0	0
3	2 (33.33%)	0
4	0	1 (14.3%)
5	4 (66.67%)	6 (85.7%)
I found Video 2 (ethical considerations) to be (*)		
1	0	0
2	1 (16.67%)	0
3	0	0
4	0	2 (28.6%)
5	5 (83.33%)	5 (71.4%)
I found Video 3 (summary) to be (*)		
1	0	0
2	0	0
3	0	0
4	1 (16.67%)	1 (14.3%)
5	5 (83.33%)	6 (85.7%)
I found Video 4 (oral presentation: first part) to be (*)		
1	0	0
2	0	0
3	1 (16.67%)	0
4	0	3 (42.9%)
5	5 (83.33%)	4 (57.1%)
I found Video 5 (oral presentation: second part) to be (*)		
1	0	0
2	0	0
3	0	0
4	1 (16.67%)	3 (42.9%)
5	5 (83.33%)	4 (57.1%)
I found the opportunity to co-author a paper presented at a National Congress to be (*)		
1	0	0
2	0	0
3	0	0
4	0	0
5	6 (100%)	7 (100%)
I found the opportunity to co-author a paper presented at an International Congress to be (*)		
1	0	0
2	0	0
3	0	1 (14.3%)
4	0	1 (14.3%)
5	6 (100%)	5 (71.4%)
From your perception, have you found what you were looking for when you signed up?		
Yes	6 (100%)	7 (100%)
Maybe	0	0
No	0	0

(*) Likert Scale (scoring between 1 and 5), where:

1 = Not at all productive/useful 5 = Extremely productive/useful (#) The option

"Not Applicable" was missing, incorporated into the Google Form as part of the improvement cycle (for the academic year 2023).

Table 4. Free text feedback (open-ended questions), with verbatims

Positive	Negative
Teaching skills and competencies, in terms of time, disposition and flexibility "The teaching staff was always available...to answer any questions that arose" "Thank you for your time and excellent inclination to teach us" "They were excellent in terms of teaching, patience, understanding, adaptability" "The team of teachers was always very eager to teach and to get us to participate, with a lot of patience." "Very attentive and predisposed to give us feedback and instruction at every meeting." "They were always helpful and responsive to our questions." "Everyone has guided us in an excellent, pedagogical way, with patience and motivation." "It is a dedicated teaching team and above all responsive to our needs." "I felt very accompanied at every moment." Implemented teaching techniques "Very good the explanatory videos and synchronous meetings, especially to learn more about practical issues" I learned a lot at the meetings, especially when we had to do an assignment and present it to the group." The meetings, the content and the people involved in the whole process were really useful and helped a lot in the whole learning process that helps for the future." "I learned in group meetings, and even more on an individual basis (emails, questions, meetings, etc.), than in the theoretical videos." "I feel I learned more in the synchronous meetings than from the theoretical videos, but they are good as a review, I watched them again to check my work." I found the bibliography sent during the first meetings very useful". Project-based learning I didn't know it was going to be so focused on learning, but it was much more useful this way." "I found it very useful to participate in a research project, and also to talk and do activities about it because -- although it was something we had seen during the course -- it was very difficult for me to understand it without applying it." "Everything you provided helped me not only to understand the work we were doing in the research project but also to apply the concepts learned in another subject of the career." Academic background (participation in congresses) "I think none of us knew what to expect because each researcher is different and gives you a different role. We had talked about the possibility of presenting at a conference, but until it happens, you don't believe it." "By doing things you learn a lot more than just chatting and reading theory, so just putting together a presentation by myself was a very valuable experience." "It exceeded my expectations. I ended up authoring several papers and participated in two congresses." "It was a good experience to learn how to present a paper formally and orally in front of many people." "I have learned a lot and received great opportunities in terms of presentations at conferences." "The preparation was very useful: I learned more about public speaking itself and how to perform in that context." Please continue to offer this possibility to students! It was a beautiful experience.	Outstanding over baseline expectations Expand content "Being able to see the process of data analysis" (statistics) "I would have liked to see the process of discussing the data to witness critical thinking and understand the reality of being the author who later writes it, but I didn't end up joining other meetings." (scientific writing) "Next time, I would get involved in more team meetings to observe the decision-making and the whole process of doing research" (regular project management meetings). Other functions for students "I suggest more involvement in writing or data uploading tasks that may be useful for the project (data uploading). More frequency "Make the meetings more frequent." Language barriers in the material provided "It certainly helped me to see presentations at other virtual congresses, but they were in English, and it would have been nice to have other examples from national congresses." Other methodological models "We could include more qualitative projects (if any) because I feel that seeing the differences between the two types of studies helped me understand much more of what we were learning." Dominant voices There were some groups that did not make many interventions in the development of the project, which I think would have been interesting" (Actively encourage the participation of the group that does not present). Stay on track It would be good that when an explanation is given, we don't go off on tangents, as sometimes we waste time on things that are not relevant to the task.

(e.g., use of citation managers). They strongly preferred group meetings over individual ones. Overall, no negative aspects were reported; however, the recorded theoretical classes (asynchronous) proved helpful as a review, support, and checklist before giving conference presentations. The desire to witness other stages of the project (such as the data analysis process and discussions on findings) was mentioned as the opportunity to participate in the scientific writing of the manuscript or the need for examples of oral presentations at national conferences (in Spanish).

On the other hand, from the teaching perspective, the implemented techniques facilitated student participation and promoted active learning. Everyone completed the established time in the initial agreement (without any dropouts) and actively participated in at least one scientific congress (national and or international), not only as co-authors but also as responsible speakers for the presentations.

Finally, 50% of the participants became authors of an academic scientific publication. The research team considered that each student contributed substantially to the project, at least enough to meet the authorship criteria. Regarding the projects in question, there have been five manuscripts published [11-15] in indexed journals (4 in PubMed and 1 in Latindex) so far, with seven students being authors.

DISCUSSION

This educational experience was successful in terms of participation (none dropped out during the academic year from the extracurricular activity) as a practical learning opportunity and facilitated the development of academic skills. The students demonstrated a high level of commitment, achieving significant milestones in their academic journey: presenting at conferences and or authoring scientific publications.

Presenting the results at a scientific congress provided an opportunity to train and assess the students' oratory skills. The focus was on structuring a speech clearly and coherently, ensuring that the ideas were logically organized and easily understandable, choosing appropriate words and using vocabulary suitable for the audience, and the ability to respond to audience questions clearly and concisely (demonstrating knowledge of the subject and critical thinking skills). We should note that the lack of participation in an international conference during the 2022 cycle (compared to the 2021 cycle) was strictly related to a lack of funding. Therefore, there was no such "window of opportunity" for the students (or the involved researchers) due to a barrier of economic accessibility.

As for scientific publications, they represent a valuable curricular milestone at the curriculum level (even a distinctive point for admission to medical residencies), and it is not such a straightforward indicator to achieve within two years because it involves time (the natural life cycle of projects) and various barriers (e.g., the maximum

number of authors per guidelines, numerous rejections before achieving actual publication, limited free journals, and lack of funding)¹⁶.

The results obtained align with the findings proposed by Rodríguez Cáceres and colleagues¹⁷, whose pedagogical experience during the COVID-19 quarantine, focusing on project-based learning, favored the development of clinical reasoning competence, allowing students to acquire skills related to assertive communication and collaborative work.

While the pandemic has impacted medical education globally¹⁸, there is a need to consider new forms of virtual teaching and new methods to provide practical skills for medical students.

With advances in technology and social media, distance learning constitutes a new and rapidly growing approach for healthcare providers at the undergraduate and postgraduate levels¹⁹. The main weaknesses of virtual teaching include resistance to change and uncertainty, technical difficulties, loss of face-to-face interaction, lack of computer access, low internet speed and quality, and technical challenges related to software for virtual learning platforms that impact the quality and efficiency of learning⁵. Of course, technical and infrastructure resources were reported as a significant initial challenge, so understanding these technological, financial, institutional, educator, and student-related barriers is essential for implementing distance learning successfully¹⁹.

It's worth mentioning some limitations. Firstly, this was a limited educational experience (with few participants), potentially subject to sample selection bias, within the context of an elective course (not mandatory), which probably predisposed to enrollment of those who showed greater motivation and interest in this field (possibly explaining the commitment, performance, and responsibility for the assumed tasks).

Secondly, there was a limited capacity, which resulted in even group meetings being small and more individualized (working in small groups), allowing flexibility and adaptation of teachers according to the needs of the group in question.

Thirdly, the Program's call attracts a motivated teaching team that relies on students as human resources, delegating tasks and functions for a specific project, thus acting as both teachers and team leaders.

In that sense, we know of the significant individual differences in how much teachers contribute to student development, even within the same institution. Bonk captures the essence of this new era of technological tools for education by stating that anyone can learn anything from anyone at any time²⁰. We can conclude that the implemented teaching techniques (virtual-hybrid modality, project-based activities, and flipped classroom) facilitated participation and promoted practical and active learning. Through this methodology, the student became the protagonist of the teaching and learning process, and the teacher was merely a mediator or

guide¹¹. The participants showed a high level of interest, attendance, and commitment. Undoubtedly, experiences of this nature are of great relevance in shaping future healthcare professionals.

Acknowledgments: Firstly, to the Instituto Universitario del Hospital Italiano de Buenos Aires for the Programa de Estudiantes de grado en proyectos de Investigación (Undergraduate Student Program in Research Projects). Secondly, to the Área de Investigación en Medicina Interna (Research Area in Internal Medicine) and Dr. Javier Pollán (as head of the Servicio de Clínica Médica – Internal Medicine Service) for the institutional and overall support of our work in research and teaching projects. Thirdly, to the Asesoría Pedagógica (Pedagogical Advisory) (led by Gisela Schwartzman and members of the teaching team at IUHIBA), who provided us with assistance and support, training, and tools to develop the virtualization process of our teaching practices.

Conflicts of interests: the authors declare no conflicts of interests

REFERENCES

1. Guze PA. Using technology to meet the challenges of medical education. *Trans Am Clin Climatol Assoc.* 2015;126:260-270.
2. Trelease RB. From chalkboard, slides, and paper to e-learning: How computing technologies have transformed anatomical sciences education. *Anat Sci Educ.* 2016;9(6):583-602. <https://doi.org/10.1002/ase.1620>.
3. DePietro DM, Santucci SE, Harrison NE, et al. Medical student education during the COVID-19 pandemic: initial experiences implementing a virtual interventional radiology elective course. *Acad Radiol.* 2021;28(1):128-135. <https://doi.org/10.1016/j.acra.2020.10.005>.
4. Casablancas S. *Reseña de libro: Schwartzman G, Tarasow F, Trech M. De la educación a distancia a la educación en línea: aportes a un campo en construcción.* Rosario: Homo Sapiens/FLACSO Argentina; 2014. 170 p. *Propuesta Educativa.* 2014;2(42):99-100.
5. Park A, Awan OA. COVID-19 and virtual medical student education. *Acad Radiol.* 2023;30(4):773-775. <https://doi.org/10.1016/j.acra.2022.04.011>.
6. Schwartzman G, Berk M, Reboiras F. Formación docente para la educación remota universitaria: nuevas oportunidades en tiempos de emergencia. *TEyET.* 2021;(28):e56. <https://doi.org/10.24215/18509959.28.e56>.
7. Burgess A, McGregor D. Peer teacher training for health professional students: a systematic review of formal programs. *BMC Med Educ.* 2018;18(1):263. <https://doi.org/10.1186/s12909-018-1356-2>.
8. Engen BK. Understanding social and cultural aspects of teachers' digital competencies. *Comunicar.* 2019;27(61):9-19. <https://doi.org/10.3916/C61-2019-01>.
9. Awan OA. The flipped classroom: how to do it in radiology education. *Acad Radiol.* 2021;28(12):1820-1821. <https://doi.org/10.1016/j.acra.2021.02.015>.
10. Ge L, Chen Y, Yan C, et al. Effectiveness of flipped classroom vs traditional lectures in radiology education: A meta-analysis. *Medicine (Baltimore).* 2020;99(40):e22430. <https://doi.org/10.1097/MD.00000000000022430>.
11. Murujosa AC, Pasik NI, Giuliani Quaglierini SA, et al. Estudio descriptivo de infección por SARS-CoV-2 en adultos con diabetes. *Medicina (B Aires).* 2022;82(1):28-34.
12. Vázquez FJ, Grande-Ratti MF, Zapiola ME, et al. Hospitalization for venous thromboembolic disease management: a 10 years registry in Buenos Aires, Argentina. *J Thromb Thrombolysis.* 2021;52(4):1187-1194. <https://doi.org/10.1007/s11239-021-02459-7>.
13. Russo MP, Pagotto VL, Burgos MA, et al. Valor pronóstico de la hipoglucemia hospitalaria. *Medicina (B Aires).* 2023;83(1):3-9.
14. Grande Ratti MF, Bluro IM, Castillo F, et al. Características clínicas y tiempos de atención en una unidad de dolor torácico del servicio de emergencias de un centro argentino. *Arch Peru Cardiol Cir Cardiovasc.* 2023;4(2):41-47. <https://doi.org/10.47487/apcyccvv4i2.293>.
15. García Cleque JP, Parot Varela MM, Quevedo MG, et al. Descripción de pacientes que acuden a central de emergencias con intoxicación por monóxido de carbono. *Arch Med Fam Gen.* 2023;20(1):10-17.
16. Ausín V, Abella V, Delgado V, et al. Project-based learning through ICT: an experience of teaching innovation from university classrooms. *Form Univ.* 2016;9(3):31-38.
17. Rodríguez Cáceres AA, Lever Méndez J, Alfonso Mora ML, et al. Aprendizaje por proyectos para el razonamiento fisioterapéutico sobre el dolor espinal durante la cuarentena por COVID-19. *Educ Méd.* 2021;22(5):267-272. <https://doi.org/10.1016/j.edumed.2021.06.003>.
18. Sandhu P, de Wolf M. The impact of COVID-19 on the undergraduate medical curriculum. *Med Educ Online.* 2020;25(1):1764740. <https://doi.org/10.1080/10872981.2020.1764740>.
19. 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. <https://doi.org/10.1186/s12909-020-02257-4>. Errata en: *BMC Med Educ.* 2020;20(1):513. <https://doi.org/10.1186/s12909-020-02428-3>.
20. Bonk CJ. The world is open: how web technology is revolutionizing education. En: *EdMedia + innovate learning.* Waynesville, NC: Association for the Advancement of Computing in Education (AACE); 2009. p. 3371-3380.