Training New Research Trainers: an Open Science and Medical Education Innovative Experience

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Abstract

Introduction: Open science is a valuable path to boost the global potential of scientific research by removing barriers for producing, disseminating, and putting science into practice, with the spirit of collaboration, inclusivity and focusing on communities' rising demands. Open science principles instigate the management of scientific knowledge and the enhancement of abilities such as research, project management, team-building skills, and numerous others, which are essential for medical practice according to international recommendations, although still underexplored by medical schools. **Methods:** Open science, peer education, student leadership and developing of scientific skills were cornerstones to promote the Training New Research Trainers, the first edition of a national Brazilian student-led online workshop aiming to capacitate medical students in such targeted competencies and abilities through active teaching and learning methodologies. **Results:** Despite the challenges of online format, as impairment in some dynamics and assessment methods, it improved the access to the event from all Brazilian regions, totaling 409 submissions. Thus, it was necessary to have a previous selection of participants and adjustments in the workshop to assist twice the expected attendants. **Discussion:** Training New Research Trainers surpassed the national distribution inequalities of research opportunities and resources; mirrored open science bases in terms of access, education and methodology; and showed to be a promising opportunity for students to be protagonists of their learning process and to contribute to future changes in their reality, especially regarding the public health landscape. Improvements and consolidation of the workshop protocol and its expansion through national and international partnerships are the following goals.

Keywords: Capacity Building; Competency-Based Education; Research Personnel; Students, Medical.

Introduction

Open Science consists of removing barriers in sharing productions, resources, methods, or tools in the research process, opening the different stages of the research cycle [1]. Most importantly, open science carries the logic that scientific knowledge comes from social collaboration, so its outputs are a public good that should be accessible at no cost [1]. Open science's essentials are to promote transparency, reproducibility, and replication in medical studies [2]. Through this sharing process, a collaborative and transparent environment in research is established, facilitating the search for factual evidence [3].

Furthermore, open science addresses the need to accept diverse understandings of knowledge. Such a challenging proposal implies that different parties should be considered in scientific production, including the medical students [4]. Given this group's exposure to societal and patients' needs, integrating research with medical education becomes of paramount importance [5]. In alignment with open science principles in which subjects can produce, share, and build on the knowledge, it is essential to consider strategies to develop scientific skills among medical students.

Peer education, among the teaching possibilities, describes interventions in which educators and educated people have a common characteristic. Moreover, peer education activities promote inclusive and integrative approaches compared to traditional teaching methods such as expositive lectures [6,7]. This issue associated with the limited access to program and research opportunities during the graduation course hinders medical students from learning and acquiring scientific skills [7].

In this sense, initiatives that value open science promotion through peer education and student leadership are necessary to ensure progress. Based on these

cornerstones, the International Federation of Medical Students Associations of Brazil (IFMSA Brazil) hosted the first edition of the Training New Research Trainers (TNRT) as an alternative to permit medical students to develop research competencies and abilities. This study is the first description of a research skills workshop entirely led by Brazilian medical students to the best of our knowledge. Therefore, this article aims to report a pilot experience from the TNRT workshop as an alternative strategy to foster science accessibility and education.

Methods

The TNRT planning happened in November 2019. The workshop was conceived to give participants autonomy on how to use, share, govern, and manage their scientific knowledge towards populational demands. The TNRT planning involved national officers from different IFMSA Brazil frameworks, including capacity building, research exchanges, medical education, and publications & research. Due to the COVID-19 pandemic, the TNRT moved online and took place in September 2020, having its first edition at the national level. The TNRT occurred on two subsequent weekends, using the GoToMeeting platform. Also, the IFMSA directors chose eight trainers to facilitate the sessions as shown in Figure 1.

The TNRT addressed the following topics: capacitate participants in characterizing study designs, train participants in formulating a research question by the PICOT method, make attendees comprehend issues on research bioethics and manage bias, enable attendees to understand types 1 and 2 errors, and apply them into scientific hypothesis tests, train the participants in articles' critical appraisal, make attendees acquainted with the peer-reviewing and publishing process, teach participants in searching on different databases, develop research skills, correlating with medical education, human rights, and global health, comprehend the concept of Open Science,

its policies and applicability within IFMSA's priorities and development of communication, project management, and team-building skills within the trainees. Targeted competencies and abilities per training session are further described in Tables 1 and 2 in light of existing frameworks [8].

To warrant the workshop feature on capacity building, the TNRT demanded active teaching and learning methodologies application, putting participants in a protagonist position in the learning process. In the workshop, trainers made use of the following methods: mind mapping [9], group presentation [10], problem-based learning [11–13], small working group [14,15], game-based learning [16], role-playing [17], learning by doing [18,19], team-based learning [20–22], scavenger hunts [23], brainstorming [24,25], online discussion board [26]. Applied methods per training session are outlined in Tables 1 and 2.

Table 1. Active Learning Methodologies and Educational Outcomes in the Training New Research Trainers Workshop

TNRT Training Sessions	Applied methodologies	Developed competencies and abilities
Presentation Skills	Mind mapping; Group presentation	Competencies: Language and communication skills Abilities: 1) Express ideas clearly, meaningfully, and articulately 2) Deliver effective presentation using oral and artistic skills 3) Adapt communication depending on the audience
Study Designs	Problem-based learning and Small Working Group; Game-based learning	Competency: research methodology Ability: Understand the statistical, epidemiological, and operational elements of distinct study designs
Critical Appraisal and Peer Review	Small working group; Learning by doing; Game-based learning	Competency: Disseminating research findings Abilities: 1) Understand the importance of and how to access, critique, and synthesize literature 2) Be aware of the differing requirements and formats of journals' submission and reviewing processes 3) Be aware of the concept of plagiarism and requirements for citations of others' work 4) Understand the publication process steps and barriers 5) Contribute to and write a publication or report 6) Write and submit abstracts to conferences or journals 7) Assist in the preparation of and deliver oral or poster presentations at scientific meetings
Publication Process	Brainstorming; small working group	
Scientific Writing	Role-playing; Problem based learning; Small working group	

PICOT-D Method	Problem-based learning; Role playing; Game-based learning	Competencies: Health-related knowledge and research methodology Abilities: 1) Recognize the knowledge gaps and suggest a reasonable and practicable research question, associating with the most coherent study design and measures 2) Understand how to access scientific literature properly 3) Extract data from database and conduct data analyses using statistical software packages 4) Identify whether conclusions drawn from analyses of data are valid and based on the material provided
Literature Search	Scavenger Hunts	
Bias, Statistical Error, and Scientific Hypothesis	Team-based learning; problem-based learning; game-based learning	
Research Ethics	Game-based learning; Small Working Group; Role-Playing	Competency: Ethics and human subject protection Abilities: 1) Understand the history and evolution of ethical theory principles and the key documents related to human subjects in research 2) Take a balanced view of the likely harms and benefits of a research project and to vulnerable communities 3) Understand the need for ethical approval to be obtained before research activities progress 4) Ensure that payments or compensations for subjects for taking part do not constitute coercion or undue influence 5) Demonstrate high integrity, and consistently respect and ensure confidentiality and privacy of research participants 6) Contribute to the informed consent process, ensuring that the participant fully understands the research
Human Rights Research	Role-playing; small working groups; problem-based learning	

Table 2. Active Learning Methodologies and Educational Outcomes in the Training New Research Trainers Workshop (continuation)

TNRT Training Sessions	Applied methodologies	Developed competencies and abilities
Project Management	Learning by doing	Competency: Project management and Human Resources Abilities: 1) Oversee study and site management, including managing multiple sites/laboratories and ensuring consistency 2) Plan schedules, timelines, and processes within study 3) Coordinate or manage teams 4) Understand project management processes and tools 5) Recruit and select team, plan, and coordinate their training as required 6) Ensure that individuals have received and understood instructions and protocols to conduct their work safely
Team Building	Team-based learning	
Training Skills	Online discussion board	Competency: Creating or delivering training Abilities: 1) Deliver effective training in front of groups 2) Produce materials such as manuals or presentations

		3) Determine the appropriate subject topic, assess audience responsiveness to training, repeat and paraphrase source material to produce an effective training session
Research Advocacy	Group presentation	Competency: interpersonal skills Abilities: 1) Enable articulation of the views of those who find it difficult to express themselves 2) Listen effectively and encourage open communication 3) Negotiation and conflict management skills 4) Effective networking skills, can build alliances and strategic partnerships 5) Be aware of the challenges in medical education research 6) Understand the principles of evidence-based medicine
Medical Education Research	Role-playing	
Global Health Research	Role-playing; small working groups; problem-based learning	Competency: Health-related knowledge Abilities: 1) Comprehend the differences between public health, global health, international health, plenary health, and one health in terms of subjects, scope, and targeted population 2) Understand the multiple health determinants and their impact on patients 3) Be enlightened on health system disparities 4) Solve problems concerning global health under the perspective of the sustainable development goals
Open Science	Online discussion board	Competency: Governance and organizational context Abilities: 1) Comprehend the characteristics of open science 2) Apply open access, open data, open methodology, open-source, open peer review, open educational resources' principles on daily situations faced by medical students and early-career researchers

Results

The online workshop yielded more than 400 submissions throughout the country, making it necessary to build a Small Working Group (SWG) for selecting the participants, who were evaluated by a double blinded written interview about motivation and previous experience regarding research. This IFMSA Brazil SWG selected 50 undergraduate medical students, twice as previously expected, from the five geographical regions in Brazil (North, Northeast, Midwest, Southeast, South) and enrolled students from the first to the sixth year of the undergraduate course. The representation of the distribution of the participants and the number of higher education

institutions, according to the city, is represented in Figure 1. The participants were divided into two groups (n=25).

The event lasted for five days, having a total workload of 25 hours. The TNRT course offered 17 training sessions, and no study materials were made available to the participants before beginning the workshop. Each training started with a presentation of the session's agenda, followed by a 20 to 30 minutes' theoretical explanation and 60 minutes of practical activities to develop targeted competencies and abilities. Finally, trainers collected feedback from participants in a method of their choice. Moreover, trainers could perform ice-breakers and energizers as an engagement strategy throughout the training.

Using active methodologies allowed participants to have meaningful involvement with the agenda topics. During the event, participants seemed more captivated by small working group dynamics. However, trainers had difficulty assessing whether a participant progressed in some skills such as oral presentation or teamwork due to the remote adaptation. From the trainers' point of view, despite the impairment of the non-verbal communication, attendees' overall participation was satisfactory considering the virtual workshop setting.

Conversely, going virtual had its challenges. In spite of the great variety of used active learning techniques, online platforms hamper the application of methodologies that would suit the face-to-face format. These alterations may impact the achievement of the expected learning outcomes for the training sessions. Another concern was to keep the energy and engagement of participants even with the extended workload. Lastly, although trainers had independence in choosing the feedback technique to evaluate their training, the assessment methods' lack of uniformity might interfere with understanding the sessions' outcomes.

Discussion

Our report described the TNRT 2020 edition, consisting of the first description of an entirely Brazilian student-led workshop focused on encouraging and democratizing research skills education. Through a virtual and active learning approach, the TNRT promoted an experience that involved students from different parts of the country and situated openness by breaking context, power, and inequality boundaries into scientific research.

Open science was the cornerstone of our initiative since themes such as open access, data, and educational resources were pervasive and mirrored on the workshop online platforms' usage, its gratuity, and application of active teaching on scientific

skills. This rationale also extends to the TNRT conception, which resembles an open science response to rising demands. When creating an open-source product, a researcher goes through an iterative cycle by 1: identifying a problem or need, 2: posing a preliminary solution to this problem, 3: appealing to the general public, 4: receiving contributions unrestrictedly from the community, and 5: releasing the product and restarting the cycle when necessary [27]. The TNRT was designed after noticing medical students' difficulty in learning research. Given this background, our workshop followed this collaborative workflow, under the perspective that it received inputs from different stakeholders, including IFMSA Brazil national officers, trainers, and attendees.

Our report also provides an example of how remote teaching encourages and democratizes research. Initiatives like the TNRT may bring several benefits to the national research structure marked by significant regional disparities. The workshop adaptation to an online format was relevant in financial, equitable, and educational terms. By adopting a virtual design, the workshop became free of charge and travel costs. Because of this increased accessibility, the TNRT attracted trainees from the five Brazilian regions, regardless of socioeconomic status, gender, race, and other factors. Such a modification permitted the attendance of more trainees as firstly speculated, having an overall of 50 participants, which came from 32 cities in Brazil (Figure 1).

According to Clarivate Analytics' assessment in Brazil, clinical research seems the most productive field in which several specialties have a high citation impact. Nevertheless, the majority of publications concentrate in the Southeast region [28]. Likewise, this inequitable pattern is perceived by the country's institutional review boards' distribution (IRBs). As reported by the National Commission on Research Ethics or *Comissão Nacional de Ética em Pesquisa* (CONEP), until February 2021, Brazil counted with 850 IRBs, 70 located in the North, 179 in the Northeast, 69 in the

Midwest, 382 in the Southeast, and 150 in the South region [29]. Since IRBs are responsible for the ethical evaluation of research projects and play an instructional and protective role for the scientific community and society, their unequal distribution compromises research and innovation expansion on national territory. Provided this context, efforts in decentralizing national research involve setting mechanisms to optimize research personnel training. Hence, activities such as the TNRT are essential to educating junior researchers with distinct socioeconomic and geographic aspects. Consequently, the odds of developing significant local projects may increase, corroborating a context-centered approach to promoting science.

A high point of our experience was applying active learning for research education purposes. Such methodologies allow the development of relevant competencies, abilities, and attitudes for healthcare and research settings. Besides being an effective strategy to improve students' attention, motivation, and professional skills [30,31], active teaching can boost students' self-criticism, team building, leadership, and advocacy capacities [32,33]. This method allows the consolidation of a peer feedback-based environment, promoting the sharing of experiences in research education [34] and vital communication skills for physicians' practice [35].

Among the adopted active-learning models, it is clear that peer education played a vital role in our workshop. Such methodology contributes to awakening students' interest in challenging tasks, enhancing scholarly achievement, and fostering prosocial behavior, features that, ultimately, are relevant for the development of student leadership [36]. During the TNRT, attendees participated in peer-led discussions that strengthened student protagonism. Furthermore, peer education is crucial to identify knowledge and abilities gaps according to the addressed public [37]. For example, whereas skills as literature search seemed unchallenging to a technological generation,

participants demonstrated constraints when appraising articles. These nuances were acknowledged owing to peer education, which helped trainers identifying major areas to tackle with attendees.

Besides these aspects, the TNRT recalls the intimate relationship between medical routine and scientific development, which directly interferes within the public health landscape. According to the Royal College of Physicians and Surgeons of Canada, doctors must contribute to advance health care, evidence-based medicine, and shared decision-making. This expertise can be achieved by identifying gaps of knowledge, formulating critical hypotheses, creating, and disseminating research findings, and translating them to applicable medical practice [38].

Similarly, the Future Doctors Programs proposed by the National Health System in the United Kingdom (UK) determines that each physician is a scientist and a scholar and needs to weigh up the scientific evidence relevant to their patient's condition and recommend the best treatment [39]. Moreover, UK doctors should demonstrate understanding of the research process and ethics, participate in collaborative research projects, honesty, and integrity within the scientific field [39]. In parallel, the Brazilian Curricula Guidelines for the Medical Graduation Course encourages medical doctors to apply scientific reasoning to daily clinical practice. Furthermore, the guidelines pose the following abilities as intrinsic to the medical profession: formulating research questions and hypotheses, searching data, executing critical analysis of sources, methods, and results. In general, by evolving on such skills, the medical doctor would favor scientific and technological development, relating those to meet patients' and public health demands [40].

Although these specific medical graduation policies offer guidance to develop critical scientific maturity amidst future physicians, previous studies exhibit the need to

provide more educational opportunities for research [41-43]. Correspondingly, our workshop represents an extracurricular activity to foster research teaching and enable students to detect health system needs from an in-depth perspective. These activities increase the critical analysis by focusing on global health, open science, and medical education. Such a context associated with active methodologies application played a role in making attendees develop interventions focused on the national health system in a scientific and responsible format. Thus, by strengthening investigations centered on health users, the development of effective and socially accountable health practices becomes possible [44].

The TNRT had some limitations. First, this paper reports a pilot edition of a student-led workshop whose protocol is still under development to consolidate future versions of the initiative. Therefore, assessing the workshop educational outcomes in the light of established guidelines and a more significant sample is required. Second, despite the increased effort in applying active learning methods, online platforms present some restrictions that allow their full utilization, interfering with the attendees' interaction. Third, as trainers used multiple and non-uniform feedback assessments, interpretation of overall outcomes was hampered. Fourth, our workshop restricted its target public to be medical students. Because the event provided an innovative way to disseminate knowledge and capacitate research skills, expanding the participation from other health-related undergraduates is another point of improvement.

Conclusion

Although essential for medical practice, managing scientific knowledge through producing, searching, appraising, and putting research into practice is still underexplored by medical schools. To ponder the advances of science to the individuality of medical care demands is fundamental to settle the best context and

ethical assistance, and graduation should be the time to develop such abilities. The TNRT was an opportunity for social collaboration to build research competencies and make students protagonists of open science. Additionally, the workshop demonstrates the feasibility of promoting a more equal, accessible, and decentralized opportunity provision in research education. Because the TNRT was online, this increases the likelihood of its reproducibility by other organizations. On the other hand, methodological limitations should be noticed since the interpretation of results was impaired owing to the virtual environment. Besides, even though the workshop focused only on medical students, it can be adapted to other courses. To propagate TNRT workshops both virtually and in-person via national and international partnerships are the following goals to expand the dissemination of knowledge and practical abilities proposed, including access and education on research, open science, and evidence-based medicine to form leaders for changes in their realities.

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