Challenges of Education In Energy and Environment: Comparison before and after Pandemic Constraints

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Abstract

Energy systems present a complex and dynamic interrelation between energy, environment, and society. Therefore, properly educating new professionals for the renewable energy sector is a challenging endeavor by itself. The COVID-19 pandemic has imposed an additional challenge on how to engage students in energy and environment education through distance learning. In this paper, we present the methodology applied at the Federal University of São Paulo (UNIFESP) for students of the discipline "Energy and Environment". The graduate student interns developed an integrated methodology of disseminating knowledge about renewable energy and environment for those students and society as a whole. A positive feedback over 95% was obtained from the enrolled students in the period of 2019 – 2020. It was also noticed a failure rate of 24% in 2020 in contrast to zero occurrences in 2019, when face-to-face activities were in place. Finally, we present a brief discussion on the primary challenges and lessons learned during the studied period.

Keywords: Training abilities, Capacity Building, Renewable Energy, Undergraduate and graduate programs, COVID-19 impact

1. Introduction

The Federal University of São Paulo (UNIFESP) is a 25-year-old public university with six campuses in São Paulo state, Southeastern Brazil. This case study was accomplished at the "Institute of Marine Sciences" (IMAR), located in Santos, a medium-size coastal city, 80 km far from São Paulo city. The IMAR is the youngest Academic Institute of UNIFESP, and its primary mission is capacity-building focused on interdisciplinary technological and scientific advances focused on sustainable socioeconomic development of the anthropic activities taking into consideration environmental and human welfare issues. Since 2019, UNIFESP has offered the Interdisciplinary Graduate Program for a Master's degree in Marine Science and Technology (PPG-ICTMAR), where undergraduate students can research renewable energy resource issues in tropical coastal regions and train their teaching competences.

The IMAR/UNIFESP started undergraduate courses in the engineering area in 2012, specifically Bachelor in Marine Science and Technology, Environmental Engineering and Engineering on Petroleum and Renewable Energy Resources. Besides the fundamental energy and science disciplines, both undergraduate courses comprise 360 h in undergraduate disciplines as a pathway to building interdisciplinary knowledge, professional competences, and training abilities to work on renewable energy resources, including solar, wind, hydro, and biomass energy. The discipline "Energy and Environment" is the first discipline of the pathway offered to students engaged in the third year of Engineering courses (UNIFESP, 2012). The primary goal of "Energy and Environment" is to promote the students' first acquaintance with technological, scientific, and social challenges related to the energy transition from fossil fuel technologies to renewable energy resources. The discipline teaching plan includes fundamental concepts on material science, energy policy, energy planning and security, energy meteorology, energy technologies, and environmental impacts from energy generation and consumption. The lecturers expect to introduce and attract young people to professional training to work in a wide range of activities in the energy sector.

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This work aims to present a brief description of the teaching and learning challenges brought to the discipline classes due to the COVID-19 pandemic crisis. The paper draws a comparison between the learning and train- ing activities developed before (in 2019) and after implementing the health security procedures to deal with contamination risks in 2020.

2. Teaching Methodology

The teaching team comprises a Professor and five masters' students selected to act as teaching interns. The teaching internship is mandatory in Brazilian regulations for the masters' students receiving financial support from CAPES, the Brazilian agency responsible for supporting and regulating the graduate courses. Two of the teaching interns worked in 2019 and the other three worked in 2020. All five had the responsibility of helping the Professor to prepare and execute the teaching plan. The interns' responsibilities included:

- Preparing multimedia and the practical content to be completed in traditional classes (face-to-face) in 2019, and for distance education in synchronous or asynchronous meetings in 2020;
- Conducting debates among students on topics listed in classes planning;
- Supporting students' activities in group dynamics and research assignments;
- Participating in pedagogical meetings with the Professor to plan and discuss the learning activities;
- Preparing and giving one lecture on a specific topic listed in the discipline plan under the Professor's supervision
- Styles for table and figure captions.

In order to enhance information accessibility of topics discussed along with the discipline, teaching interns created the "@ema_brazil" page on Instagram: a digital platform whose objective is to help people to appro- priate the scientific concepts through symbolic images, metaphors representations, practical examples, reading recommendations, art and cultural presentations, and thematic discussions on issues related to energy, environment, and society. The "@ema_brazil" project mission is to share in-depth knowledge about the aforementioned topics in accessible language and provide didactic and technical definitions whenever required. The targeted public is mainly enrolled students, young researchers, technicians, and civil society as a whole.

The evaluation of the teaching-learning process adopted was continuous along with the academic term. It sought to identify the student's progress throughout the semester based on activities that engaged students to look for information and knowledge at reliable and confident sources such as international universities and research institutions. The students had to prepare infographics, digital media projects, thematic games, and debate speeches on specific topics according to the discipline's topics. The "@ema_brazil" Instagram page disseminates the best student media products.

The COVID-19 pandemic crisis required reorganization of the face-to-face activities in the 2019 academic term to the discipline offer in 2020 taking into account the COVID-19 pandemic conditions. The teaching team worked to adapt and create conditions to execute the discipline plan using MOODLE platform to asynchronous interaction, provide reference materials for study, and prepare the discipline activities. Google Meet tools were applied for synchronous meetings and group discussions.

Prior to the beginning of the semester and in order to enhance full engagement in the learning process of all people involved, the Federal University of São Paulo provided training courses on the remote teaching tools available for the teachers. For the socioeconomically vulnerable students, notebooks and cellphone chips for internet access (UNIFESP, 2020) were lent by the fulfillment of a requisition form.

3. Results and Discussions

In 2019, fifty-five students enrolled in the "Energy and Environment" course, and eighty-one students enrolled in 2020. In 2019, all classes happened at the IMAR Building, but the COVID-19 pandemic made it impossible to do so in 2020. In an effort to follow the safety and health protocols, an alternative distance learning methodology was applied. Before the enrollment period, all students were informed about the methodology and the media platform to be used for the virtual meetings along the academic semester of the undergraduate course.

During the academic term in 2020, the students should accomplish several activities, including reading tasks,

watching recommended documentaries and movies, listening to podcasts, preparing texts, and taking part in discussions in synchronous class meetings. All proposed tasks have some correspondence with activities developed in face-to-face classes in 2019.

Since the first virtual meeting of 2020, we already had a great barrier to overcome. Several students did not have access to a reliable Internet connection or electronic equipment (computer or tablet) to support audio and image transmission. Other students did not have an adequate environment to keep full attention on the classes activities. In summary, the synchronous activities did not get the key goal — interact and integrate students group, teacher, and teaching interns. The socioeconomic vulnerability was much beyond the technology access and required to meet alternatives to overcome the lack of time and physical space for students attend classes, even with the university technical support. This issue got worse along the academic semester, and some students had to give up the university activities to help their families deal with home tasks, health issues and financial demands.

Mental and physical well-being are very important for a learning process to succeed. The fear and isolation promoted by a global pandemic severely affected the students behaviour, who showed signs of anxiety and depression, in a way that made all the teaching team more aware of the need to respond the student's emotional worries towards their academical and personal lives as proposed by Morgan (2020). Taking a few minutes of the synchronous encounters to ask the students about how they were dealing with the pandemic impacts on their households and study performance led to changes on the content application of online classes and evaluations, which improved the yet enrolled students' commitment around the end of the semester.

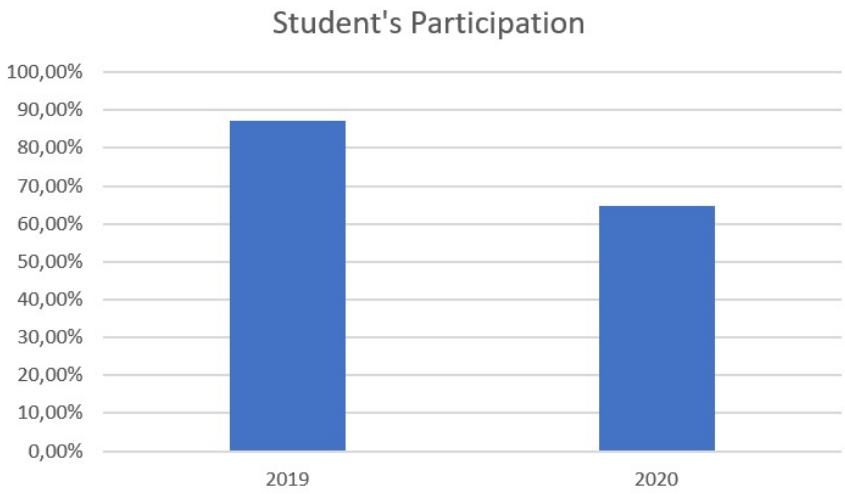
Figure 1 presents the data obtained from the discipline records from the university's academic system and the enrolled students throughout 2019 and 2020's academic terms. It can be noticed a decrease in the number of students that answered the evaluation survey at the end of the semester. The students were asked to provide their vision about the contribution and interaction with Master's students in the discipline activities. For both years, more than 90% of the students declared acknowledgment of the participation of teaching interns and their attributions, with over 95% evaluating interns' performance as "good" or "very good". However, an increase in students' alleged lack of acknowledgment about the activities for the 2020 period was also observed.

Figure 2 presents examples of knowledge dissemination material developed through the methodology. On the left, a publication on "@ema_brazil" Instagram page (Figure 2a), and, on the right, an infographic elaborated by a group of "Energy and Environment" enrolled students (Figure 2b). Such examples highlights the importance of transmitting complex ideas through accessible vocabulary and visually appealing design.

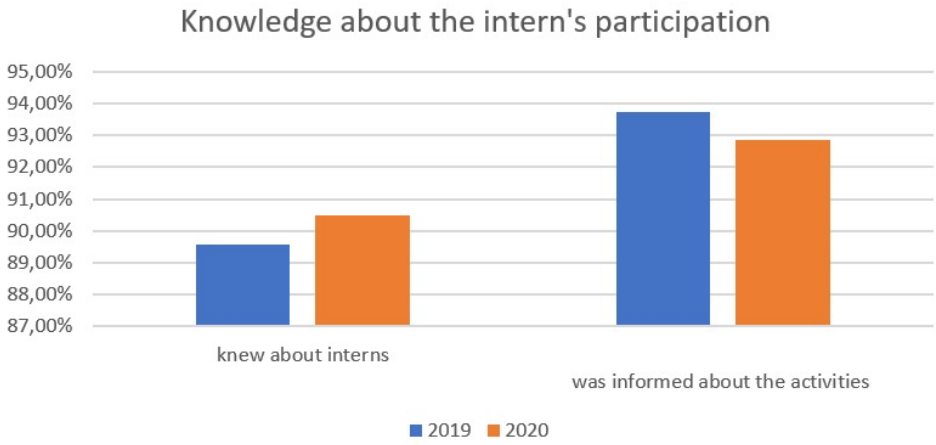
All enrolled students in 2019 had active participation and produced several inspiring products for knowledge dissemination. In addition, high attendance and student engagement during classes with conceptual debates on energy topics were noticed. None of the students failed the course at the end of the semester, but not the same happened in 2020. Distance learning put new obstacles to breakthrough: how to encourage students to engage in debates without feeling the agreement or disapproval of their proposals, and how to maintain students concentrated when they have easy access to several other exciting activities that may distract them from synchronous classes are questions that must be addressed in order to enhance the learning process outcome. In 2020, 24% of the enrolled students failed at the end of academic term.

On the other hand, there's information regarding the development of the teaching interns through the PAD program. Internship certification requires the leading professor to send a personal note and the enrolled students' evaluation to score the interns' tasks and performance to the PAD coordinators at the end of the academic semester. All the interns were approved and certificated on their actions. Given that most of them were previously enrolled in the same graduation course – Marine Science and Technology, it was helpful to work as a junior teacher considering the merge between their old student experience with the new duty of communicating scientific knowledge with the undergraduates already considering, on the content preparation, which terms and subjects would be best or least understandable for the listeners – being that a valuable skill for future works involving not only education, but human resources management in general.

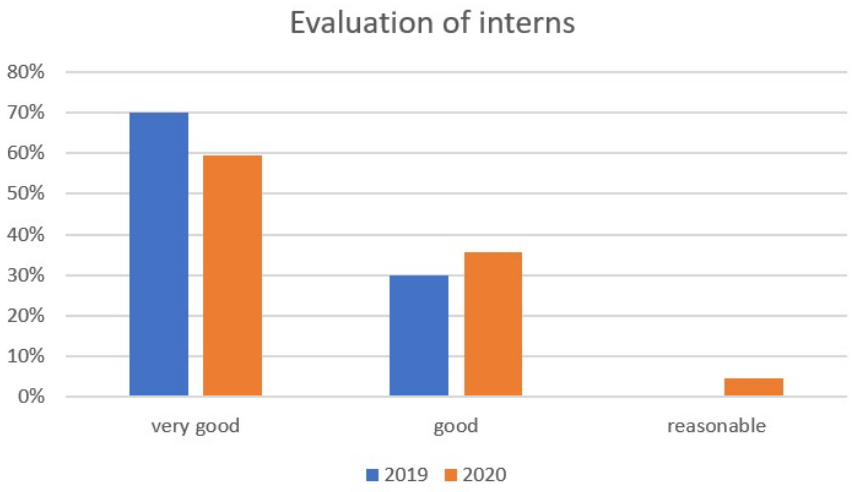
Finally, looking for technical and financial support alternatives and emotional incentives is fundamental to keep students committed to their professional and academic education. There is no doubt that affirmative actions for social inclusion should be planned and executed in Brazilian public universities to avoid increasing student dropout in higher education. The ODS of the Agenda 2030 demands such actions to meet a sustainable socioeconomic advance, reducing social vulnerabilities still impacting Brazilian society.



(a) Student's participation.



(b) Knowledge about the intern's participation.



(c) Evaluation of interns.

Fig. 1: Comparison of discipline data records in 2019 and 2020.

Fig. 2: Example of science Communication products elaborated by the enrolled students in Energy and Environment discipline: (superior) Post in Instagram network prepared by a student's team discussing solar spectral irradiation reaching the Earth surface (in Portuguese); (inferior) Infographic elaborated by a student's team discussing energy flux in biological ecosystems (in Portuguese)

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