Reporting and Analysis of a Teaching Experience in Confinement Time

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ABSTRACT

This article intends to describe and analyze one of the adopted solutions, during the period of confinement, in the teaching of the Physics curricular unit. This curricular unit is part of the syllabus of the Degree in Mechanical Engineering at the Instituto Superior de Engenharia do Porto, with the peculiar characteristic of having a high number of enrolled students. At the end of the semester, a survey was carried out among students to better understand the impact of the measures implemented on their learning. The description of the measures adopted, the results obtained, and the opinion of the stakeholders will be clarified throughout the text.

CCS CONCEPTS

• **Applied computing** → Physical sciences and engineering; Physics.

KEYWORDS

Distance learning, Video content, Text content, Synchronous sessions

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1 INTRODUCTION

The year of 2020 appeared timid but promising. Another period of exams that had passed with the usual normality, several projects planned to reach the implementation phase and the 2nd semester to start. In that semester, one of the teaching tasks that was assigned was the teaching of the Curricular Unit (UC) of Physics of the degree in Mechanical Engineering (LEM). It is a UC of Basic Sciences whose objectives aim to consolidate, and deepen knowledge, in the field of electricity.

Although traditionally with a high number of students (306 in the 2019/2020 scholar year), it did not offer any concern as it was perfectly planned. However, without anyone predicting, an invisible threat from the east overturned all these predictability and certainties, sending an entire country to confinement with no prediction of its end. The entire academic community was taken by surprise watching helplessly to emerge from this new reality that, months before, was unthinkable could happen. Nevertheless, this new reality needed to be faced, assimilated, and acted to minimize the consequences on student's learning.

The relationship between the number of students and that of problematic situations is no longer linear when this value is very high. In this UC case, with more than three hundred students enrolled, it did not take long time for a very significant number of e-mails to appear in which, in addition to several personal problems, there was a common concern: What now? How are we going to continue our teaching/learning process?

It is about this teaching experience (Chap. 2), the description of what was adopted (§2.2), the way it was implemented, the results obtained (§3.1), the student's reaction and a critical analysis based on the result of an inquiry carried out at the end of the semester (§3.2), which will be shared in this publication.

2 THE DISTANCE LEARNING EXPERIENCE

Distance learning was something that had never been considered to teach in this Curricular Unit. Since this is a UC with a strong practical component, the skills acquired, both in handling the equipment and in the work group, would not be easily replicable with distance learning. This is, in fact, the opinion of the members of the teaching team, who are clearly apologists of face-to-face methods as the preferred form of training, considering all the advantages associated with it. The professors who taught this UC had already considered, debated, tested, and adjusted the various methods to use them in face-to-face teaching. Here, the focus was to maintain a balance between expository, demonstrative, interrogative and active methods. On the other hand, distance learning methods had never been approached, nor was it in the time horizon to take this path.

2.1 Curricular Unit characterization

The UC which, given the situation experienced, was the target of the application of this teaching strategy, is a Physics UC taught in the 1st year and 2nd semester of the LEM of the School of Engineering (ISEP) of the Polytechnic of Porto (IPP). It is a Basic Sciences curricular unit, which aims to consolidate and deepen knowledge in the field of electricity. The UC does not require previously acquired

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knowledge, and only information, skills and general competences acquired in secondary education should be mobilized.

In previous academic years, this UC consists of theoretical classes (T), which predominantly use expository and demonstrative methods, with constant references to physical systems whose description is most appropriate for engineering students. At the same time, there are laboratory practical teaching classes (PL), where the student performs group work, previously prepared, where the students implement electrical circuits, the physical quantities involved are measured and the laws that were previously presented and deduced in the classes (T), are studied. These classes (PL) alternate with others, in the classroom, to solve exercises.

With the attendance and approval on this UC, a student can analyze and implement direct current (DC) electrical circuits, identify and interpret the physical quantities and the concepts involved, in particular, the notions of electrical resistance, electrical energy sources, drop of electrical voltage, power and electrical energy, capacitors and coils, as well, the most relevant aspects of the electric and magnetic fields.

2.2 Measures adopted to mitigate the confinement

Without a period for careful preparation, and after moving from the phase of denial to awareness, it was urgent to find the best tools to continue the classes that, at the time of confinement, was already in the third week.

The organic units of the IPP and those responsible for the study cycles of ISEP began to act immediately, promoting motivating and clarifying meetings, and defining plans and strategies to overcome and resolve this adversity. In addition, very effectively, training was provided about online platforms, distance learning methods, and suggestions for solutions to be implemented.

The most expeditious way to shorten the school break was using one of the available platforms, which in this case was ZOOM, to continue synchronously teaching the classes as if it were a face-to-face class. Everything that distance-learning experts strongly advise against. Moreover, the first online experiences were not motivating and frustrating. Student's attendance participation was almost non-existent, microphones and webcams were always turned off (and, consequently, gave rise to a low participation), broadcast breaks due to the difficulty in accessing a quality network, sound failures, etc. There is also the difficulty in understanding whether they were assimilating the contents taught, as there was practically no visual contact. All these situations are amplified by the fact that it is a UC with a high number of students, and many of them are not technologically prepared for distance classes. To give an idea, by that time, equipment, such as tablets, monitors, and computers, were sold out in stores for a significant period.

This solution was not pleasing to the professors. The high number of students and the technological restrictions, led to the emergence of the idea of creating short and objective videos on the various theoretical subjects [1, 2]. In this way, it would allow students, regardless of the restrictions and limitations they may have, to access the explanation whenever they wanted, when they could, and whenever they needed it [3]. It was initially planned to make these contents available in the institution's Modular Object-Oriented

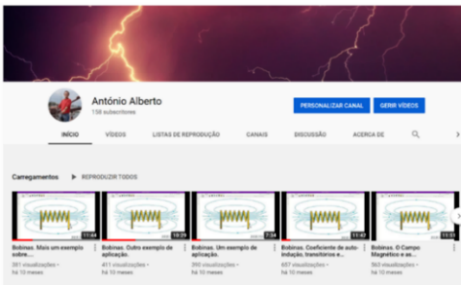

Figure 1: YouTube channel created for the Physics UC – Electricity Branch.

Dynamic Learning Environment (Moodle). However, the space limitations imposed by this teaching and learning support platform prevented its implementation, dictating the creation of a YouTube channel, a well-known video sharing platform. The choice of this specific instrument is also related to the fact that it is widely used by the age group of the target audience, with which everyone is familiar, and which can be easily accessed through a smartphone. That is how a YouTube channel was born with the material contained in the (T) classes (home page in Figure 1).

In the preparation of this teaching material, two basic rules were followed:

- That the videos were not too long so as not to become tedious and tiring, and consequently failed to capture the student's attention, therefore, the subjects covered were divided so that the average duration of each video was around 10 minutes;
- Do not use any content already available on the internet, therefore, all drawings and diagrams were made with the computational tool employed.

The inexperience in producing this type of content, and a very short time interval to do it, meant that the first videos appeared without great aesthetic pretentiousness, with the focus being more centered on scientific issues. In Figure 2 (left side) there is one example of the first content created. With the progress of the semester, less pressure in terms of time, and more experience with the tools used to prepare the videos, there was some esthetic concern in order to make them more attractive (right side in the Figure 2).

In total, 25 videos were made, alluding to the various subjects that were included in the UC. At the same time, the student also had at his disposal all the support material already used during the in-person classes of previous academic years, such as the slides of the theoretical classes, the list of exercises, etc.

3 FINAL ANALYSIS OF WHAT WAS IMPLEMENTED

Online teaching without prior preparation, time, and experience, is not an easy task. Particularly in Physics UC, where in most cases a schematic demonstration is a sort of explained problem, this becomes difficult without adequate tools [4, 5]. Although all the professors had a computer with a camera and microphone available, explaining certain matters using a mouse or a digitizing table was a Herculean task. In addition, responding to requests (for example,

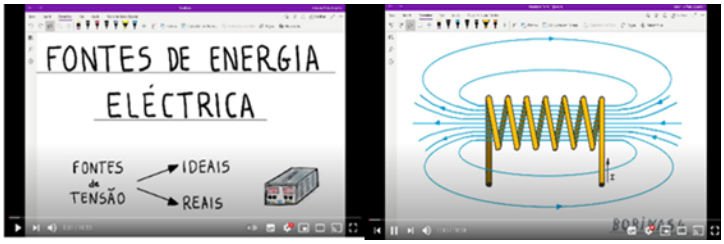

Figure 2: Appearance of the videos made.

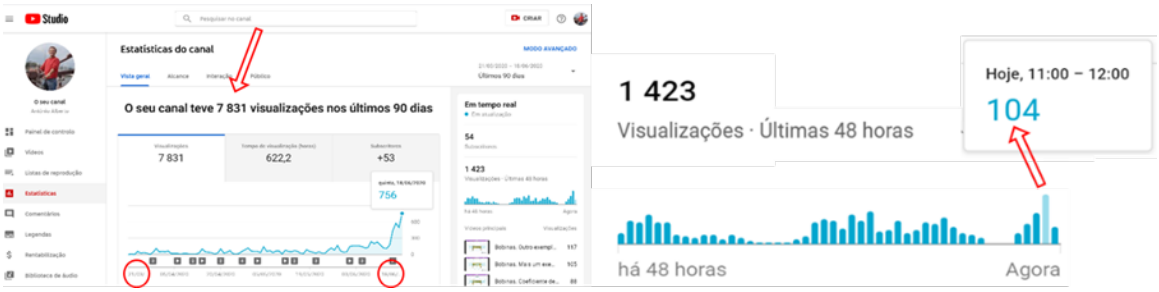

Figure 3: Statistical charts provided by YouTube.

answering questions outside of class time) from such many students seemed like a lost cause.

3.1 Analysis from the teaching team's point of view

To the entire teaching team, the option of providing videos with a theoretical explanation of the subject's topics seemed to be a good solution. So, the students could manage their study when they could, without being limited to the timetables of the synchronous sessions (which were the same as the face-to-face classes that took place in the first weeks of the semester), and they always had the information available in case of doubts.

The only tool available to get feedback from the implemented measure was to access YouTube "Channel Statistics". This instrument allows access to a set of data, such as the number of hourly, daily, weekly views, viewing time, among others, thus allowing monitoring the impact of the content provided. Figure 3 (left side) shows an example of a graph taken at the end of the semester. This chart shows the number of views from the period when videos began to be published (21/03/2020) until the day before the written exam (18/06/2020). In these 90 days, the total number of views was 7831, with a full viewing time of 622 hours. A result that seemed to be frankly good, as there is an average of 87 views per day, something better than, sometimes, the attendance to the in person theoretical classes.

Another interesting fact to mention, in addition to the intensification of access to the channel in the days prior to the written exam (also carried out online through Moodle), is the way in which this access is distributed throughout the day. To illustrate this fact, the right side in the Figure 3 shows the hourly views in the 48 hours prior to this written exam. Here, it can be seen that during all day there are practically always students watching the videos. This proves that in this way students carry out their autonomous study according to their own pace and availability.

3.2 Analysis from the student's point of view

Student's opinion during synchronous sessions was scarce. Being essentially students attending the first year for the first time, they had not yet had time for a perfect integration into higher education. They were not very participatory and critical. Sometimes, some referred to it as "a good help", but it was too little to know the real impact, and how it helped them in learning of concepts. Therefore, to quantify this impact, a survey aimed at students was created in Google Forms (a survey management application where it is possible to collect information obtained through questionnaires and forms) to inquire about their opinions. In preparing this questionnaire, the two approaches commonly used in educational research were considered: quantitative methods and qualitative methods. With the first method, it was intended to know the opinion on the functioning of the UC and on the measures adopted. With the second, as it is more of an interpretive nature, to know the personal opinions that are less evident, but which could go unnoticed by the teaching team, to detect anomalies to be corrected and opportunities for improvement.

This work will not analyze all the issues covered in the student's survey. The objective is only to assess some of the questions related to the topic under analysis, that is, how the videos made available on the YouTube platform had helped students in understanding the subject. Therefore, 157 responses were registered, which corresponds to 50% of the total number of students enrolled in the Curricular Unit. To characterize the sample, some general questions were asked. In the first question, the aim was to know if the student was attending the UC for the first time or if he had already attended

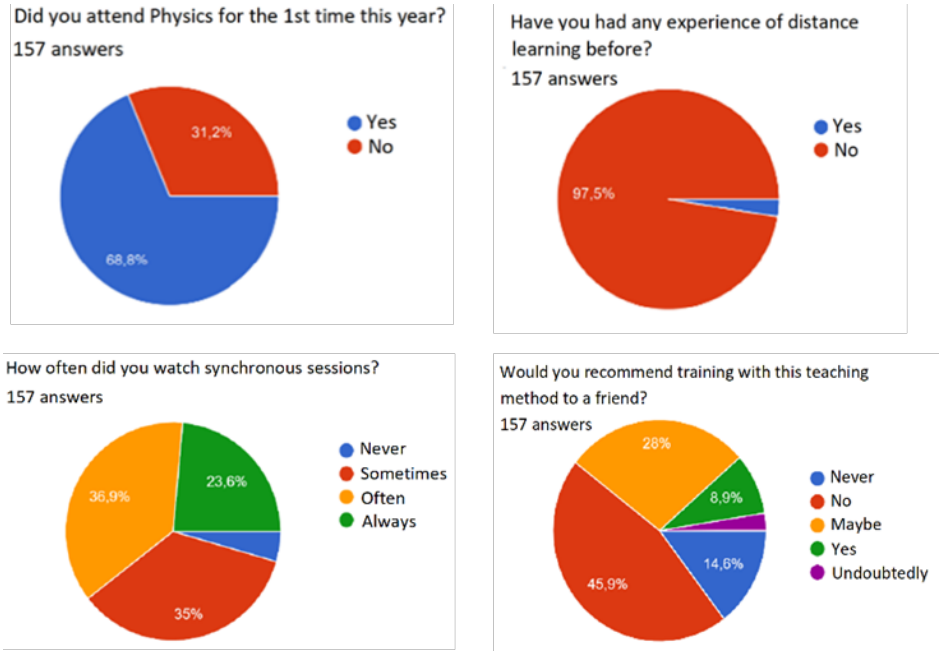

Figure 4: Results of the answers to the various questions.

it with face-to-face teaching in previous academic years. The results obtained are illustrated in Figure 4 (upper left side) Thus, it was found that the sample was representative as about 2/3 of the students attended this UC for the first time. Which corresponded to the total population.

To assess previous experiences in distance learning, a question whose answer, expected, was a predominant no. Only 2.5% of respondents had a previous experience of distance learning as shown in Figure 4 (upper right side).

Two more questions, intended to inquire about the student's involvement in the UC. One of the questions was related to the attendance to the synchronous sessions (bottom left side of Figure 4) and the other, to evaluate the online experience, if they would recommend this training method to a friend (bottom right side of Figure 4).

From the analysis of the results to the various questions, it can be observed that a majority of students (more than 60%) frequently attended the synchronous sessions. Which is an indicator of their involvement in the UC. However, as was to be expected, this experience of distance learning, even more forced, was something that the students did not like at all. A percentage of 60% would never recommend this form of teaching to a friend and around 30% only question the possibility of possibly giving advice.

To better assess the impact of the videos, the question compared the adequacy and effectiveness of explanatory videos on the subject with the most common distance learning practices: the use of a program for presentations, whose objective is to inform about a certain topic, and may use images, sounds, texts and videos, which can be animated in different ways (such as Microsoft PowerPoint), the use of Microsoft PowerPoint with voice explanation, synchronous classes in the traditional format, and synchronous classes for

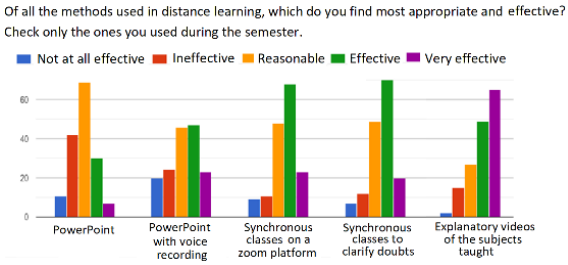

Figure 5: Result of answering the question: Of all the methods used in distance learning, which do you find most appropriate and effective?

clarification of doubts. The comparative result to this question is shown in Figure 5

It should be noted that, of the various methods used, including synchronous classes, the one using explanatory videos was considered by 73% of respondents as effective/very effective, and only about 10% considered it to be little or not at all effective. The method of explanatory videos was chosen as very effective by practically half of the respondents.

The open-ended questions were very participatory and fruitful. Among the countless answers, some opinions and some outbursts were selected, which somehow help to corroborate the conclusions of this work.

- "... fortunately, the Physics professor made video lessons and recorded them, making them available on an online platform, which made it possible to watch the same video several times at an alternative time, which greatly facilitates

learning. I believe that, especially for after-work students, the video-lesson method used by the Physics teacher helps a lot in learning as it makes it possible to watch it several times at an opportune time, as well as being a facilitator in the study for the exams . . .".

- ". . . Nothing replaces practical classes and a teacher explaining and seeing our mistakes . . .".
- ". . . In my opinion, the only thing missing was to make available the exam solutions from previous years to facilitate the last phase of exam preparation. Moreover, of all the subjects I had this semester, this was the one that best made up for the lack of in-person classes . . .".
- ". . . Although useful, the videos cannot make up for the lack of in-person theoretical classes . . .".
- ". . . The videos were extremely useful, presenting more exercises as well as the respective resolution (regarding more complicated subjects) . . .".
- ". . . I think that the methods that were used by the various engineers, the video one is the best . . .".
- ". . . Considering the circumstances, the part of teaching the classes, giving study materials, etc., I have no criticisms. We had explicit explanation videos, classes every week, theoretical material, solved exercises and doubt classes in several hours. Availability was exceptional. . . ."
- ". . . an effort was noted to convey the material to the students in the best possible way. Despite the effort, distance learning will never be as productive and enlightening as in-person . . . ".
- ". . . Unfortunately, with distance learning, the practical laboratory part is not done, and I consider it extremely important to better understand the subject . . .".
- ". . . it was the curricular unit that best addressed the lack of classroom classes. The methods used, especially the videos, were a very successful and useful tool for our training . . .".
- ". . . when the videos are very long, as much as we want to be attentive, we are never able to absorb everything that is said, and thus, in short but very explanatory videos, it is easier to assimilate all the material. In my opinion, it was an excellent idea, and even when the virus situation is normalized, I think that the students making the class will be very happy when they see all the content, they have available. . . ."
- ". . . This was an atypical semester for everyone, so, as difficult as it was for us students, there is not much the teaching team could do differently. So, albeit anonymously, I would like to congratulate you for the work you have done . . .".

From the reading of these testimonies, and the analysis of the quantitative issues, the team that taught the Physics UC can conclude that the option taken to compensate for the absence of face-to-face classes had been a successful bet. In the end, the degree of student and teacher satisfaction with the implemented measures was very high. Based on the opinions expressed by the students and the sensitivity of the entire teaching team, this method will be used in the future whenever necessary.

4 CONCLUSIONS

The second semester of the 2019/2020 academic year, in which there was a period of confinement, was for the majority of students, and a high percentage of teachers, the first experience in distance learning.

Despite the very valid efforts of the organic units and those responsible for the study cycles to rapidly provide training and computer tools, the fact is that there was no time to conveniently organize a UC to be fully taught online in a synchronous manner.

In adverse and hostile periods, human beings discover unknown capacities that allow them to adapt and reinvent themselves. This is well expressed in the well-known Portuguese word "*desenrasque*" which in an informal definition means: "To do with relative ease and improvisation, usually without the proper means".

This atypical period, for which almost no one was prepared, was characterized by a lot of experimentation and improvisation. That is what the teaching team of the UC Physics at LEM did. From the mechanisms at its disposal, opt for the one that at the time seemed to be the best solution to face the problem. Additionally, that was how a YouTube channel was born with explanatory videos on the various themes that appear in the program of this UC. Using videos on the YouTube channel is not an innovation. There are several contents available that students have been using autonomously for some time to complement their study. In this case, in addition to the novelty for the teaching team, it was the full replacement of theoretical classes by this new approach.

With the described solution, it was possible to reach all students in a more comfortable and less invasive way, which, according to different opinions, even from their own, as concluded in the surveys, was a good option.

At the end of this text, we are at the end of the second semester of the academic year 2020/2021. The Curricular Unit maintains roughly the same number of enrolled students, and the most classes were in person with the respective laboratory component. Despite this, the number of views of the YouTube channel had a significant increase. In this academic year, the daily peak reached 1108 views against the 756 shown in Figure 3 (left side).

This was the teaching experience, resulting from the suspension of the on-site semester, and its replacement by distance learning, in a period of confinement due to COVID-19, which was the subject of characterization and analysis throughout this article.

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