



## A semester of home-classroom

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### Abstract

The 2020 academic year began in an unusual way. After a week of traditional classes at San Nicolas Regional School, National Technological University, Argentina, teachers and students had to go into a mandatory lockdown due to the COVID-19 pandemic. The objective of this paper is to discuss the experience and show the obtained results in a Numerical Analysis course of an engineering career. An online alternative was designed for the Numerical Analysis courses, and the second week of the course, the tasks in the virtual classroom started. The content of each module was presented in a series of lessons and weekly assignments were proposed throughout the semester. Students had to sit for two assessments, covering two topics each, as was usually done in face-to-face classes. The experience was demanding, for both professors and students, but good outcomes were achieved. This paper recommends that everyone involved in teaching and learning has had to adapt, given the circumstances.

**Keywords:** Numerical Analysis, online course, assessment, home-classroom, semester.

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## 1. Introduction

The 2020 academic year began in an unusual way. In Argentina, teachers and students had to go into a mandatory lockdown since March 20th due to the COVID-19 pandemic. When the first semester ended at Faculty Regional San Nicolas (FRSN), Technological University National, the number of patients who tested positive was 55,343 and the number of deceased was 1,184 (Ministry of Health, 2020a). The second semester was scheduled to start on July 27, but the isolation will continue at least until the beginning of August. On July 27, the number of patients who tested positive grew up to 167,416 and the number of deceased to 3,060 (Ministry of Health, 2020b).

It is highly unlikely that face-to-face lessons will resume this school year, given the circumstances. Nevertheless, FRSN has prepared emergency procedures for continuity when the time arrives. It includes instructions for the transfer to the building and the entrance, use of protection elements, work in the laboratories, among others.

All over the world, faculty are adapting their activities. Smith and Hornsby (2020) suggest some starting points to go through pandemic pedagogy, a change in the learning environment due to this new disease. Hornsby (2020) offers some principles to adopt in converting online classes into meaningful learning environments. Other authors call the present situation emergency remote teaching and learning to differentiate it from designed online education (Hodges et al., 2020; Milman, 2020a). Although well-designed online education can be just as effective as face-to-face teaching, the contemporary conditions are far from ideal to rush into virtual classrooms (Milman, 2020b).

Some experiences on turning face-to-face instruction into online, in different disciplines, have been described (Li et al., 2020; Rahiem, 2020; Stambough et al., 2020) and ideas about the way higher education will continue are now discussed (Govindarajan & Srivastava, 2020; Krishnamurthy, 2020).

We are facing a crisis that is unprecedented at FRSN, the building is completely closed since March 16. After a week of traditional classes, at FRSN an alternative way of taking the Numerical Analysis courses, fully online, was designed. This course was not initially intended to be delivered online, but the chair team had some background in flipped classroom, a pedagogical model that modifies the way that time is spent both in and outside the class, working with active learning, centered on students (Caligaris et al., 2016). There are several studies on flipped classrooms and the videos prepared for them (Lin, 2020; Zappe et al., 2009; Zhang et al., 2006).

### 1.1. *The purpose of the study*

In the last years, faculty have gained experience in designing and preparing material for an online course. The objective of this paper is to discuss the experience and show the obtained results in the first semester of the Numerical Analysis course of the Mechanical specialty Regional San Nicolas (FRSN), Technological University.

### 1.2. *The 2020 Numerical Analysis online course*

Numerical Analysis, a subject of the third level of Mechanical Engineering, covers the topics Nonlinear equations, Linear equations systems, Interpolation and curve fitting and Numerical Integration in the first semester; and Initial value problems, Boundary problems, Partial differential equations and Introduction to finite elements method in the second semester.

By the second week of the course, the tasks in the virtual classroom started. Modular Object-Oriented Dynamic Learning Environment (Moodle) was chosen as the learning management system. The content of each issue was presented in a series of lessons consisting of different videos with

theoretical explanations and the solution of exercises, showing the implementation of different methods. These videos were of two different styles: some of them were made using the app Doceri for Ipad. This software converts the tablet into an interactive blackboard that records voice and what is being written. Other videos were generated from PowerPoint, recording voice over the presentation. In addition, a link to a specially designed website was included. Websites were developed by Engineering & Education Group (GIE, Grupo Ingenieria & Educacion in Spanish) at the FRSN. A series of proposed exercises and a document with solved ones were also incorporated.

Weekly assignments were proposed throughout the semester as formative assessments, with immediate feedback. After 3 weeks of working with this virtual mode, a survey was carried out with the aim of knowing if students still worked as usual or in a different way, their possibilities of accessing the Internet, and their opinions about online work up to that moment. Students had to sit for two assessments covering two topics each, as was usually done in face-to-face classes.

A good relationship between teachers and students is very important to retain them and avoid dropouts, especially if these students have difficulties with the subject (Hagenauer & Volet, 2014). The contact with students in the Numerical Analysis course was permanent. Timetables and working hours are more flexible in this scheme and so faculty was always ready to reply to messages, through the virtual classroom or by email. Conference meetings through the Zoom platform were also scheduled, before summative assessments.

In Numerical Analysis at FRSN, every student has to sit for six exams, three in each semester of the year. If the grade of any of the exams is below 4 out of 10, they fail the subject; in order to pass the subject, though, they have to get a 6 out of 10 mark or higher on all tests and have no failed exams. The possibility exists that the student did not fail a single exam but got a four or a five in any of them, so they have to sit for the final exam to pass. There is a chance to make up for one exam from each semester if the grade is less than six; the mark is replaced only when it is higher.

## **2. Methods**

### *2.1. The research models*

A survey about the way of working in the subject was carried out after 3 weeks of online work.

### *2.2. The participants*

Participants include the teachers and students.

### *2.3. A first survey*

The responses provided by the students who took the first assessment are presented here (22 of the 26 enrolled students). Figure 1 shows that 45% of the students do not have a job during the mandatory social isolation and almost 23% works from home. Figure 2 shows that only 41% of the students consider that their Internet connection is good and 18% consider their connection bad.

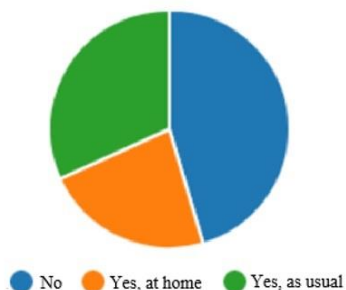


Figure 1. Students who still have a job during social isolation



Figure 2. Students' Internet connection

Figure 3 shows students' studying routine. It is observed that less than 30% of them have a scheduled routine. Some students (when expanding 'Others') answered that they try to keep up to date with all the subjects, dedicating more time to the tasks to be delivered closer or that they try to study every day, without schedules or routine for each subject.

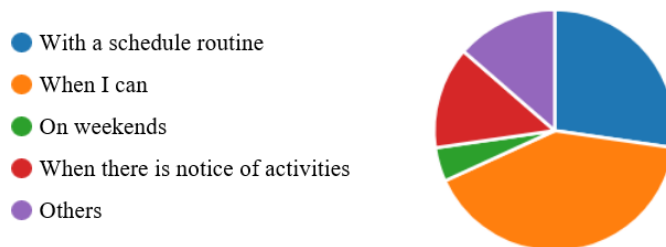
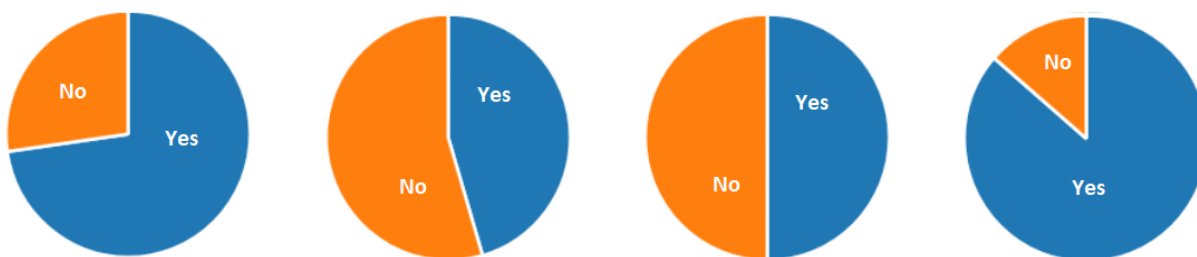


Figure 3. Students' studying routine

All students have seen the videos specifically prepared for them, 77% of them saw the videos more than once, and 86% spent time solving the exercises proposed in the activities booklet. Figure 4 shows their preferences regarding other materials used for studying.



a) Numerical Analysis website b) Videos from other websites c) Books d) Proposed exercises

Figure 4. Material preferences

One student replied that he did not feel able to do an online assessment. However, that student passed the two evaluations proposed in the semester.

The survey included some open-ended questions. Regarding whether they had difficulties, they answered that they did not have difficulties and that the videos were very useful. Students suggested

that we should incorporate synchronous classes with Zoom or Teams, to discuss their doubts about the topics studied. Some of the answers given when asking if they consider that this type of work has advantages are:

- 'Yes, in some way it forces us to be up to date with the issues and not fall behind in the planning. In addition, in a normal situation, if I hadn't been able to attend a class, I would have already given it up, even if I asked what was done in classes to a classmate. With this modality, in this particular subject, I have the class at my fingertips every day and at any time of the day'.
- 'I have more time for studying'.
- 'As I have a video, I can go back as many times as I want if I don't understand something'.
- 'Yes, being able to watch the videos more than once allows me to repeat important explanations that perhaps were not very clear at first, in addition to being able to see them as a couple of exercises solved as an example, I find it useful to see since I can relate practice and theory'.
- 'Having the explanatory videos is as good as taking notes in class, but you can skip things or ignore them, and then repeat those ones when you watch the video again'.
- 'This way of learning works fine and it's nice and easy, it's not the same as a face-to-face class, but it isn't difficult'.
- 'It's not a bad option in my opinion, I'm just too used to face-to-face classes. Anyways, I didn't find it difficult to adapt to this particular subject'.
- 'I don't think that it has great advantages'.
- 'Personally, it has no advantage to be found since I prefer face-to-face classes'.

### 2.3.1. First assessment

The authorities of the Regional San Nicolas (FRSN), Technological University recommended respecting the schedule of the face-to-face classes assigned to each subject, even for online classes, so as not to incur time overlaps. Numerical Analysis could be completed in an asynchronous way; the students could watch the videos and carry out the tasks at any time.

Teaching is the prelude to assessment. The first assessment of this course was proposed in the regular class schedule with the following structure:

- Questionnaire about solving nonlinear equations (3 points).
- Questionnaire about solving linear equation systems (3 points).
- Conceptual questionnaire for the two units (4 points).

The assessments were designed using Microsoft Forms, a tool for conducting questionnaires that allow creating surveys with multiple-choice or open-ended questions, among others. Each part of the assessment remained accessible for a half-hour, the first two in consecutive hours. The following half-hour they had to send a photo of one of the indicated exercises to the faculty emails, and then complete the third questionnaire. Thus, the assessment should have been completed in 2 hours.

For a question to be considered valid, the information sent by mail had to match the option selected on the form or the answer written on it. The correction was not automatic, it was calculated

manually since there were not only multiple-choice responses requested. The day the grades were published, a document with the questionnaires and their responses were uploaded, since feedback is essential for students to move forward.

In this first assessment, no students failed. Two students got 5 points, but they still have the right to make up for the assessment or sit for the final exam.

#### 2.4. Second survey: online assessment

Feedback is also important for professors, so a survey was carried out after the first assessment. In the first part of the survey, 11 close-ended questions were proposed to get students' opinions. Each of these questions was analysed using a Likert-type scale (Hernandez Sampieri et al., 2010). The Likert-type scale used, and the numerical value assigned to each of the options are: 1: Totally agree; 2: Agree; 3: Neither agree nor disagree; 4: Disagree; 5: Strongly disagree. Table 1 shows the obtained results.

Table 1. The second survey

Items	Mean	Mode
The assessed concepts were adequately explained.	1.5	1
The proposed activities were pertinent to be able to face the assessment without problems.	1.8	2
The weekly homework contributed to the consolidation of each one of the studied methods.	1.8	2
The technological resources helped the learning process of each of the involved concepts.	1.7	1
The communication channels were pertinent to solve doubts during learning.	1.8	1
The instructions given to approach the evaluative instance were clear.	2	1
The tool used to make the evaluative instance was easy to manipulate.	1.8	2
The activities in the assessment were consistent with those proposed during the teaching process.	1.6	1
The way the assessment was organised (in three parts) facilitated its resolution.	2.2	1-2
The realisation of assessments in a virtual way allows the development of competences needed nowadays.	2	2

As can be seen, students were generally satisfied with the assessment and the corresponding practice. This is based on the fact that the average value obtained in each of the items was less than 2, except the item with the lowest rating, linked to the organisation of the assessment in three parts.

The survey also asked students if they would make any changes in the teaching strategies that were used or if they would make any changes in the way learning was assessed. The most repeated answers

referred to the fact that the time to complete the assessment was short. Another frequent answer had to do with the fact that it was not practical for the exam to be in three parts.

#### 2.4.1. Second assessment

The second assessment covered the topics Interpolation and curve fitting and Numerical integration. It was organised in a Moodle quiz. A question bank was created, organised into categories, including true-false and essay questions. Moodle randomly selected 12 questions from the bank, for each student. One of the advantages of Moodle quizzes over those that can be done in O365 Forms is that by setting time limits, responses can be sent automatically when students arrive at the end time.

The first assessment could not be done in Moodle, as the platform did not support user congestion. It was hosted in a local server with resources meant for far fewer users than the ones that pandemic generated. Now the platform is hosted on a cloud server with better resources and more availability, where the only weak point is the user's Internet connection.

Students suggested that the assessment should not be divided into three parts. Based on that fact, another strategy was chosen. Although the students did not do a new survey, they informally commented that the new way of assessment was better for them.

Figure 5 shows the results of the two assessments. Two students got 2 points, so they have to make up for the assessment. A student got 4 points, but he still has the right to make up for the assessment or sit for the final exam.

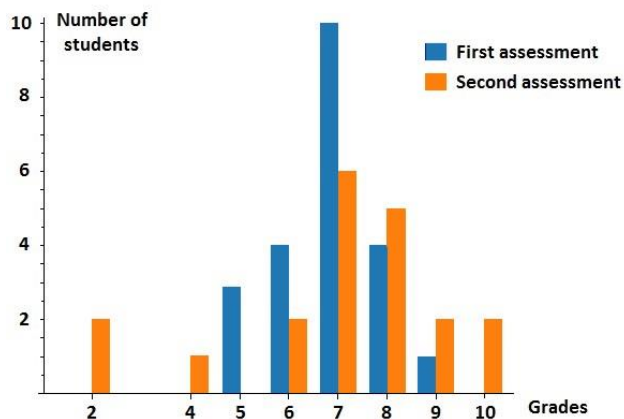


Figure 5. Grades obtained in both proposed assessments

### 3. Conclusion

The world faces an exceptional situation due to COVID-19 pandemic. This complex context creates difficulties for everyone and the university community is no exception.

The experience carried out in the Numerical Analysis course at FRSN was demanding, for both professors and students, but it was overall successful. The chair team considers that this practice helped students to develop transferable skills that will allow them to face new challenges in their career and their professional life.

Everyone involved in teaching and learning has had to adapt, given the circumstances. Now we have to decide which practices to sustain, based on the weaknesses and strengths identified in this first semester of 2020.

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