AUDIOVISUAL RESOURCES IN LABORATORY PRACTICES FOR HYDRAULIC ENGINEERING

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Abstract

During the laboratory practices of a subject, students write all the data, methodology, development and final results for later study at home. When a certain period of time passes since the essay was carried out, there are details that many of the students forget. They do not relate the methodology and development with the laboratory equipment used. The use of audiovisual resources can help students to better study the practical part of the subject.

The new teaching resources will be applied in a block of the Hydraulics subject, which is included in the second year of the degree in Civil Engineering, at the Algeciras School of Engineering and Technology. The subject has a theoretical-practical part and another of laboratory practices. The course is divided into three blocks: Hydrostatics, Hydrokinematics and Hydrodynamics. The article will focus on the improvement of the teaching resources of the part of the laboratory practices, of the hydrostatics block.

Audio-visual resources will consist of explanatory videos with the development of laboratory practices. The videos show for each of the tests the initial data, the methodology to be applied and the development of the practice. These videos help students to reinforce the knowledge acquired in the laboratory. In addition, the use of these resources helps Erasmus students (for language reasons) to understand the practices. Additionally, the generated material can be used as a resource in the case of non-face-to-face practices (as in previous courses due to the Covid-19 pandemic). For the implementation of this initiative, a teaching innovation project has been developed.

Eventually, the students show a great interest in the virtualization of the laboratory practices and a high degree of satisfaction with the available videos. Moreover, their academic results improved slightly with this new methodology.

Keywords: Educational Innovation, Technical Education, Audio-visual resources.

1 INTRODUCTION

A decade ago, university studies in Spain were adapted to the European Higher Education Area (EHEA). Improving the quality of teaching is one of the main objectives of the EHEA. To do this, introduce both internal and external system evaluation mechanisms [1], as well as a change in teaching methodologies are necessary. This change in methodologies should tend to complement part of the theoretical teachings with new techniques, where new learning methods are included. The evaluation system must integrate both previous aspects. The most active and practical education improves the training of students [2].

Information and Communication Technologies (ICT), as well as the autonomous work of students [3], are fundamental in improving teaching and learning [4]. The use of ICT improves the performance of those students who receive this type of methods [5]. Any change in teaching methodology should be assessed through surveys [6] [7].

Particularizing in engineering, in recent years, virtual resources have been developed [8], audio-visual resources [9], specialized books [10], tutorials to promote self-directed learning [11] [12], use of tools such as drones [13], GPS and Google Earth [14], methodologies for bibliographic search and promotion of teamwork [15] and methodologies for teaching with students from different countries [16]. All this, without forgetting the practical rules of traditional teachings [17] [18] [19].

The subject of Hydraulics is included in the second year (semester 2) of the degree in Civil Engineering of the Higher Technical School of Engineering of Algeciras. The subject of 9 ECTs credits, formed by a

theoretical-practical part (6 ECTs credits) and another one of laboratory practices (3 ECTs credits). The subject is divided into 3 blocks: Hydrostatics, Hydrokinetics and Hydrodynamics. The present work will focus on the improvement of the teaching resources of the part of the laboratory practices, of the hydrostatics block.

As a consequence of the mobility restrictions caused by the Covid-19 pandemic, classes became non-face-to-face for extended periods of time. While the theoretical-practical classes could be developed virtually in an acceptable way, the laboratory practices were done with more difficulty. Although the teacher explained the practices with the support of images, support with explanatory videos was necessary.

The aim of this paper, the solution of this problem, is the realization of a series of videos, which the students will be able to see as many times as they need. Thus, they will be able to remember the procedure to carry out the practices. These files will be made available to students on the virtual campus of the subject. With the return to normality and face-to-face classes, the generation of these videos can help students who attend practices to reinforce the knowledge acquired in the laboratory. Moreover, this new resource can help Erasmus students (because of the language) to improve their understanding of internships.

2 METHODOLOGY

During the first semester of the course, video recordings of the different laboratory practices of the first block of the subject (hydrostatics) were made. For the recording of the videos, a camera with a tripod was used, as well as a fixed white screen background. On that same screen background, the different practices were mounted and recorded.

The recorded videos were edited and assembled using the Active Presenter software. When the edition was finished, in order to be viewed by any user, it was exported to a video file using this same software.

The duration of each of the recordings was variable depending on the length of the practice (2-6 minutes each trial). The videos were completed with a pdf presentation indicating the test data, the methodology to be followed, as well as the results to be obtained.

During the teaching of the subject in the second semester, the students viewed the videos in the laboratory, as well as at home through the virtual campus.

Once the hydrostatic block was finished, a survey was made in which the students determined the degree of satisfaction with the new resource. Results presented the % of students who:

- Found the videos useful for laboratory practices
- Found the videos useful for the study of practices
- Found the videos necessary for remote laboratory practices
- Had already used this method.
- Liked this new method
- Thought that laboratory practices should be virtualized

The academic results achieved by the students have been analyzed.

3 RESULTS AND DISCUSSION

As mentioned in the methodology, a survey has been made to the second-year students of the degree in Civil Engineering (table 1). The survey has been answered by 100% of the students. Even when the practices are held in person, and the students can see and manipulate the test equipment live, a high number of these students consider the videos useful to watch them in the same laboratory.

A high percentage (90%) of the students consider that videos have been useful for the study of the practices. If for any unforeseen circumstance, the classes returned in a non-attendance way, all the students consider that these videos would be necessary.

Most of the students liked this new method. Only 5% of the students had already used this method in other subjects. All students consider that laboratory practices should be virtualized on the web.

Table 1. Results of the surveys

	Civil Engineering Bachelor
Students who …	**%**
They have been useful for laboratory practices	40
They have been useful for the study of practices	90
They are necessary for remote laboratory practices	100
Already had used this method	5
Liked this new method	95
Laboratory practices should be virtualized	100

The academic results achieved by the students in the last year, together with the average of the results of the five previous years, have been analyzed (table 2).

Table 2. Comparison (percentage) of the results obtained in the previous five years (without videos) with last year (with videos)

Academic year	Enrolled students	No show	% No show	Fails (D)	% Fails (D)	Total Pass	% Total Pass	Pass (C)	% Pass (C)	Very Good (B)	% Very Good (B)	Excellent (A)	% Excellent (A)
2015-2016	78	24	30.8	7	9.0	47	60.3	36	76.6	9	19.1	2	4.3
2016-2017	63	13	20.6	10	15.9	40	63.5	26	65.0	11	27.5	3	7.5
2017-2018	50	6	12.0	9	18.0	35	70.0	20	57.1	12	34.3	3	8.6
2018-2019	39	12	30.8	3	7.7	24	61.5	14	58.3	9	37.5	1	4.2
2019-2020	24	2	8.3	0	0.0	22	91.7	9	40.9	10	45.5	3	13.6
Average 2015-2020	50.8	11.4	22.4	5.8	11.4	33.6	66.1	21.0	62.5	10.2	30.4	2.4	7.1
2020-2021	15	3	20.0	2	13.3	10	66.7	6	60.0	2	20.0	2	20.0

The number of students enrolled per course has been decreasing year after year. This is due to the decrease in the number of new students in the first year of the Degree in recent years.

The new method has reduced the percentage of students who did not show up (from 22.4% to 20.0%), with the percentage of students being somewhat higher than the average of previous years (from 66.1% to 66.7%). With regard to the qualification of the students who have passed the subject, it has been possible for a higher percentage of the students to obtain the maximum qualification (from 7.1% to 20%). There are some coastal processes whose interpretation is not easy for engineering students, e.g. [20-21].

4 CONCLUSIONS

The survey and student comments reflect a high degree of satisfaction with the videos made available in the course.

The videos are fundamentally interesting for the students, for the study of the practices outside the laboratory, as well as in the non-face-to-face classes.

Academic results have been improved with this new methodology.

The students have shown a great interest in the virtualization of the laboratory practices.

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