USING VIDEO LECTURES IN E-LEARNING PLATFORM TO IMPROVE PHYSICS TEACHING AT UNIVERSITY LEVEL

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Abstract

The aim of this work is to improve the quality, flexibility and effectiveness of the teaching in the scientific degree courses at the University of Camerino (Italy). The main specific goals of the project here presented are: (i) Counteracting the first year drop-out of the students; (ii) Improving learning outcomes of the students in terms of quality and with higher marks in average; (iii) Analyzing and understanding the behaviour and perception of the students on the use of the on-line video lectures.

As a first case study and practical realization, we have chosen the Physics course in Classical Mechanics for the first year undergraduate students, enrolled either to the Physics degree or to the Mathematics degree at the University of Camerino. We offered the students the opportunity to use online video lectures recorded during the frontal lessons and embedded in the e-learning Moodle platform of our university, together with supplementary teaching material and with interaction tools. To monitor the validity and the outcomes of this project, we have realized a detailed analysis on how the students used the e-learning platform containing the full video of the lectures. In order to increase the understanding of the behaviour of the students and to acquire information on their perception about the video lectures, we have asked the students to fill in an open ended questionnaire. We believe that the recorded video lectures delivered by the e-learning platform represent a powerful tool for improving learning outcomes and reducing the drop-out of the first year students.

Keywords: video lectures, on-line learning.

1 INTRODUCTION

In recent years, video lectures have been used in the university system mostly to help the students unable to attend the front lessons, mainly for working reasons. Nowadays this motivation remains, but in addition the video lectures are used to fulfill other objectives: (i) to support the students who regularly attend the front lessons, but sometimes miss few lessons; (ii) to give supplemental material to the students in order to better understand the more difficult course topics; (iii) to help the students with several and important difficulties in passing the exams, as for example international students who have difficulties with the language during their first years of the university courses [1]. On the other hand, the deployment of the video lectures is still partial and quite often it is not organized for the whole curriculum of studies of the degree, with a large variety of situations within the different Italian universities. Since 2014, the University of Camerino started to use the video lectures in a systematic way for selected courses. In particular, last year we organized a complete video recording of the Physics course for the two degrees in Physics and in Mathematics, embedding the videos with additional teaching material in the e-learning platform of the University of Camerino [2] with a free and flexible delivering of the video lectures to the enrolled students. In this work we aimed to understand how much this integrated multimedia project was able to help the students to improve their learning experience, including the success in passing the final exam with a high grade.

This will be investigated and here discussed on the basis of the student performance at the exams and on the perceptions of the students about the use of the video lectures delivered by the e-learning platform obtained from the answers to the questionnaire [1,3]. Moreover, we intended to investigate if the video lectures, together with the instruments of the e-learning platform, were able to give a substantial support to the students having important difficulties in the Physics course, such that for them the final exam could represent a serious obstacle to continue their university path. In this respect, the ultimate objective of this project is to start reducing the level of dropped out students after the first year of university, which is one of the most critical moment in the university career of a student [4]. Depending on the level of realization of these objectives, our University of Camerino will decide to expand the initiative of the video lectures to other subjects and to other degrees, and the video
lectures already realized for this project will be used to organize highly interactive and innovative courses based on the flipped classroom approach [5,6].

2 METHODOLOGY

Participants. This study was carried out with a group of 70 students (43 female and 27 male) of the Physics course in Classical Mechanics enrolled at the first year either of the Physics degree or of the Mathematics degree at the University of Camerino. All students of the course were enrolled in the Moodle e-learning platform. The use of the video lectures, teaching materials and interactive tools was not mandatory. All students involved in this work, attended also the frontal lessons.

Methods. We offered the students the opportunity to use video lectures that we recorded during the frontal lessons of the Physics course in Classical Mechanics and embedded in the e-learning Moodle (Modular Object-Oriented Dynamic Learning Environment) platform of our university. In order to offer to the students a more interactive learning environment we integrated video lectures with supplementary teaching material and with interaction tools such as forum for discussions. In total we recorded 40 videos of the lessons (covering all the syllabus of the course), for a total of 60 hours of recording. We used these video lectures to support frontal lessons and not to substitute them. As recording method, we chose to record the video lectures in the class during the front lessons, and not in a neutral and empty environment in front of a video camera, for three main reasons: (i) reducing recording costs; (ii) saving working hours of the teacher; (iii) and, as some authors showed, lessons in the classroom are more fun and motivating for the students [7][8]. To access to the Moodle platform we sent to each student an e-mail with username, password and information. The students had the possibility to visualize video lectures, teaching materials, and interact with the teacher and peers starting from the same day of the frontal lessons and at any time of the day, until the end of the final exam. The aim was to offer to the students the opportunity to visualize the materials several times, to meet their individual learning needs, thus enhancing learning outcomes, performances, reducing also the university dropout. We chose as e-learning environment the Moodle platform because is a learning management system (LMS) that enables to upload learning materials, to use tools for the on-line collaboration and instruments of data analytics that allow to monitor the training activities of the students and evaluate their behaviour [9].

Data analysis. For the data analysis we used data extracted from the Moodle platform, on how the students used the e-learning platform containing the full video recording of the lectures. The use by each student of the video lectures uploaded in the e-learning platform was analyzed either quantitatively and qualitatively, and a detailed comparison with the performance of the students was carried out. To increase the understanding of the behaviour of the students and to acquire information on their perception about the use of on-line video lectures, we have asked the students to fill in a questionnaire with 23 closed questions. The questionnaire was created using the feedback module of Moodle platform.

In particular in this work we analyzed: (i) the number of the total views for each video lecture performed by the 70 students; (ii) time distribution of the views of the video lectures, performed by the students; (iii) the correlation between the number of on-line video lectures viewed by each student and the final exam grade; (iv) how the on-line video lectures were viewed by the students, if as integration, replacement or both with respect to the lessons in presence; (v) selected questions of the questionnaire about students' perception on the use of on-line video lectures.

To verify the possible correlation between the variables of our results we performed a linear regression analysis, utilizing a linear function for the fit as y(x)=a*x+b, to derive the Pearson correlation with bootstrap analysis. We analyzed the available data with the help of graphical representations and statistical processing, using the statistical functions of the software Microsoft Excel.

3 RESULTS

As a first result we report the analysis of the data about the number of total views, for each video lecture, performed by the 70 students (Figure 1). We notice that all video lectures were highly viewed by the students, with an average equal to 57,6 views for each video lecture. This result shows that most students considered very useful the on-line video lectures for actively integrating classroom lessons. The analysis of the data in Figure 1 highlights that there are video lectures with a higher number of views. Most probably these video lectures cover topics that the students consider and find
more difficult to understand. This information can be very useful to get indications on how to reorganize and improve the lessons for the following year, devoting more attention to these topics.

As second result, in Figure 2 we show the time distribution of the visualization of the video lectures done by the students. The 58% of students used the video lectures, on a constant basis, while also attending the course in presence, whereas, the 26% of students viewed the video lectures from time to time and 16% only close to the exam. This means that the highest percentage of students found the video lectures as an important instrument to integrate the information taken during the frontal lessons.

As a third result in Figure 3 we report the correlation between the number of video lectures viewed by each student and the grade obtained during the final exam. In this case the analysis of the data was done on a group of 33 students that completed the final exam soon after the end of the course. We identify two groups of students: a first group of motivated students, with a good physics background, who had a limited use of video-lectures (the data reported inside the circle in Figure 3), and a second group who employed intensively the video-lectures and whose final performance significantly benefited from its use (as witnessed by the final self-assessment questionnaire), illustrated by the arrow in Figure 3 suggesting a correlation for this subset of data, see discussion below.
Figure 3. Correlation between final grade and number of video lectures viewed by each student.

Using the data in Figure 3 for the restricted group of students who viewed more than 12 video lectures, we obtained the correlation between the number of video lectures viewed by each student, and the grade obtained during the final exam, with a Pearson correlation coefficient $r(x,y) = 0.43$. This value shows a moderate correlation between the variables, suggesting an appreciable improvement of the learning outcome.

In Figure 4 we report the results of a particular question of the questionnaire on how the on-line video lectures were used by the students with respect to the frontal lessons. There are three possibilities while using the video lectures: only integration of the lessons attended in presence, only replacement of them or both. The answers to this question were grouped in three groups according to the level of usage of the video lectures. In the first group of students who have used rarely, from time to time, the video lectures, we find that the video lectures were viewed or as an integration of the front lesson, either as a replacement of it, but no one used the videos for both reasons. In the second group of students who used the videos on a constant basis, the videos were viewed as an integration or both as an integration and a replacement. This is an expected result. In fact, the students who regularly use the videos as an integration of the front lesson, when not present at the front lesson, will be naturally lead to consult the video lecture as a resource to replace the missing front lesson. Finally, in the third group of students who used the videos only close to the exam, we find an equal distribution of results, indicating the flexibility of this method.

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<th>Integration</th>
<th>Replacement</th>
<th>Both</th>
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<tbody>
<tr>
<td>From time to time</td>
<td>60%</td>
<td>40%</td>
<td>0%</td>
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<tr>
<td>On a constant basis</td>
<td>30%</td>
<td>0%</td>
<td>70%</td>
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<tr>
<td>Only close to the exam</td>
<td>33,3%</td>
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Figure 4. How the video lectures were used with respect to the lessons in presence.

In Figures 5 and 6 we report the results of two questions of the questionnaire about students’ perception on the use of on-line video lectures as a tool for improving their knowledge, understanding and problem solving skills. The results of Figure 5 are very positive, showing that the 26% of the students think to have improved their knowledge and understanding in appreciably way, while 63% of the students answered very much on this question, and 11% yes by all means. No negative results were obtained.
In Figure 6 the results of the students’ perception on their improvement of problem solving skills through video lectures, albeit positive, are lower than the students’ perception about their improving in the knowledge and understanding on the concepts of the course. We see, in fact, that 63% of the students answered that they have improved their problem solving skills in appreciably way, the 16% of them very much, the 11% by all means, and the 10% no too much.

In Figure 7 we report the answers of the students to the question on the usefulness of the video lectures to pass the final exam of the Physics course. 44% of the students did not find useful or more simply they did not need the video lectures to study the contents and pass the final exam. This is in agreement with the distribution of data in Figure 3, where we found a group of 11 students who got high grades (plus 3 students who got intermediate grades) at the final exam without using too much the videos. A large group of 41% of students answered that the video lectures helped in an appreciable way to pass the final exam. In addition, 15% of the students found very useful or even extremely useful (“by all means”) the support of the video lectures in order to pass the exam.
Again we can state that this is in good agreement with the results reported in Figure 3, where a second group of students had the grades in (a moderate) linear correlation with the number views of the videos. Because 56% of the students, hence the majority of the group, found useful the use of the videos to pass the final exam, we can consider this first experience of the video lectures delivered by the e-learning platform as quite successful.

4 CONCLUSIONS

In this work we focused on the behavior and perception of the students in using the video lectures recorded during the lessons in presence of the Physics course of the degrees in Mathematics and Physics of the University of Camerino (Italy). A group of 70 students was involved in this study. We analyzed the data extracted from the Moodle e-learning platform and collected by delivering a questionnaire to the students at the end of the course. The main objective was to understand the level of improvement and satisfaction of the learning experience of the students who have used the video lectures organized in the e-learning platform together with supplemental material and interaction tool.

A general result is that the video lectures were used in a very intense way because in average each video lecture was viewed 56 times, which is a large value considering that almost all the students were also attending the frontal lessons. Interestingly, when analyzing the number of views of the video lectures in connection with the grade obtained by the students at the final exam, the presence of two distinct groups of students has emerged. A first group of students rarely used the videos and got an high grade at the exam because they were already able to complete their learning with the frontal lessons, and used the videos only for revisiting difficult topics. A second group of students used in a very intense way the videos to overcome several difficulties encountered in the course. For this second group, we found a correlation between the grade of the exam and the number of video views. From these data and analysis we conclude that the video lectures embedded in the e-learning platform fulfilled one of the main objective of this work: to contribute to decrease the drop out of students at the first year and at the same time lead to an average increase of the marks for all the students. In addition to this main result, two other important objectives were fulfilled: a considerable improvement of the knowledge and the understanding of the topics of the Physics course by the use of video lectures; the acquisition of problem solving skills, which are usually developed by the students in the laboratories or during practical sessions. Overall we can say that supporting and enhancing the lessons in presence with the video lessons delivered by the e-learning platform was a very positive and enriching experience for the students, as well as for the teacher, suggesting to extend this method to other disciplines and to repeat it for the Physics course in the following years.

REFERENCES


