INFLUENCE OF SEVERAL FACTORS IN THE ACADEMIC PERFORMANCE OF STUDENTS OF PHYSICS IN THEIR ACCESS TO THE UNIVERSITY

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Abstract

In this experience, level test was made to students of Physics subjects, who are attending to three different degrees, which belong to the area of knowledge of sciences and engineering, selected between from the offered from the University of A Coruna. It was developed during the first quarter of the academic course. The objective at the beginning of the experience was to evaluate the physics knowledge level which the students log in the university, attending to factors as: student previous studies, initial knowledge level about subject contents or the university degree which the student is attending for. It was pursued that students become aware of the knowledge level which they arrive to the university with. Likewise, transmitting the importance and usefulness of physics in the field of science and engineering was attempted.

Once the quarter was finished, the progress of the students was analysed by repeating the same level test in order to evaluate the effectiveness of the didactic methodology applied during the course. Relations between the progress of the student and the factors before mentioned were searched. Improvements in the learning of all students was observed with the application of the methodology used and levelling of learning was reached for all the degrees studied. Clear differences were observed according to the academic origin of students, being the most notable and clear the progress of those who came from professional studies.

Keywords: Level test, Physics, Previous Knowledge.

1 INTRODUCTION

The teaching of Physics becomes complex in general due to the lack of motivation of students towards this discipline. Physics is classified within the subject’s scheme as basic training and it is given during the first courses of the degrees in the field of knowledge of science and engineering at the University of A Coruna. The subjects referred to as basic are usually seen by students as mandatory subjects to overcome to reach the higher courses, in which they will receive the specialized knowledge they really have motivation to acquire when they choose this degree. Therefore, these subjects are impediments for students to overcome because they are not able to see the applicability of knowledge learned in these matters and even, it results boring for them. This makes them try to pass with the minimum qualification, without deepening on the learning. This is a usual drawback even in students who come from sciences and technological bachelor studies who have already received classes in this matter. [1]

Generally, students do not realize the interest of mastering this discipline in the development of their future academic and professional activity, so the lack of motivation becomes evident day by day supposing an obstacle to the daily activity of the teacher [2]. The first step to motivate the students in their learning of physics starts becoming aware of the level of knowledge with which he/she reaches the university classroom and about the need to advance in this knowledge to their future academic and professional development. It is necessary and fundamental the student knows all the potential of the discipline of physics and the wide range of applications it has in other areas, especially in the area towards the degree selected by the student is focused. Finally, the student must be informed and aware about the level of learning will be necessary for their learning process in higher education and what will be required at the end of the subject. Various methodologies can be used to achieve the described objectives, however, in the present work a test of level physics knowledge was chosen to carry out. It was designed to encompass various basic concepts appearing within the program of any physics subject in a first course of a university degree in the field of sciences and engineering.

Through the resolution of this knowledge test prior to the start of the course, the student can be aware of the level with which it reaches the university classroom and the difference between this level and
the one that will be required at the end of the subject, which is reflected in the questions of the test. The ultimate goal is the student discovers the knowledge window existing between the learned before entering the university and the knowledge will be demanded at the end of the quarter, hoping that this serves as motivation to study [3, 4].

After this first contact with the level test, the subject is developed during a quarter, in which various techniques will be applied in order to promote the teaching-learning balance. Once the quarter is finished, the test is repeated, in order to evaluate the evolution of the student's learning and the effectiveness of the techniques that have been used to teach the subject.

The differences in terms of academic origin and level of knowledge with which students access to these first courses were analyzed and related by using the results of this level test done before and after addressing the subject. Relations were established between these factors and the results obtained with the aim of analyze the success of learning methodology used to improve the future results.

2 METHODOLOGY

This experience was performed in the subject of “Physics I”, in the degree in Automation and Industrial Electronics Engineering and in the degree in Electrical Engineering, both of them provided in the Polytechnic University College, as well as in the matter of “Physics” in the degree in Nautic and Maritime Transport, provided in the School of Nautical Science and Marine Engineering. All of them belong to the study plan offered by the University of A Coruña (UDC) in the field of sciences and engineering knowledge. In case of the degrees in Automation and Industrial Electronics Engineering and in Electrical Engineering, both of them enable to exercise the regulated profession of Technical Industrial Engineer (Order CIN/351/2009) and Industrial Engineer (Order CIN/311/2009), if the student complements his training with the Master in Industrial. In case of the degree in Nautic and Maritime Transport, which has two specializations: “Ship’s Nautical Operation” and “Management and Maritime Administration”, the first allows to access to the professional exercise of Deck Officer of the Merchant Navy and the second is focused on companies of the nautical and port sector and to the Maritime Administration. For graduates in Nautical and Maritime Transport (mention “Ship’s Nautical Operation”) the Master Degree in Nautical Science and Maritime Transport gives access to the professional qualification as Master Mariner (Ship’s Captain) once that they have completed a period of approved education and training stipulated by RD 973/2009 and they meet the standard of competence specified in the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW).

As it is seen, the three degrees have a marked professionalizing character so the students usually arrive with a clear objective and with the idea of acquiring the knowledge and the training to practice the profession. Subjects as physics are part of the so-called basic subjects offered in these degrees, what makes them uninteresting for the student who approaches them with a very low motivation. These subjects of “Physics I” and “Physics” have a duration of 6 ECTS credits (European Credit Transfer System) each one and they are given in the first quarter of the first year of the degree, which make them the ideal situation for analysing the level differences which the students are arriving in function of their academic origin as well as the later evolution along this first quarter in the university. With this aim, the completion of the level tests is proposed to the students the first class day, after being the subject presented and before start with the matters. The level test was common to all the degrees and to the whole students. The asked concepts belong to a common part of the subject matter of both, “Physics I” and “Physics”: Dimensional analysis and unit systems, kinematics of the point and of the circular movement and dynamics of the point, of the systems of particles and of the rigid solid. It was a multiple choice test with four options in each question and a single correct answer as can be seen in figure 1. The option to answer “not known/no answer” is available in all the questions. Special emphasis is placed on using this option in case they do not know the correct answer.
The test was completely anonymous and only the academic origin was asked between the following options: bachelor, professional formation, repeating or others. The results were compared attending to two variables: degree which the student is going to access and previous studies. So, the lecturer can get information about the initial knowledge the students have at the beginning and about the previous development level they have in different parts of the subject matters depending on their academic origin.

With the aim of evaluating the effectiveness of educational techniques used along the quarter and their relation with the variables mentioned before, the same level test in Fig. 1 was repeated at the end of the quarter, once the subject matters was completed in all the degrees. Again, the students were asked for the academic provenance between the options described above. To study the differences in the results between academic origin and degree taken, the course was developed in the way as similar as possible in the three degrees, by using the same teaching material in all cases as well the schedule was the same as far as possible. The obtained results in this case were used to analyze the evolution of student’s knowledge along the quarter with the educational techniques used, which include documents comprising all the basic concepts of themes explained in the classroom, problem resolution sessions, development of a work related with the subject and exhibition centered in a topical issue related with the degree taken as well as laboratory practice sessions. All these accompanied of continuous evaluation test useful for fixing knowledge and marked objectives of the course.
3 RESULTS

The results for the test at the beginning of the course and before taking the subject were evaluated in function of the academic provenance of the students and of the chosen degree. As can be seen in Fig. 1, the test consists of 10 questions. Each question is valued in one point and the wrong answers do not penalize in any case.

3.1 Results based on the grade taken.

3.1.1 Physics I. Automation and Industrial Electronics Engineering Degree / Electrical Engineering Degree.

The obtained results for students in the degree in Automation and Industrial Electronics Engineering and in the degree in Electrical Engineering are shown in Fig. 2.

![Figure 2. Correct results percentages obtained in each question of the level test for students of subject: Physics I.](image)

At the beginning of the course, the questions with higher difficulty for the students of the subject Physics I, with a success percentage minor than 25%, include concepts about dimensional analysis (1), two-dimensions movement (3) and friction work concept (8). These are basic concepts necessary for the university student in degrees in the field of knowledge of sciences and engineering. However, the questions related with basic dynamics (6), pressure concept (7) and fluids (9) got a success percentage above 50%.

In all cases, the results improve in the test made after having finished the quarter. Five questions were correct answered in a percentage higher than 50%, and no success percentages below 25% were obtained, as happened before starting the course.

3.1.2 Physics. Degree in Nautic and Maritime Transport.

Results obtained for students of degree in Nautic and Maritime Transport can be seen in Fig. 3.

![Figure 3. Correct results percentages obtained in each question of the level test for students of subject: Physics.](image)
In general, at the beginning of the quarter the results of the Nautic and Maritime Transport degree students are worse than the obtained for the student of degree in Automation and Industrial Electronics Engineering and in the degree in Electrical Engineering. Almost all the questions reach a success percentage minor than 25%. These questions include concepts about dimensional analysis (1), two-dimensions movement (3), circular movement (4), point dynamics (5), friction work concept (8) and rigid solid dynamics (10). Just two questions: the number 6 about simply dynamics and the number 7 about pressure concept reach a success percentage higher than 50%. Clearly, the students of Nautic and Maritime Transport degree arrive to the university with a minor academic level than the students of degrees in Automation and Industrial Electronics Engineering and in Electrical Engineering.

The improvement along the quarter is more pronounced in these students if we compare the initial and the final results with the obtained by students of degrees in Automation and Industrial Electronics Engineering and in Electrical Engineering. A total of five questions reach a success percentage higher than 50% at the end of the quarter and all of them, except for one (the number 3) exceed the success percentage of 25%.

### 3.2 Results attending the academic procedure of the student

#### 3.2.1 Physics I. Automation and Industrial Electronics Engineering Degree / Electrical Engineering Degree.

Results depending on the academic origin of students are collected in Fig. 4. The percentage of students reaching each qualification in the different groups: bachelor, professional formation, repeating or others, are shown as well in Table 1.

![Figure 4. Results depending on academic provenance of Physics I students.](image)

<table>
<thead>
<tr>
<th>Qualification =&gt;</th>
<th>0</th>
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<th>3</th>
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<tr>
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<td>Professional Formation</td>
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<tr>
<td><strong>FINAL TEST (%)</strong></td>
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<td>Professional Formation</td>
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With respect to the students coming from bachelor, although before starting the course the qualifications not overcome 7, at the end of the quarter qualifications higher than 7 are reached and even, the 1% of students reach the maximum qualification (10). In case of repeating students, the
difference is not as remarkable, even though achieve the 5 qualification a 2% more at the end of the quarter.

3.2.2 **Physics. Degree in Nautic and Maritime Transport.**

Below are the results for students of the Nautic and Maritime Transport degree, attending to their academic origin (Fig. 5 and Table 2).

![Figure 5. Results depending on academic provenance of Physics students.](image)

As for students of degrees in Automation and Industrial Electronics Engineering and in Electrical Engineering, a clear tendency towards higher qualifications is observed in all cases after having taken the subject matters. Again, a more pronounced improvement in students coming from professional formations, even more than in case of students of Physics I is, reached. This is generalized for all cases: Physics students start from a lower level when they reach the university classroom but their improvement is greater than that of Physics I students who started at a higher level. Therefore, the equality of levels is achieved in all students regardless of academic origin and the degree taken.

**Table 1. Percentage of students reaching each qualification in function of the academic procedure for students of Physics.**

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<tr>
<th>Qualification =&gt;</th>
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<td>Bachelor</td>
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<td>Repeating</td>
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<td>Repeating</td>
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In this case, a clear improvement is contemplated in the results with lower qualifications: at the beginning of the year there is a high percentage of students who obtain lower grades (0-3) and at the end of the subject this percentage decreases considerably.

4 **CONCLUSIONS**

In this study, a diagnostic test has been used to assess the level of knowledge of the subject of physics with which students, from different academic origins, enter at the first course of university degrees in the area of science and engineering attending to their academic origin and in function of the chosen degree. This level test has also served to analyse the effectiveness of the educational techniques used during the course.

Improvements were observed in the qualifications obtained in all cases, regardless of the academic origin or the degree taken. In addition, these improvements are greater in those issues that at the beginning had given the worst results.

Regarding provenance, there are clear differences: students coming from professional formations has shown the least initial level but, they were who achieve the highest performance. In all cases, bachelor
students are those who have a better initial level. Repeating students show the least margin for improvement.

At the end of the quarter, a leveling is achieved in the totality of the students regardless of the academic origin and the level of initial knowledge of the subject and in all the degrees.

REFERENCES


