IMPROVING THE TEACHING EFFECTIVENESS: AN EXPERIENCE IN AN ITALIAN MECHANICAL ENGINEERING DEGREE

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Abstract: The implementation in Italy of the so called "3+2" system, in adoption of the Bologna process, led to an initial increase of the efficiency of the overall results, in terms of the ratio of the number of students who completed the degree over the number of the students enrolled. These findings are measured in the first cycle (BS level) in a mechanical engineering University degree. After a several years tendency to increase, the data show a relevant change of the slope, that became negative. In this poster the actions implemented to face this situation and revert the tendency to a positive behaviour are described.

THE NEED FOR A CHANGE

At the end of the 20th century, the overall results of the Italian universities, in terms of the number of graduate with respect to the number of enrolled students, and of the duration of their academic careers, where dramatically unsatisfactory. The problem of dropouts is of course worldwide present; as is reported, for example, by Meyer M. and Marx S. (2014), notwithstanding this, in Italy it reached a particular high level of severity. If the data were integrated over all the universities and all the branches of knowledge, about only one third of the total number of students enrolled concluded the studies, furthermore in a greater time with respect to the regular duration of the course. This, together with the need of complying to the statements of the Bologna process to harmonize *"the architecture of the European Higher Education system"*, led to the adoption of the so-called "3+2" system.

The main characteristic of the reform is the organization of the courses in three cycles: first degree (similar to a BS) that lasts three years, and degree, that lasts two years, even id particular courses are planned as single-cycle five or six years degree courses. The course of first degree aims to provide students with an adequate command of general scientific methods and contents as well as the acquisition of specific professional skills, while degree program aims to provide students with an advanced level of education for the exercise of highly qualified activity in specific areas. The third cycle is provided as a 3-year doctoral research (after obtaining the degree). Other possibilities that are offered consist in 1 year university masters of first and second level (which you can sign up with the title, respectively, of the first degree and master's degree).

Another reason for the reform was to allow individual universities to have to some extent a teaching autonomy: the reform aimed to ensure the freedom to each university to build curricula tailored to the needs of the local economic and social reality. In any case, the courses of study designed by each university must meet certain general criteria in terms of objectives and of the general aspects of the training activities, defined at the national level. This autonomy regarded:

− the name and training objectives that characterize the courses of study;
− the criteria of access (free access, limited number of students, assessment of initial competencies);
− the type of educational activities and the corresponding number of Credits (complying with "ECTS" European Credit Transfer System);
− the identification of alternative forms of teaching, such as those at a distance;
− the mode of conducting curricular activities of professionalizing;
− the characteristics of the final test to achieve the qualification.

THE OUTCOMES

The data that show the time evolution of the number of freshmen enrolled at the mechanical engineering degree, the total number of students and the number of graduate, are reported in the table. The ratio of the number of students graduated in the prescribed time with respect to the number of the students that had enrolled, is assumed in the first instance as a measure of the efficiency of the course of study. At a glance, it is evident that the total number of graduate, ranging from 40% to 60%, greatly exceeds the 1/3 ratio found before the reform, thus it can be stated that the adoption of the 3+2 system had a positive effect.

Similar results have been obtained by Chiandotto B. and Giusti C. (2006) on a national scale; defining a *duration index* as

$$duration\ index = 1 + delay\ /\ legal\ duration$$

where the delay is the number of days elapsed between the end of the last academic year "in progress" and graduation, while the legal duration of the course refers to the one where the student has enrolled. The index therefore allows to compare the graduates in different courses and is also easy to interpret since it increases with

the delay and takes values greater than or equal to one. It has been found that the duration index, which was equal to 1.62 for the pre-reform graduates, decreased to 1.59 (thus showing an increased efficiency of the system) in the years immediately after the reform (when students that had
enrolled before the reform switched to the new organization), with a further slight decrease in the successive years.

Academic year	Freshmen	Total enrolled	Graduate	Ratio
2003-2004	179	552	39	
2004-2005	184	625	82	
2005-2006	125	580	72	0,40
2006-2007	131	584	73	0,40
2007-2008	134	597	70	0,56
2008-2009	159	610	65	0,50
2009-2010	157	632	82	0,61
2010-2011	185	659	76	0,48
2011-2012	160	677	88	0,56
2012-2013	139	639	99	0,54
2013-2014	104	567		

Table: Number of freshmen, of all the students enrolled in the first level degree and of the graduate for the academic years from 2003-2004 to 2013-2014. The number of graduate for the current academic year is not reported as the exams will terminate next February The ratio is the number of graduate with respect to the students which enrolled two years before.

Returning to the local data, reporting them on a graph, it results that the ratio has two different temporal behaviors: from the academic year 2005/2006, till the a.y. 2009-2010, the slope of the regression line is positive, showing an increasing efficiency of the system (as long as the above mentioned ratio can be assumed as a measure of it), whilst in the following years the same slope becomes negative. Similar data were obtained in other courses. The data must be analyzed more critically, because they could be affected by other factors. but in any case they warn about the need of improving the efficiency of teaching.
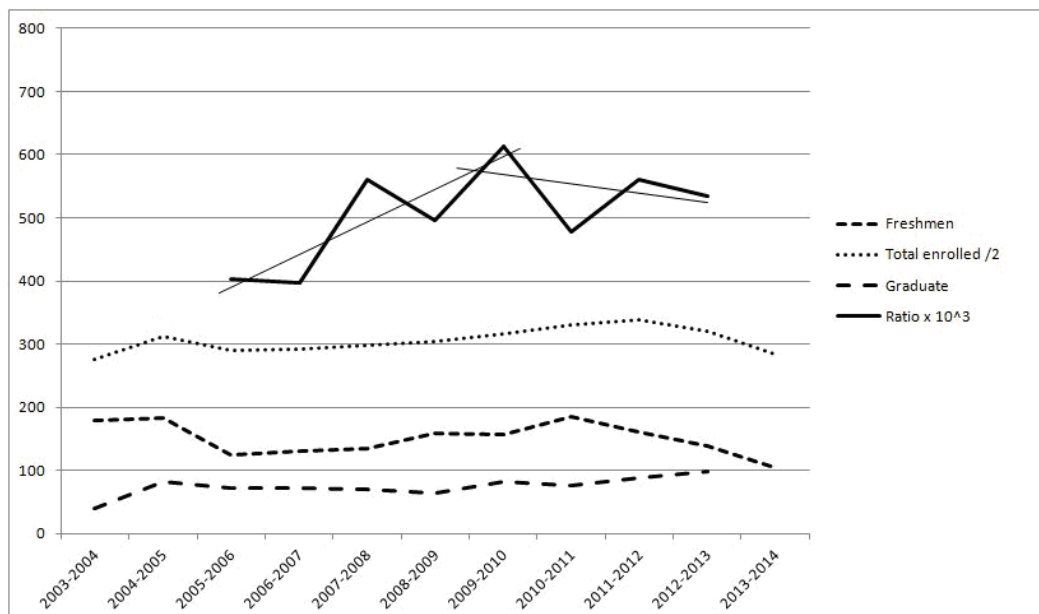

Figure: the graphs represent the data reported in the table. The ratio (above) is defined as in the table caption. Two regression lines are drawn for the periods 2005-2010 and 2010-2013 respectively, showing two different tendencies.

THE ACTION

The quality of teaching, the efficiency of the organization and the satisfaction of the students is a constant concern at the University of Perugia. As data similar to the ones shown above were observed in various courses, some actions were devised and implemented to face what could possibly be a decrease in the performance of the system.

- The number of monitored courses raised to nearly 90% in the a.y. 2011/2012, a 5% higher than in the previous year. The monitoring concerns indicators which measure the degree of achievement of the objectives of teaching at the level of individual structures.
- The University decided to appoint the Joint Teachers/Student Committees, that are established in every course, to perform an analysis of the issues / observations / considerations more directly related to the experience of students, who are the first recipients of the services of the University. This was performed examining the data relating to the recognition of students' opinions.

From this analysis, some particular actions were performed in the BS degree in mechanical engineering:

- A first measure consists of a careful analysis and evaluation, in particular, of the classes that are the most critical. This work has already been started during the academic year. 2012-2013, and will be further developed.
- A second proposal seeks to address the other most critical element found from the students' evaluation: their consideration that the workload is too heavy. This examination goes hand in hand with the need for a better organization of the classes.
- To address these two aspects of the proposal a process of examination and re-definition of the overall degree programs and classes has been started. This review should aim at the optimization of the various programs to a better synchronization, in order to reduce the workload for the student without compromising the quality and quantity of teaching.

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