



Assessment Activities in Mechanics: How Many of Them Are Enough?

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Abstract

This paper presents the results of a set of continuous assessment activities undertaken in the subjects of Theory of Mechanics and Mechanisms, in order to analyze if the amount of the assessment activities performed during the course, their level and the method to perform them have influence on the student's subject failure. During five academic years, the evaluation system have changed the amount and form of assessment tasks done along the course, or in many cases just simplifying them. The results point out that as higher is the perception of amount of work that students have, higher is the success of the students in the subject. Noticeably, the decrease in the number of assessment activities increases the subject dropout. Equally, the recurrence of the assessment model during two consecutive semesters may be the cause of lack of motivation that some students show, principally, those students that repeat the subjects. To reduce the level of failure in Mechanics and last minute poor delivered exercises, instead to reduce or eliminate the assessment tasks, we are performing, for this 2016-17 academic year, a new way to do the assessment activities based on Agile Methodology. Consequently, we present the results of this methodology for only one subject.

1. Introduction

The content of the subjects of Mechanics and Theory of Mechanisms I and II (MTMI and MTMII) develop knowledge, skills and abilities indispensable for the professional future of the students, as statics, kinematics and dynamics of machines and mechanisms. Thus, the professor must be sure that the student acquired, assimilated and put into practice the knowledge developed in these subjects. At the website of the University Rovira i Virgili (etseq.urv.cat) one may consult the curricula of the bachelor degree in Mechanical Engineering (ME). The need to rely on a method of subject evaluation that guarantees the gradual assimilation of ME knowledge by the students, made us perform evaluation activities based on solving problems in the classroom and through virtual platforms (moodle.urv.cat). However, when preparing new tasks, the professor should be able to give a fair assessment of these activities, so that the students perceived that the time spend resolving each task is in agreement with the mark received. In addition, they should ask themselves whether these tasks would produce on the students the opposed reaction that the professor wants to obtain: instead of increases the curiosity of the student for the subject through new activities, the number and level of them will produce the students' indifference, and in some cases, the abandonment of the subject by them.

The purpose of this paper is to show the relation between the amount of the assessment activities performed during the course, their level and the method to perform them and the student's failure in the subjects of Theory of Mechanics and Mechanisms, and during six academic years (AY). Moreover, this paper proposes a new methodology to do the assessment activities in order to reduce the level of failure in Mechanics.

2. Analysis of the previous Methodologies

The first edition of both subjects (2011-2012), the tasks included in the assessment of each subject were of two types. The first, called "delivery problems (DP)", were developed in class and in pairs of students, every two weeks. At the end of the class, each pair of students give the problem solved to the professor. The professor returns to the student the problem evaluated in the subsequent session of DP, ensuring the effectiveness of the academic information exchange between teacher and student. In this way, every two weeks the teacher is aware of the level of knowledge acquired by their students and at the same time, it allows students to rearrange their dedication to the subjects as their truly

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know their advance in the subject. There were six DP in each subject. They had a weight of 10% on the final grade per subject.

The second type of task included in the assessment were problems similar to DP but resolved at home and delivered via Moodle platform (MP). In total, each student did four to six problems per subject. The assessment was of 10% of the final grade per subject.

The aim of the MP and DP is the student can learn statics, kinematics and dynamics in a practical way. In addition to the DP and MP, the students did two exams (65% each) and one test (15%) per subject. All these activities composed the assessment of the students in order to obtain the final mark per subject.

Meanwhile the level and the number of DP remain equal through the last six AYs, the MP tasks changed AY after AY.

In 2012-13 AY, we created a network of cooperative learning (CL) [1] to replace the MP done in 2011-12 AY. This CL proposed to the student activities that were very different to DP tasks. These had to be delivered on certain dates exclusively via Moodle and had to be set on by combining analytical calculus and simulation programs (WinMecC, [2]).

Besides the good results obtained with DP and CL tasks in 2012-13 AC, these CL tasks changed for the 2013-14 AY, due to the students complains. We proposed again four MP tasks to solve by WinMecC instead to do the CL ones.

In 2014-2015 AY, the number of students raised up to 80, which made us rethink the number of problems to evaluate. The number of MP was reduced to two problems for MTMI and one problem for MTMII. However, the weight within the student's mark remained the same. In 2015-16 AY, and for MTMI, we chose to repeat the MP tasks done in 2014-15 AY. For MTMII, the MP was the same that those performed during 2012-13 AY. We think that the level of the MP and DP asked to the students in this 2015-16 AY were the lowest of all AYs.

2.1. Results

Figure 1 shows the results of the introduction of MP and DP for MTM I. As you can see, the best rates of all AYs are for the 2012-13 AY (red column): the number of students that passed MTMI subject (71.43%) increased respect to the 2011-12 AY and no students dropped-out the subject. However, as a paradox, the perception of the students in front of the subject workload (Figure 2), had the worst results of all AY. As the MP tasks were simplified through AYs, specially, in the 2014-15 and 2015-16 AYs, the perception of the students in front of the subject workload became better. However, the drop-out ratio increased up to 8.3% (2014-15).

We analyze the results of MTM II (see Figures 3 and 4). You should consider the MTM II students already know the dynamics of the MTMII subject: the way we work is equal to MTMI. The high rate of subject failure and drop-out done in 2011-12, slightly decreased in 2012-13, with the introduction of the CL. Moreover, in this 2012-13, the participation in the MP and DP tasks increased near of 12% respect to 2011-12. In relation to the workload student perception (Figure 4), this 2012-13 AY, as occurs with MTM I, was again, the worst of all AY. Therefore, we can say that the CL method in MTM II have not had the same success than in MTMI subject.

The number of MP were reduced in 2013-14 AY, obtaining better MP participation, the perception of the student was more positive, along with an increase in the subject success. We reduced again the number of MP tasks in 2014-15 and 2015-16 AY, however, we obtained the worst results of all these five AYs (see Fig. 3). A high level of subject drop-out occurred along with a negative perception of the workload. We should say that the students did in 2015-16 the same MP than in 2013-14 course.

Therefore, the following consideration on these results is necessary to do. Is it better to push in excess the students with many tasks but, do not have subject drop-out? Alternatively, is it better to decrease the number of MP and DP tasks and assuming a high number of subject drop-out but receiving lower student complains?

3. Agile project for MTMI and MTMII

The proposal for this 2016-17 AY is to reduce the number of drop-out in both subjects by change the different MP for a single project that holds both subjects and with a weight of 20% in the evaluation system. The aim of the project is to learn statics, kinematics and dynamics for a mechanism of a degree of freedom. However, the methodology to perform this project will be very different of



everything that we done in MTMI and MTMII during these years. This project will be done under the so-called Agile methodology [3].

With the Agile project, we hope to increase the student motivation, especially in MTMII, and, make the learning task more attractive for the student as for the professor. The Agile is based on principles of collaboration between students, adaptability and non-stop improvement of the work done. Its objective is to deliver a product to a client at the end of the course. However, the product has to do in successive steps through both semesters. Each step is called Sprint. The Sprint duration is two weeks and it has a list of tasks to do. At the end of each Sprint, each team shows its product increase achieved during this period. Additionally, the team has to facilitate the activities that they have done to perform the Sprint, specifying who has done each task. This methodology, thus, requires continuous work of the team. In addition, the students will do five DP and two exams.

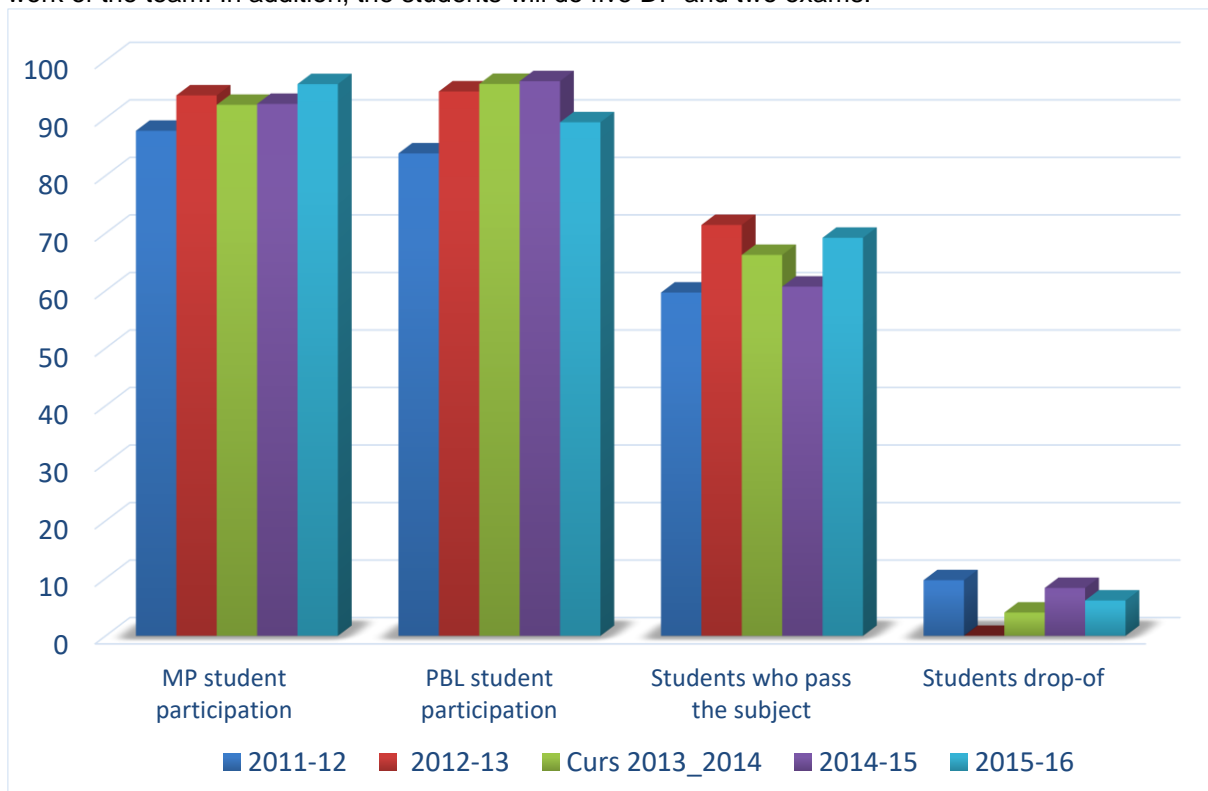


Fig 1. MTM I results.

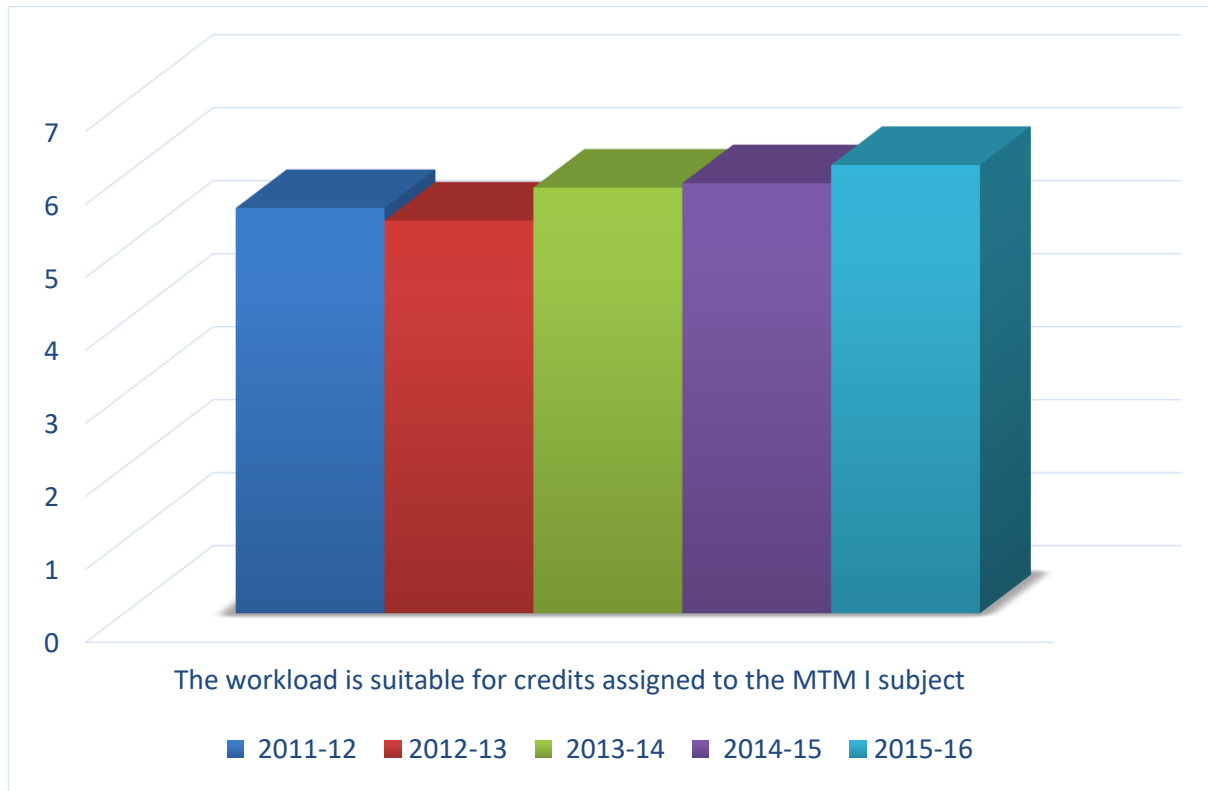


Fig 2. Students' perception of the subject workload (7, strongly agree; 1, totally disagree).

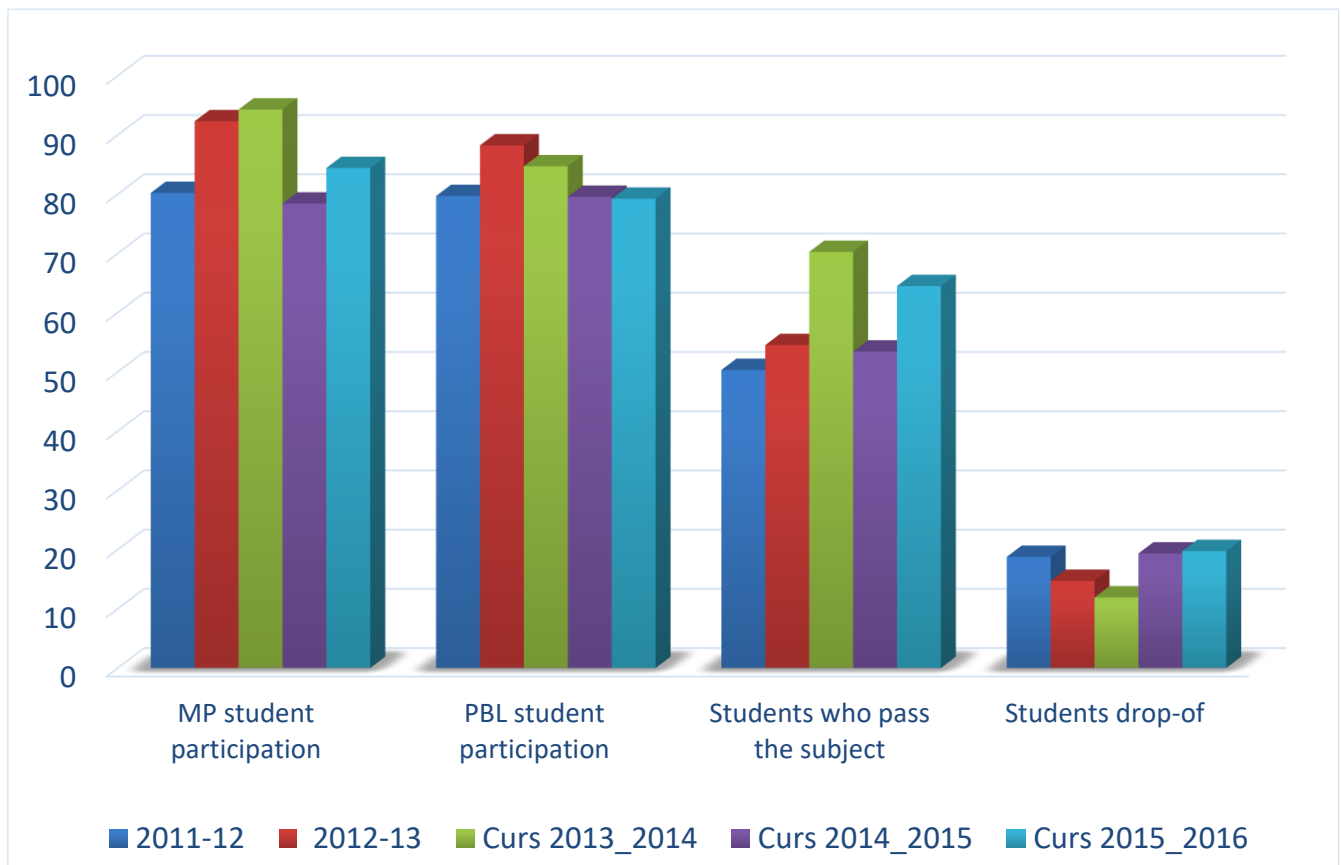




Fig 3. MTM II results.

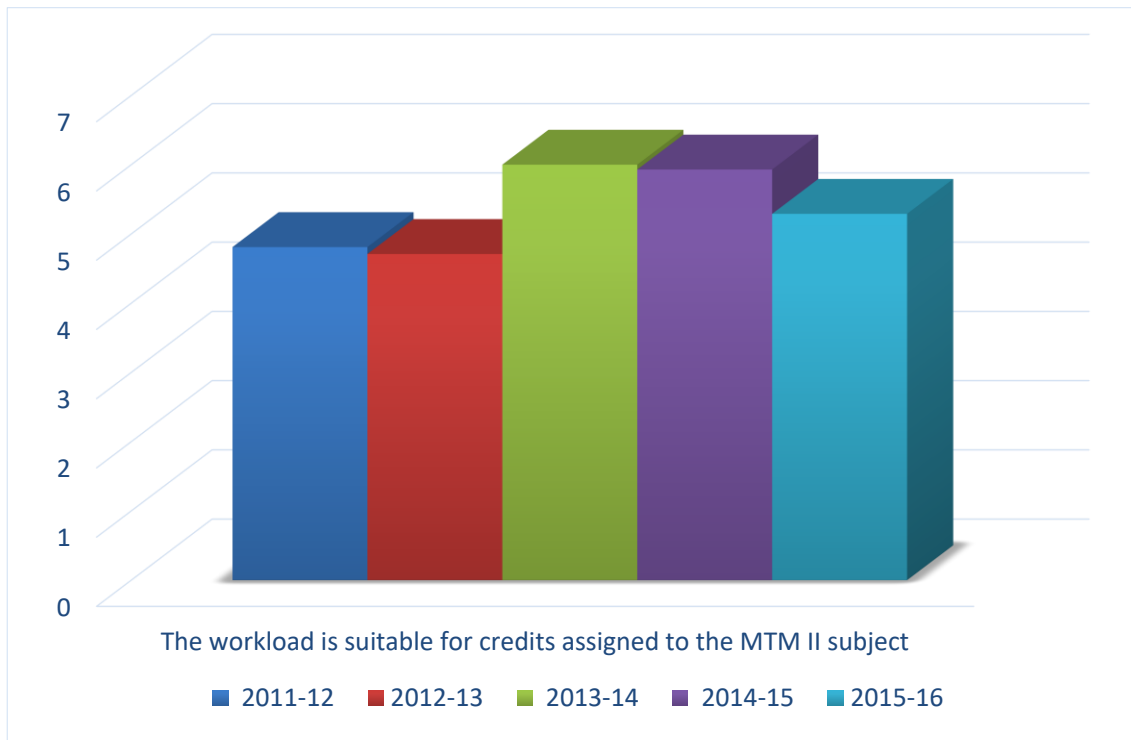


Fig 4. Students' perception of the subject workload.

Table 1 show the results for MTM I:

Participation In tasks for 2016-17	No-show students for the first test done in the middle of the semester		Students that DID not pass the first test done in the middle of the semester	Drop-out students	Students that pass the subject
Participation in Agile project	2011-12	8	62.9	9.7	59.7
100%	2012-13	0	55.1	0	71.4
	2013-14	1.3	55.4	4.05	66.2
Participation in delivery problems	2014-15	1.2	69	8.3	60.7
96.1%	2015-16	0%	71.2	6.2	69,2
	2016-17	1.5	55.4	4.7	73.5

Table 1. Results to apply Agile project in MTM I

4. Conclusions

Comparing the two subjects and the results in Figs 1 to 4, we have the following:

- MTMII subject has a higher ratio of students drop-out than MTMI: as well as MTMI never reaches a ratio higher than 10%, for MTMII and for all AYs, this ratio always exceed the 9% ((2013-14 AY), with a maximum of 20% (2015-16 AC).
- The rate of participation in MP and DP tasks always decreases for MTMII, where the number of failure students is notable. Activities that are currently in both subjects seems to help to this result. Is it possible that the student suffer a certain type of fatigue?



- The incorporation of MP and DP activities has been carried out with high levels of participation, but it does not mean that students are more motivated for the subjects or are excited to have more work to do.

About the results exposed in table 1, we can say that the influence of the Agile project in the marks of the MTMI subject seems clear because we have reduced the level of failure for the mid semester test, having similar results to the 2012-13 and 2013-14 AY. In addition, the DP participation is the highest of all these six AYs. Moreover, we reduced the subject drop-out and finally we increased considerably the number of students that pass the subject.

Therefore, we think that not only it is important the number and type of activities, but also the way to perform them! We highly recommend Agile as a way to do assessment activities in Mechanics.

However, we should wait for the Agile results next semester in MTMII.

References

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