Influence of assessment frequency on final exam results

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Introduction

In the first year of every engineering course, mathematics and physics subjects are a substantial part of the curriculum. Looking at the engineering courses given at the University of Minho, around 53% of the credit units a student has to do in the first year consists of mathematics and physics subjects. Every first year engineering student starts with Physics I and II and at the same time Calculus I and II (Análise Matemática in Portuguese) and Linear Algebra. These subjects are the core curriculum for the first year of the engineering courses. They provide a foundation for the knowledge and skills that the student acquires during the rest of the course. Bad results on these subjects can cause many problems for the students later on in their course. When a student faces difficulties with mathematics and physics subjects, problems with other subjects are inevitable. Bad results on some of the first year mathematics subjects caused alarm at the courses of the Engineering Council of the University of Minho in Guimarães. Análise Matemática I is the first mathematics subject for every engineering student. The success rate of Análise Matemática I in 1997/98 varied from 13 to 25% in the different engineering courses, looking at the number of students that is registered for the subject. This is far below the desired success rate, which should be at least around 60%. The bad results cause problems like overcrowded classroom, overcrowded exam rooms, not enough teachers and serious delays in the progress of students.

A study was done to find possible causes of the bad results. This study indicated that there were several reasons for the bad results. In the first place, the number of students who attend the compulsory tutorials is low. Secondly, the number of students who actually appear at the exam compared to the total number of registered students is far below 80%. Finally, students who do not attend the exam in the first year in the first exam period tend to postpone the exam for at least a year, though many postpone the exam till their very last year. Students who postpone the exam till

the fourth or fifth year of their course are normally completely out of touch with the content of the subject and have to make much more effort in studying than a first year student.

Project

A project was started in the first semester at Polymer Engineering to improve the results and to decrease the enormous number of students who are not in their first year anymore, but who still have to pass the exam. The main goal of the problem was to accomplish that the students who had to do Análise Matemática I, were actively involved in the subject from the beginning till the end. According to Biggs & Moore (1993), task involvement depends on both the expectation of success a student has, as well as the value of what they are doing. "If students do not value the succeeding in the task in question, or do not expect to be successful however much they might want to succeed, then they will not be motivated to handle the task" (p. 258). Both the expectations about their success and the value of the task were low in this case. Many students did not expect to pass the exam in their first or their second year, so they postponed the exam several times. Some were told by older students that is was an almost impossible exam to do, others gave up trying the exam after their first years, when they had experienced that it was a difficult subject. The supposed value of the subject was low. Due to the selection system in Portugal, a vast amount of students is not studying the course of his or her own first choice. Furthermore, they do not see the importance of the subject for the rest of their course. The students are in an engineering course, but have mainly mathematics and physics in the first year, which are not their main interest.

Several measures were taken to get the students' attention and to keep them involved. Firstly, the tutorials were divided in two lessons of 1h30 instead of the usual three hours. Secondly, the sequence of the topics changed and students did not start with a familiar topic anymore, but with something completely new, that they did not recognise from their secondary school. Furthermore, exercise sheets were introduced, containing a theoretical part and exercises. There was also homework that was checked every lesson. Some of the students had to hand in there homework and the lecturer would correct it. The fifth measure that was taken was an adjustment of the tutorial groups. The number of students in a group was split in halves and the groups would contain a maximum number of students from the first year, who did the subject for the first time. Unlike other tutorial groups, these groups only consisted of Polymer Engineering students and were not mixed with students from other courses. Finally, the assessment was changed. Besides the usual final

exam, three extra tests were introduced in order to keep the students active and to make sure that they continued studying during the entire semester instead of only at the end of the semester. In the last few years, there had always been one final exam at the end of the semester and no intermediate assessment.

In the second semester, Análise Matemática II for Polymer Engineering was organised in the same way as Análise Matemática I in the first semester, including all the measures mentioned above. This time, the goal was to know what would happen if frequent assessment was implemented in other courses as well. In Civil Engineering, Industrial Electronics and Production Engineering, the three tests were introduced. It was supposed that frequent assessment would contribute significantly to the improvement of the results of the final exams. It was also supposed that the division of lessons in two lessons of 1,5 hour instead of one lesson of three hours would make a big difference.

Assessment

Brown e. a. (1997) distinguish three types of purposes of assessment. In the first place assessment can have a developmental purpose, from the point of view of the student. Assessment diagnoses strengths and weaknesses of student learning, it provides feedback to improve learning, it helps to develop skills of self-assessment and it can motivate students. Secondly, assessment can have a judgmental purpose. It can be used to pass of fail a student, to select students for future courses, to grade or rank students, to predict success in future courses or to select for further employment. Assessment can also be used for development from the point of view of the teacher. It provides them with feedback about their teaching, they can use the assessment results to improve their teaching and it evaluates the course's strengths and weaknesses. In this article, the focus will be on assessment as a tool to help students. It is used as a way to give them feedback on their learning process and make them see their strengths and weaknesses during the semester and not only at the end. Entwistle and Marton (1994) point out that ways of learning are a results of the way students are assessed. A surface approach of learning is encouraged by poor feedback on the progress a student makes, by assessment methods that create anxiety, by previous experiences with the subject matter and by cynical or conflicting messages about the reward.

Race (in Knight, 1995) describes ten principles of assessment. In this situation, two of these principles are of special importance. In the first place, assessment as a mean of giving feedback to

students. In this study, assessment could help the students, some of whom had lost touch with the material years ago, to give feedback about their performance and to show them, that they actually had learnt some parts of the material. Especially the students from the later years were getting more and more insecure about their performance on the exam and their chances of passing the exam. The results of the test could show them that they were not in a hopeless situation and that they were making some progress. Another relevant principle described by Race is the appropriate assessment amount. It is important to include a feasible amount of material in the test. Although the amount of material that had always been included in the final exam, was feasible according to the lecturers and many of the students, for those who had almost given up on the subject, the amount of material was not appropriate and they thought is was far too much to study for an exam.

Method

In the first semester, frequent assessment was only applied at Polymer Engineering. 138 students were registered for Análise Matemática I and had to make three tests and a final exam. The students received at letter at the beginning of the semester to make them register for a tutorial group and attend the compulsory tutorial. The 3-hours tutorial lessons were divided in two lessons of 90 minutes. In the second semester, frequent assessment was applied at Polymer Engineering, Industrial Electronics and Apparel Engineering. It was not applied at Textile Engineering, Production Engineering and Apparel Engineering. The lessons at Polymer Engineering were still 90 minutes twice a week and at the other courses students had one tutorial of three hours. Every course used the new materials that were developed for the Polymer Engineering students.

Results

The results of the measures taken at Polymer Engineering were positive. In the first place the number of students actually appearing at the exam increased: 82% of the students appeared at either one, two or three of the test, or the exam, or at both test and exam. In the previous year, only 52% of the registered students appeared at the exam. Secondly, of all the students who did three tests and the exam, 59% passed. Table 1 shows the success rates for each course.

	1997/98	**1998/99**
Civil Engineering	25,4%	48,9%
Industrial Electronics	20,9%	32,5%
Mechanical Engineering	17,3%	28,6%
Polymer Engineering	*13,6%*	*49,6%*
Production Engineering	13,4%	17,5%
Textile Engineering	20,3%	25,0%
Apparel Engineering	23,3%	41,0%

Table 1 Percentage of students who passed Análise Matemática I in 1997/98 and 1998/99

The total pass rate of Polymer Engineering more than tripled and increased from 13,6% to 43,4%. It is likely that the three tests have played an important role in this increase. They provided the students with a reason to attend lessons on a regular basis and in that way accomplished an increase in participation in the final exam. The increases in success rates of the other courses varied from 4,1% to 23,5%, whereas the increase for Polymer Engineering was 36,0%. Looking at this result, it cannot be concluded that the tests are the main reason for the improvement of the results.

In the second semester, the frequent assessment system was continued at Polymer Engineering and implemented in Industrial Electronics and Apparel Engineering. The type of material used for Polymer Engineering in the first semester was used for all the other courses in the second semester.

	1997/98	**1998/99**
Civil Engineering	45,2%	32,7%
Industrial Electronics	*27,8%*	*32,7%*
Mechanical Engineering	35,5%	23,0%
Polymer Engineering	*23,9%*	*43,0%*
Production Engineering	30,2%	27,5%
Textile Engineering	38,4%	42,4%
Apparel Engineering	*38,7%*	*31,2%*

Table 2 Percentage of students who passed Análise Matemática II in 1997/98 and 1998/99

The success rates of the second semester for Análise Matemática II are shown in table 2. Polymer Engineering made again the largest increase of success rates. In 1997/98 23,9% of the students passed the exam, whereas in 1998/99 43,0% passed. The other courses either had a decrease in results or a slight increase.

The frequent assessment system was implemented in Industrial Electronics and Apparel Engineering. The success rate of Industrial Electronics only had a small increase of about 5%. The success rate of Apparel Engineering decreased with 7,5% to 31,2%.

Conclusions

It was supposed that the frequent assessment system on its own would contribute to the increase of success rates. Looking at the results of the first semester of Análise Matemática I and comparing these with the results of the second semester of Análise Matemática II, it must be concluded that frequent assessment on its own is not sufficient to involve students actively in their course. In Análise Matemática I for Polymer Engineering, a number of measures was taken to improve the success rates. Together, these measures helped to improve the results. Implementing only part of the system has not worked properly for the second semester. It did work for Polymer Engineering, but this is likely to be a result of the different way of working the students had learned in the first semester and adapted in the second. The Polymer Engineering students were already more involved in their mathematics subjects than the students of other courses were. When the Polymer students started the second semester, many of them knew that if they would make an effort, they would be able to pass the exam, whereas students of other courses were less confident about their exam performance.

To improve the results of engineering students in mathematics, especially when they are not intrinsically motivated for the subject, it is necessary to take different kind of measures. In the first place, something has to be done to catch the attention of the students and get them involved. In Análise Matemática I, a letter was sent to their home addresses to tell them that it was compulsory this year to attend lessons and that they had to register for a tutorial group. This made the number of students attending lessons much higher than the year before. Secondly, one has to keep them involved in the subject and gain their interest. Smaller classes, shorter and more effective tutorials

with more attention of the teacher kept them involved. Thirdly, it is necessary that the students keep studying. The frequent assessment system kept them studying during the semester. Separating these measures and only implementing the frequent assessment, meant that students who were not yet involved in the subject were confronted with a system that wanted to make them study, although they were not really in touch with the content of the subject. Frequent assessment as a means to improve results cannot work on its own, but needs to be accompanied by other measures to involve students with the subject.

In the academic year 1999/2000, students have to register for a tutorial right at the enrolment for their course. Furthermore, the tutorial for each mathematics subject in the first year takes 90 minutes instead of the usual three hours.

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