

## ASSESSMENT OF STUDENT BASED LEARNING APPROACH IN BIOMATERIAL SCIENCES

A.C. Queiroz\*

ESEIG – IPP, Escola Superior de Estudos Industriais e de Gestão, Instituto Politécnico do Porto

**Abstract:** Student based learning (SBL) brought up new challenges to both students and teachers. A new approach to this methodology is being made in a biomaterials unit of biomedical engineering.

Over the years, traditional lectures were replaced by controlled small assignments. Topics and respective references are given to students. A web based platform (moodle) is an essential tool in this method since all the assignments, information and students' questions may be posted online.

Students are encouraged to search for more information on scientific search engines and engineering specific libraries.

The learning process is achieved by discussion and brainstorming in the classrooms.

Due to an evaluation system based on specific tasks and exams, one of the major drawbacks was the difficulty that students showed in understanding how the evaluation would occur. Though they had specific assignments, 50% of the evaluation was based in process learning.

Huge difficulties have been overcome by a trial and error process that leads to a smoother learning process.

The approval rate of the students that fulfilled the learning process was very high from the start, nevertheless problems with understanding the evaluation have decreased and the self learning and the students' autonomy is achieved at an earlier stage, also, the overall assignments quality has improved.

An assessment of the last three years of the implementation of this new teaching methodology is presented, pros and cons are evaluated and the methodology evolution is described.

This new methodology has proven to be effective because the students' interest, answered questions and "passion" for the biomaterials unit has been increasing over the years. Nevertheless this is an evolving methodology, much like the (biomaterials) area itself, and new and better routes will be found.

*Keywords: biomaterials, engineering education, student-based learning.*

*\*Correspondence to: AC Queiroz, ESEIG, R. D. Sancho I, 981, 4480 Vila do Conde, Portugal.  
E-mail: aqueiroz@eu.ipp.pt*

## 1. INTRODUCTION

As Biomedical engineering is a new degree, post-Bologna, created in Escola Superior de Estudos Industriais e de Gestão (ESEIG) only in 2006-2007, the Bologna paradigms (Bergen Communique, 2005; Bresciani, 2006; Hubball and Burt, 2004; Hubball and Gold, 2007) are applied in different ways. In fact, in the Biomaterials course there was never a teacher-based learning, nevertheless changes are occurring each year.

In student-based learning several approaches may be made ranging from self-evaluation, student-based research, teacher-based research, and other simpler methods such as simple assignments and worksheets to perform a continuous evaluation.

The Bologna paradigms affected not only the students but, and probably mostly, the teachers, once they were used to a teacher centred methodology. Thus, the fact that this degree was created in a so called post-bologna spirit does not necessary mean that teaching is actually 100% student-based, and in fact is far from that. Student-based learning takes more effort from the teacher and the effective teaching hours did not change towards this new time consuming way of teaching. Also, teachers are expected to be always available as new technologies like MSN, Facebook and other social networks are ready to be used.

Even though the degree is relatively recent, first year students enrolling in the degree have a 12 year handicap of an undergraduate teacher-based educational system. In fact, students are neither prepared nor motivated for single student-based learning.

Because of an increased pressure in the undergraduate educational system to produce results both in terms of grades and success rates, students show a more immature behaviour, lower knowledge and, overall, have a different (less positive) attitude towards university. This reflects in a more passive behaviour, lack of autonomy, lower self-confidence, but also no oral presentation, group organisation or debate skills.

The Biomedical Engineering degree in ESEIG had its first edition in October of 2006. As this is a wide spectra degree comprising areas of interest such as biology, medicine, materials science, electronics among others, it was developed in close collaboration with the Escola Superior de Tecnologias da Saúde do Porto (ESTSP). The degree's main goal was to educate biomedical engineers with a good background in medical machines to work in both maintenance and development.

As the biomedical engineering, biomaterials itself is a wide spectra course, where students have to have a previous knowledge in anatomy, physiology and be able to relate this matters to materials science and engineering.

## 2. CASE STUDY

The biomaterials course comprises the understanding of biomaterials properties and its influence in their applications, to understand and correctly apply the specific language of the biomaterials field and to describe the importance of the properties for the chosen application applying the acquired knowledge.

In order to accomplish the course's learning outcomes several approaches have been made and will be described and assessed.

### 1.1 Study group

The assessment will be presented for the last three years, even though the final results for the last year will only be available in July of 2010.

The student distribution is shown in table 1.

Students	2007/2008		2008/2009		2009/2010	
	1 <sup>st</sup> time enrolment	2 <sup>nd</sup> time enrolment	1 <sup>st</sup> time enrolment	2 <sup>nd</sup> time enrolment	1 <sup>st</sup> time enrolment	2 <sup>nd</sup> time enrolment
Female	9	- - -	10	1	15	- - -
Male	10	- - -	3	2	4	4
Total	19	- - -	13	3	19	4

**Table 1 - Study group distribution.**

Students' distribution evolved from the first year to the last being that the number of female students has clearly increased. It has also to be noticed that this last year has more enrolled students than in previous years, even though the number of first year enrolled students has been the same for the three years.

### 1.2. Methodology and Learning outcomes

The expected learning outcomes in the biomaterials module are:

- To be able to recognize and select biomaterials for specific applications.
- To understand biomaterials properties and its influence in their applications.
- To comprise the specific language of biomaterials field.
- To be able to describe by order of importance the main properties of a chosen application.
- To know the principal biomaterials references.
- To apply the acquired knowledge.

The methodology is student-based learning and the evaluation is supported in one major assignment and one project. Even though the support evaluation has been maintained there have been several changes in the way that both assignment and project have been undertaken over the three years, as follows:

1. On the first year, an interdisciplinary project based on a specific medical device was proposed involving all 2<sup>nd</sup> year courses. For Biomaterials the aim of this project was to learn about different medical devices, different biomaterials applications and corresponding interactions.

The results of this project were of difficult assessment and the learning outcomes were below the expectations. The references used were mainly internet based and the critical analysis to the device almost didn't exist.

The duration of the project, which was of two semesters (probably too long), and the involvement of many areas of expertise led the students to loose focus and lost themselves in the

extended amount of information they had gathered, and in fact they only started to have direct questions by the beginning of the 2<sup>nd</sup> semester. Furthermore, it was difficult to keep track of how the project was developing since the students approach to the teachers was extremely compartmented and they offered resistance to throw all that work behind them and start over, even when it was explained that they would fulfil the learning outcomes.

2. On the second year, the project involved only two courses, Biomaterials and Electromagnetism, the duration was of one semester and the expected learning outcomes were approximately the same. The project theme was different for each group, having different biomedical devices to study. The themes were chosen to be different than the ones of the previous year.

The results were easier to assess since a lot of constraints were drawn at the beginning of the project. This led to a more focused approach from the students and a more effective supervision from the involved teachers. In this project the learning outcomes were clearly overcome by most of the students, leaving only the scientific compliance and the actual critical analysis of the device behind.

In the first two years, several biomaterials were presented and sorted by each group as an assignment. The groups were expected to understand the field of applications of a specific biomaterial and be able to relate the biomaterial to the host location. In fact, the learning outcomes were completely shattered since most of the groups weren't able to research in trustworthy publications and shown little knowledge of the biomaterial and its field. Furthermore, their analysis was neither critical nor scientific. Nevertheless, the second year learning outcomes clearly surpassed the first year ones.

3. Although, last year project had surpassed initial expectations due to course rearrangements, this year the project is course specific, although with similar expectations, it has to be noticed that this year the project has only a semester duration and some adjustments are being made. And new and smaller assignment was given in order to overcome these problems. The assignment in the current year is a "review" article of one of three themes. This way the students are expected to, at the very least, learn how to search in the scientific field using scientific databases, articles and reference books. In fact the results were extremely positive. The students had to work hard to use scientific literature, but the most important thing was they effectively recognized that it was a good effort that was asked.

The main theme is the same for all groups and within this theme the groups have to choose different applications and/or devices.

The learning outcomes expected from the assignment were that students learnt how to research in and about the biomaterials field in trustworthy publication.

In the first year since the expected learning outcomes weren't achieved with both the assignment and the project, the students' knowledge on the biomaterials field was lower than expected in most cases.

To overcome this, in the second year, the evaluation comprised worksheets which were randomly given during classes in order to ensure that the students have wider range knowledge on the biomaterials field and don't just learn about the specific themes of both assignment and project.

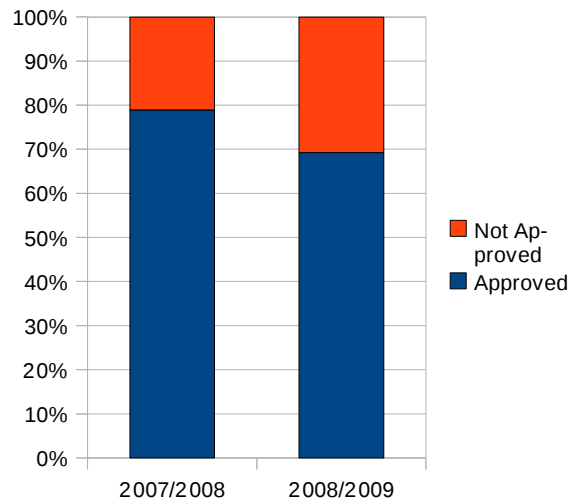
Still, this was found to be insufficient and this year, in addition to worksheets, a percentage of the final grade is evaluated by simple tests.

### 3. RESULTS AND DISCUSSION

The results of first year reflected a hard working group of students with a high percentage of approved students but grades lower than expected.

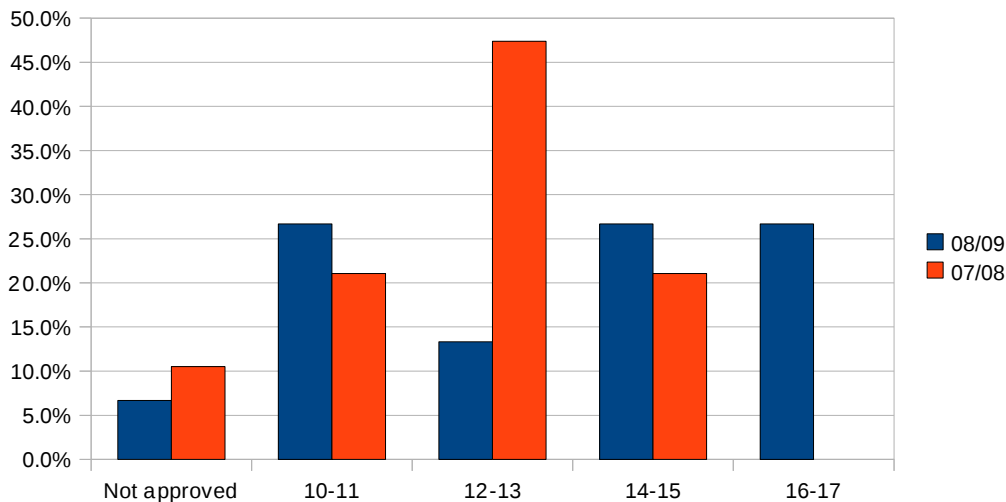
The increase number of not approved students in the second year was a direct consequence of a more demanding evaluation combined with more supervised assignments.

Comparison of the approved and not approved ratios is shown in figure 1.

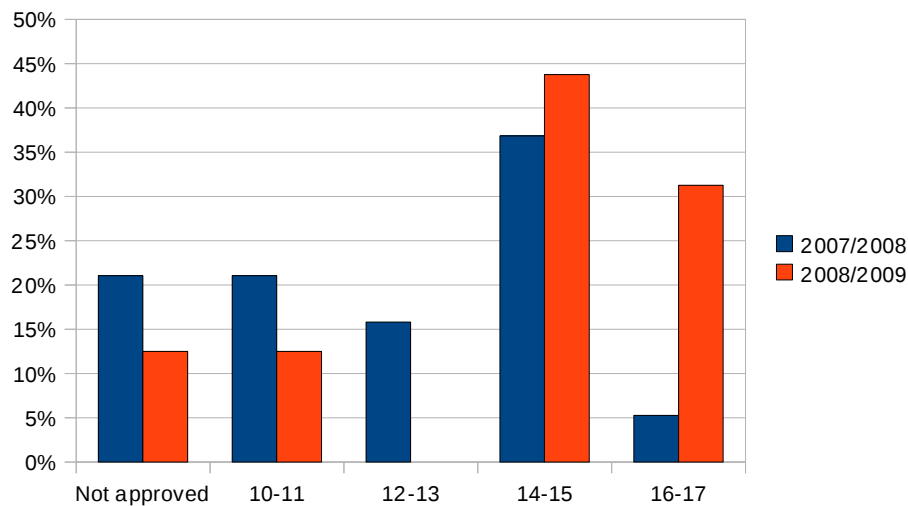


**Figure 1 – Comparison of the approved and not approved ratio in the first 2 years.**

To be noticed that the quality of both project and assignment were improved. This is shown clearly by the overall improvement in the grades in both project and assignment (Figure 2 and 3).



**Figure 2 – Project grading in the first two years.**



**Figure 3 – Assignment grading in the first two years.**

#### 4. CONCLUSIONS

The evolution of the evaluations methodologies are clearly indicating that the students are effectively learning more, even though the percentage of students failing the course has increased.

It is also noticed, and although this is unrated that the enthusiasm and dedication of the students to the course was higher in the second year than in the first year and is expected to rise over the following years.

The expectations are high in what concerns this years' evaluation since better and better results in terms of learning outcomes are being achieved and students are showing increase knowledge in the biomaterials field.

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