ENGINEERING STUDENTS' PERSPECTIVE ON THEIR LEARNING EXPERIENCE IN HIGHER EDUCATION: FINDINGS FROM A PILOT STUDY

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Abstract

Understanding the ways in which students at higher education live and assess their learning experiences is a key issue in improving the education and development opportunities provided to them, especially in times of change and challenge. This work draws upon data taken from broader and ongoing research project aimed to investigating engineering students' perspectives on teaching and learning in higher education. Data were colleted through questionnaires administrated at the end of the semester in module 'Biomechanics' (45 hours per semester). The questionnaire included the following dimensions: motivation for entering an engineering degree, teaching methods, assessment procedures, teacher's performance, classroom climate, content, timetable, resources and equipment. Preliminary findings suggest that, by and large, students enjoyed both the diversity of the learning activities and content of the module. They also highlighted the key importance of the teacher/student relationship. However, issues such as intrinsic motivation, student participation in defining assessment procedures and the available resources (including time) and equipment emerged in explaining both similarities and differences in students' responses. These will be discussed further in the paper.

Keywords: Mechanical Engineering, Education, Bologna Declaration.

1. Introduction

The traditional approach of teaching based on 'chalk and talk' style attempts to transmit knowledge from teachers to a passive recipient. However, during the last years, there is a growing awareness among engineering educators that while this style of instruction is suitable for teaching engineering analysis, it has some limitations when it comes to nurturing creativity, synthesis and engineering design, where different possible solutions have to be tested (Akay, 2002, Lima et al. 2007, Teixeira et al., 2007). Thus, it is essential to combine teaching by lectures and active learning techniques in order to have high motivation and participation of the students and, consequently, to reach better understanding of the issues taught. It is well known that over the last few years a number of research works on the subject of teaching and learning at higher education have been developed and presented (De Graaff and Christensen, 2004). Issues like new modules, new curriculum structure, active learning, and student independent work, cooperative learning (as is the case of Project-led education) became key features in this process. Along with this is the discussion of what should be done in terms of teaching and learning, assessment, development of competencies/skills (technical and soft) within the view of lifelong learning in the context of higher education (Hedberg 2003, Heitmann 2005).

High levels of education have been identified as prime factors necessary for sustained development. This desideratum is essential for the improvement of life conditions and safety of the Portuguese society, which should approach those of other European Union countries. The European Union has defined goals that intend to ensure that the European space becomes more competitive and improve the capability of economic and social development. Innovation and Knowledge were identified as the supporting pillars for this process and the driving force for its implementation (Akay, 2003, De Graaff and Christensen, 2004). The University, as a centre for knowledge creation and for promoting the knowledge chain, assumes a central role in the implementation of those objectives.

In a rapidly evolving society it is naturally expected a deep change in the demand of Engineering skills. Any restructuring of an Engineering curriculum must take into account the correlation between society, engineering competencies and the changing paradigm of engineering education. The globalization and the development of information society play a crucial role in the thought on the "Engineers of Tomorrow". Globalization challenges engineering students from all over the world to prepare themselves for work in a culturally diverse environment where they will encounter others who define and solve problems in a different way. The future engineer must be able to work in international project groups with multidisciplinary and cross-cultural participation. During their studies the students must be given the opportunity to apply their acquired skills, to develop a deeper insight into technical subjects and to integrate them through work. Thus, understanding the ways in which students at higher education live and assess their learning experiences is a key issue in improving the education and development opportunities provided to them, especially in times of change and challenge. Engineering programs are under restructuring according to the so-called Bologna Process in Europe (Hedberg 2003, Heitmann 2005, Teixeira et al., 2007). This work draws upon data taken from broader and ongoing research project aimed to investigating engineering students' perspectives on teaching and learning in higher education. Preliminary findings suggest that, by and large, students enjoyed both the diversity of the learning activities and content of the module.

2. Methodology

The goals of the study reported in this paper were twofold: to analyze the perceptions of students in relation to their opinions about the Biomechanics subject, and to discuss the implications of these for improving teaching/learning process, in particular the teacher and student's role. A questionnaire was designed including both closed and open-ended questions. The questionnaires were administrated at the end of the semester in module Biomechanics (45 hours/semester), which is included in the fourth year of the curriculum of the Biomedical Engineering course offered at the University of Minho. Different levels of information were included in the questionnaire, namely: (i) motivation for entering an engineering degree; (ii) teaching methods (iii) assessment procedures; (iv) teacher's performance; (v) classroom climate; (vi) content; (vii) timetable.

The process of qualitative data analysis (open-ended questions) was undertaken according to a comparative or horizontal analysis (Miles and Huberman 1994). Quantitative data were analyzed statistically with the use of SPSS software. All the students of module Biomechanics (18 in total) participate in this study. The involvement in this study was not compulsory for students. The sample of the research can be described as follows. A total of 55.6% are female and 44.4% male. The average age is 21.4 years. Figures 1 and 2 show the results obtained from the students relative to the gender and age, respectively.

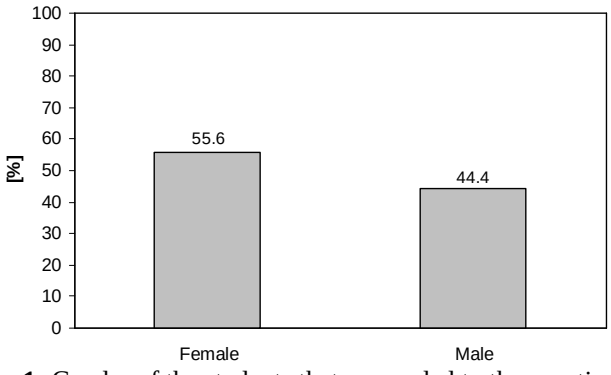

Figure.1: Gender of the students that responded to the questionnaire.

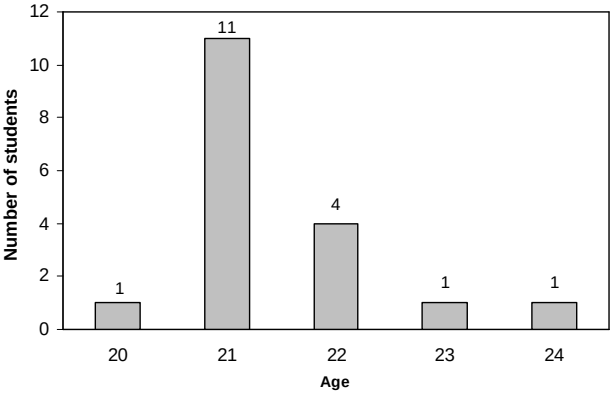

Figure.2: Age of the students that responded to the questionnaire.

3. Findings

In this section some of the main results and opinions from students relative to the topics included in the questionnaire are presented and discussed. From the data collected, it is possible to know that for the large majority of the respondents (77.8%) students was the first choice in terms of career when applying at a post at University, see figure 3. This is also the case of the University of Minho, which was the first choice for 88.9% of the respondents, as it illustrated in figure 4.

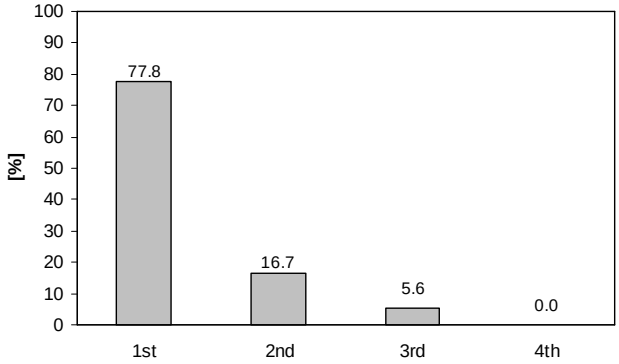

Figure.3: Option for choosing Biomedical Engineering course when entering at the university for the first time.

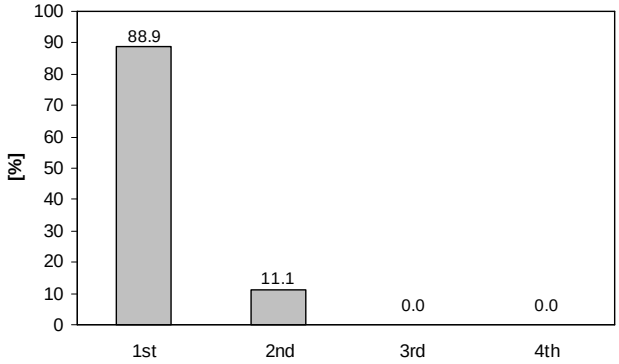

Figure.4: Option for choosing the University of Minho.

The large majority of the participants in the study (70.6%) revealed that the course has met their expectations (see figure 5). They emphasized the following issues for this: good preparation to face future work/profession; being broad enough in terms of knowledge and competencies; practical component and curricular organization adequate; lecturers' professionalism. Yet, 29.4% stated that the course did not meet their expectations and they highlighted the following issues: being too theoretical; the lack of liaison between University and industry; poor preparation to the labour market; lack of articulation and inadequate curricular organization, and lack of support, and poor pedagogical preparation from some teachers/lecturers. The following quotations are illustrative of this:

"*Because I have few expectations to get a job.*"
"*Although I like the course, there is a lot of confusing things …*"
"*The course offers a medium-low formation.*"

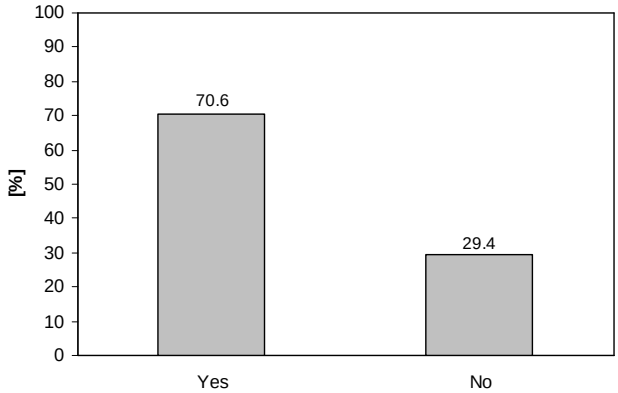

Figure.5: Does the Biomedical Engineering course correspond to the initial expectations.

In the present study, the respondents also identified a number of issues related to their experience in the Biomechanics subject, in relation to which they feel more or less satisfied. Concerning with the stimulation during the classes, 66.6% of them considered that the classes are intellectually stimulants. When asked about if the students learn something in the Biomechanics subject, 88.9% answer that they are satisfied. In line with this, 88.9% of the respondents are satisfied or completely satisfied with the pledge in the preparation and organization of the classes demonstrated by teacher. 77.70% of the students stay that they understood the subjects taught in Biomechanics. Finally, 72.2% think that the rhythm in classes was adequate. Figures 6 through 10 show these opinions.

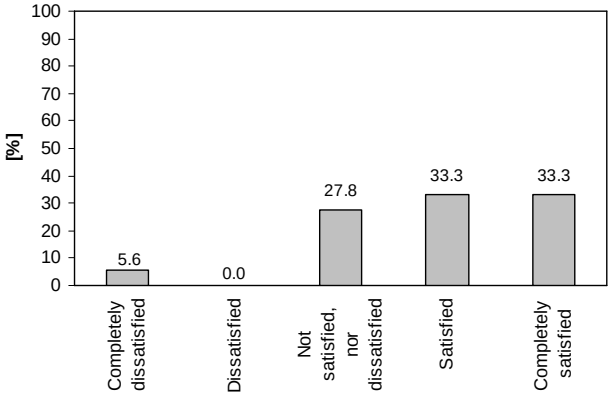

Figure.6: Were the classes intellectually stimulants?

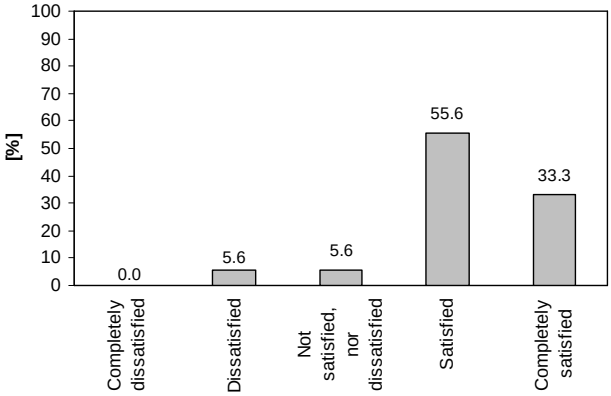

Figure.7: Do I learn something important?

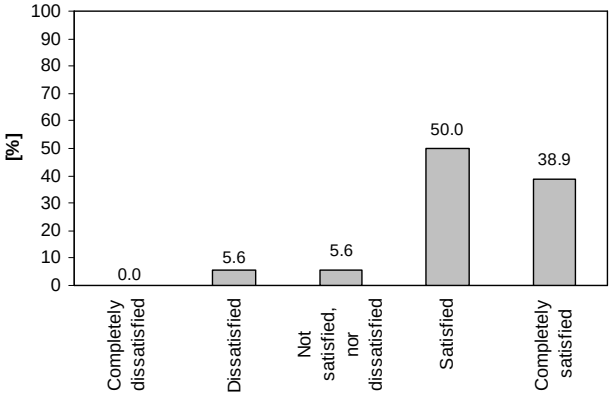

Figure.8: Did the teacher demonstrate pledge in the preparation and organization of the classes?

Overall, findings suggest a positive evaluation of Biomechanics subject from student's perspective, namely the environment of classes, the diversity of themes taught, the type of group work (project) developed by students, the particularity of programming in the Biomechanics context. They also highlight a number of issues to be improved: the high number of homework, the high degree of complexity of some subjects (biomodelling of human system).

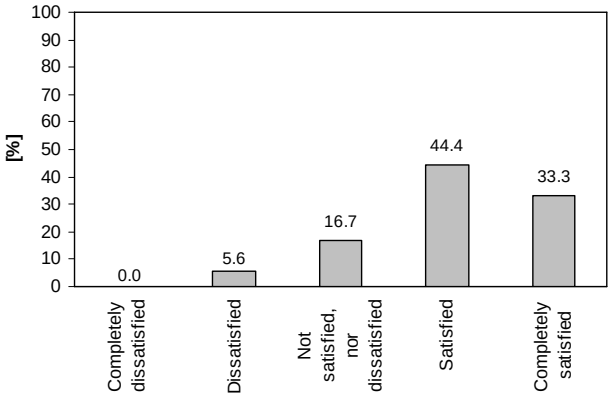

Figure.9: In general, I understood the subjects taught?

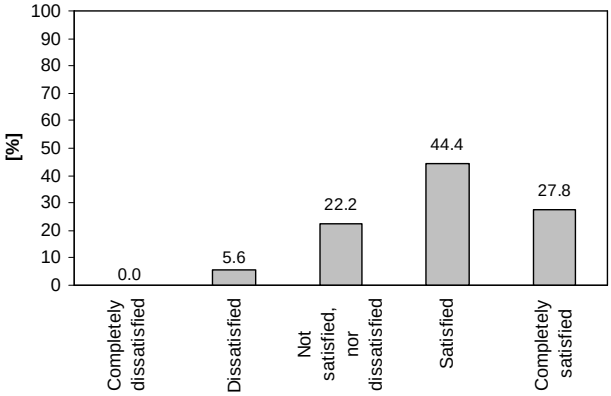

Figure.10: Was the rhythm in classes adequate?

In what follows, some statements of positive aspects related to Biomechanics in the students' perspective are:

"*Environment in the classes, interesting contents, relationship between teacher and students…*"
"*I liked the way how the Biomechanics was taught.*"
"*The philosophy associated with the works realized is quite good.*"
"*It was very positive that fact that the teacher taught programming.*"
"*I think that the teacher helped us very much and was always present.*"

In what follows, some statements of negative aspects in the students' perspective are presented,

"*Too many hours dispended in Biomechanics subject.*"
"*I think that only one work should be made in Biomechanics, and more basic teaching should be made.*"
"*The works in Biomechanics can be integrated with other subjects.*"
"*The theoretical component should be stronger.*"
"*I think that the theoretical component, with exercises should be dominant.*"

4. Concluding Remarks

In this paper, some results from a study carried out at the University of Minho in the academic year 2006/07 were presented and discussed. This study is concerning with the data taken from broader and ongoing research project aimed to investigating engineering students' perspectives on teaching and learning in higher education. Data were colleted through questionnaires administrated at the end of the semester in module 'Biomechanics' (45 hours per semester). The questionnaire included the following dimensions: motivation for entering an engineering degree, teaching methods, assessment procedures, teacher's performance, classroom climate, content, timetable, resources and equipment. Preliminary findings suggest that, by and large, students enjoyed both the diversity of the learning activities and content of the module. They also highlighted the key importance of the teacher/student relationship. However, issues such as intrinsic motivation, student participation in defining assessment procedures and the available resources (including time) and equipment emerged in explaining both similarities and differences in students' responses.

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References

Akay A., The Renaissance Engineer: Educating Engineers in a Post-9/11 World. European Journal of Engineering Education, 28(2), pp. 145-150, 2003.

Akay, A., New directions in Mechanical Engineering; Big-Ten-Plus Mechanical Engineering Department Heads. Clearwater Beach, Florida, 2002.

De Graaff, E. and Christensen, H.P., Editorial: Theme issue on the active learning in engineering education. European Journal of Engineering Education, 29(4), pp. 461-463, 2004.

Hedberg, T., The impact of the Bologna Declaration on European Engineering Education. European Journal of Engineering Education, 28(1), 1-6, 2003.

Heitmann, G., Challenges of engineering education and curriculum development in the context of the Bologna process. European Journal of Engineering Education, 30(4), 447-458, 2005

Lima, R.M., Carvalho, D., Flores, A.M., van Hattum-Janssen, N., A case study on project led education in engineering: students and teachers' perceptions. European Journal of Engineering Education, 32(3), pp. 1-11, 2007

Miles, M., Huberman, M., Qualitative data analysis. An expanded sourcebook. 2nd edition. (Thousand Oaks: CA, Sage), 1994.

Teixeira, J.C.F., Silva, J.F., Flores, P., Development of Mechanical Engineering Curricula at the University of Minho. European Journal of Engineering Education, 32(5), 539-549, 2007.