

# HOW TO ATTRACT STUDENTS TO GEO-INFORMATION COURSES: A DIFFERENT APPROACH

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## ABSTRACT:

In 1997, the University of Aveiro created the polytechnic school *Escola Superior de Tecnologia e Gestão de Águeda* (ESTGA) administering, among others, a B.Sc. degree in Geo-information Engineering. In 1999, the curriculum was redesigned within the University's overall strategy to try to invert the ongoing tendency in Portugal, like in most of Europe, of dramatically declining student numbers in engineering degrees in general, and in Geo-information in particular. The new curriculum has been developed around a methodology of learning called "Problem Based Learning" (PBL), which is firmly established in various degrees in several teaching institutes around the world.

The essence of PBL is to learn by working around open-ended problems, which in our case assumes the form of projects. Each project is dedicated to a specific theme. A set of so called "associated courses" support the project, by covering the basics of the theme's scientific content. The project and associated courses make up a Thematic Module which is the core of the semester.

The degree in Geo-information at ESTGA comprises 3 years. In the first year, the fundamental concepts are taught whereas in the two subsequent years, 4 themes are addressed, one per semester. The Themes are, in this order, "Photogrammetric Restitution", "Cartographic Production", "GIS Applications", and "Urban Cadastre".

In this paper, we will further elaborate upon PBL and on its implementation in the Theme "Photogrammetric Restitution". A first evaluation of the Theme's implementation will also be addressed, in terms of acquired knowledge and skills as well as the response of the students.

## 1. INTRODUCTION

Over the last few years, Engineering courses in Portugal have been faced with dwindling numbers of newly enrolling students, the Geo-information Engineering courses being no exception. In view of modern society's unparallel demand for geo-information, a scarcity of Geo-information Engineers and Technicians on the labour market may easily occur and will have negative repercussions in areas as diverse as urban planning and natural resources management. There is therefore an urgent need, including on the part of the educational institutes and agents, to propose and implement possible measures for putting a halt to and inverting the current trend of decreasing student numbers.

Perhaps a first area of measures to consider is that of the divulgation of the course amongst candidate students. In Portugal at least, Geo-information Engineering would seem to be associated first and foremost with Topography, and with the more traditional methods and techniques in general. It is perfectly imaginable that a stronger focus on the many informatics-related facets and high-tech aspects of present-day Geo-information Engineering will attract more students and with a wider variety of skills and interests. There is surely no lack of "eye-openers" on how Geo-information Engineering is, and will increasingly become intertwined with every-day life.

A second, more structural area of possible measures involves the contents of the Study Programme as well as their

structuring. Arguably, most of the current Study Programmes of Geo-information Engineering courses in Portugal are inadequate. This is most clearly evidenced by their strong emphasis on theoretical disciplines, specifically those related to Mathematics. The generalised lack of equipment, being a symptom of restricted budgets, is also a definite symbol of Geographical Engineering being a subsidiary field of Applied Mathematics at the classical Portuguese universities.

At the University of Aveiro, one of a generation of more recent universities in Portugal, some 4 years ago a general review of the pedagogic approach led amongst others to a proposal for a comprehensive revision of the 3-year Engineering courses at ESTGA. The crux of this proposed revision was the introduction, for the first time in Portugal, of an entirely different pedagogic model, i.e. that of Problem Based Learning (PBL). This paper discusses how PBL was implemented for the Geo-information Engineering course in general and for the discipline of Photogrammetry in particular, and furthermore reviews the first experiences with this new pedagogic model.

## 2. PROBLEM BASED LEARNING

The fundamentals for learning based on problems were developed in Germany in the early 1970s, and later adopted and adapted by various institutes in several countries, including Denmark, The Netherlands, Canada and the United States of America. The

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pedagogic model of PBL constitutes a radical inversion of the classical, teacher-centred approach, in which problems eventually serve the purpose of demonstrating and/or practicing the knowledge to be acquired. In PBL, in contrast, a complex and as much as possible real-world problem is the starting point for a learning process that is primarily conditioned by the main aim to come up with and implement a solution, preferably the best. Although this learning process takes place in close collaboration with other group members and under intensive guidance by the teaching staff, it is in essence an individual-centred process in which the student's responsibility plays a crucial role (Boud & Feletti, 1991; Savin-Baden, 2000). In PBL, compared to traditional teaching models, the role of the student thus becomes that of actor rather than listener, whereas the role of the teacher becomes that of guide rather than "master" (Cowan, 1998).

Perhaps contrary to what may be expected, this new role of the teacher is rather more demanding than the traditional one. The emphasis in PBL on helping the students to define and concretize their individual learning processes through e.g. posing exploratory questions without providing answers, requires from the teacher a greater flexibility and disponibility than is customary in traditional teaching. In the case of the students working in groups on real problems and closely accompanied by the teachers creates a learning environment that is highly favourable for the development of professional as well as personal skills (Cowan, 1987; Fallows and Seven, 2000). In addition, with PBL the student will work in an environment that bears definite resemblances with what they will frequently encounter on the labour market.

### 3. PROBLEM BASED LEARNING AT ESTGA

The Study Programme that implements PBL for the 3-year Geo-Information Engineering course at ESTGA, is shown in Table 1. The first study year aims at providing basic training in the fields of Mathematics, Informatics and Programming, and English as well as a general introduction to Geo-Information Engineering, specifically the disciplines of Geodesy, Topography and Cartography. After this introductory year, the actual PBL is developed around 4 specific themes of a semester each. In chronologic order, the 4 themes are "Photogrammetric Restitution", "Cartographic Production", "GIS Applications", and "Urban Cadastre". Worth stressing is that the themes are ordered such so as to allow subsequent themes to make use of data and information produced in the preceding theme(s), and, thereby, to allow students to develop an overall perspective of the information flows in the production of geographic information.

The individual themes comprise a project as well as the so-called associated disciplines that convey the basic knowledge and training that are an absolute requisite for students to be able to start off with the project. The so-called autonomous disciplines provide training complementary to the theme. The associated and autonomous disciplines are administered in blocks of typically 4 hours, and their time share decreases stepwise in the course of the semester as opposed to that of the project (Figure 1). The disciplines are evaluated by means of exams or periodic assessment, whereas the project work is evaluated on the basis of a final report, including its public defence before a jury. This public defence, of typically 1 hour, comprises a joint presentation of the work as well as a discussion with each of the individual group members. The jury comprises 3 members, 1 of which is from an external, public or private organisation.

|   | H-15W |     | ECTS |
|---|-------|-----|------|
|   | TP    | P   |      |
| <b>Year 1</b>   |       |     |      |
| Mathematics I   | 75    |     | 6,5  |
| Geometry & Trigonometry                                 | 60    |     | 4,5  |
| Mathematics Applied to Geo-Info. Eng.                   | 75    |     | 6,5  |
| Introduction to Informatics                             | 70    |     | 5,0  |
| Programming Applied to Geo-Info. Eng.                   | 70    |     | 5,0  |
| Elements of Geo-Information Eng                         | 80    |     | 6,5  |
| English   | 30    |     | 5,0  |
| Global Positioning Systems                              | 70    |     | 5,0  |
| Data Base Structuring                                   | 70    |     | 5,5  |
| Geology   | 70    |     | 5,0  |
| Topography I  | 70    |     | 5,5  |
| <b>Year 2 – semester 1: Photogrammetric Restitution</b> |       |     |      |
| Project   |       | 260 | 11,0 |
| Associated disciplines                                  |       |     |      |
| <i>Topography II</i>                                    | 70    |     | 5,0  |
| <i>Photogrammetry I &amp; II</i>                        | 90    |     | 7,5  |
| Autonomous disciplines                                  |       |     |      |
| <i>Mathematical Treatment of Observations</i>           | 80    |     | 6,5  |
| <b>Year 2 – semester 2: Cartographic Production</b>     |       |     |      |
| Project   |       | 240 | 10,0 |
| Associated disciplines                                  |       |     |      |
| <i>Computer-assisted Cartography</i>                    | 70    |     | 5,5  |
| <i>Cartographic Representation</i>                      | 70    |     | 5,5  |
| Autonomous disciplines                                  |       |     |      |
| <i>Remote Sensing</i>                                   | 70    |     | 5,0  |
| <i>Orthophotocartography</i>                            | 50    |     | 4,0  |
| <b>Year 3 – semester 1: GIS Applications</b>            |       |     |      |
| Project   |       | 240 | 10,0 |
| Associated disciplines                                  |       |     |      |
| <i>Geographic Information Systems I</i>                 | 80    |     | 6,5  |
| <i>Project management</i>                               | 40    |     | 2,5  |
| Autonomous disciplines                                  |       |     |      |
| <i>Geographic Information Systems II</i>                | 80    |     | 6,5  |
| <i>Quality of Geographic Information</i>                | 60    |     | 4,5  |
| <b>Year 3 – semester 2: Urban Cadastre</b>              |       |     |      |
| Project   |       | 260 | 11,0 |
| Associated disciplines                                  |       |     |      |
| <i>Cadastre Planning &amp; Execution</i>                | 50    |     | 4,0  |
| <i>Quality Control &amp; Superintendency</i>            | 40    |     | 3,5  |
| <i>Graphical &amp; Numerical Cadastre</i>               | 70    |     | 5,5  |
| <i>Legislation &amp; Norms</i>                          | 30    |     | 3,0  |
| Autonomous disciplines                                  |       |     |      |
| <i>Socio-economic Aspects of Cadastre</i>               | 40    |     | 3,0  |

Table 1. Study Programme of the 3-year Geo-Information course administered at ESTGA  
H-15W = number of hours over 15 weeks; TP, P = number of theoretical-practical and practical hours, respectively; ECTS = European Standard Credits

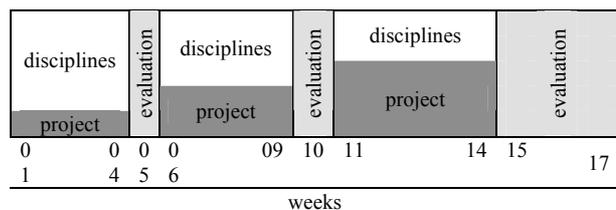


Figure 1. Time schedule of PBL semester



The planning of the control points is thus done for the set of 20 photographs for which aerial triangulation is carried out. Figure 5 shows a sketch of a control point and the students in the field measuring it.

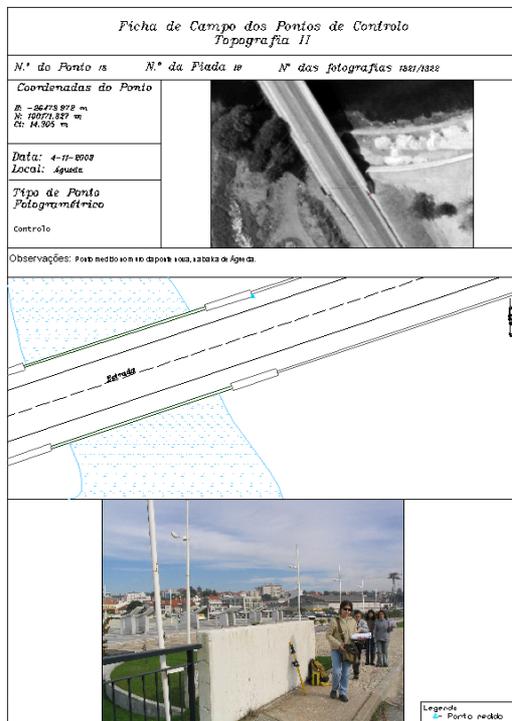


Figure 5. Measuring the control points

The measurements of the control points were done with a Trimble GPS, using the relative method. An example of the final output, produced by one of the students group, is illustrated in Figure 6, showing the planimetric information extracted with the Photogrammetric Image Station SSK Pro of Zeiss/Intergraph, for an area corresponding to a single stereoscopic model. This planimetric information still needs verification, which is a task well suited for the subsequent semester with its theme of Cartographic Production. The gathering of the corresponding altimetric information is, by way of standard, addressed in the autonomous discipline of Orthophotocartography (see Table 1).

## 5. FINAL CONSIDERATIONS

A committee was installed to accompany and evaluate the implementation of PBL at the ESTGA. The first evaluation results revealed a generally positive response by the students. In particular the clear-cut resemblances of the learning environment with the future working environment contribute to a stronger motivation of the students. Some negative notes must also be mentioned, most notably with respect to the expected workload, difficulties in planning and keeping work schedules, and difficulties in assuming the new role division between students and teachers. Also from the perspective of the teachers, this new role division constitutes a major challenge with noticeable implications ranging from logistic and organisational aspects to the human side of relating to students as well as colleagues.

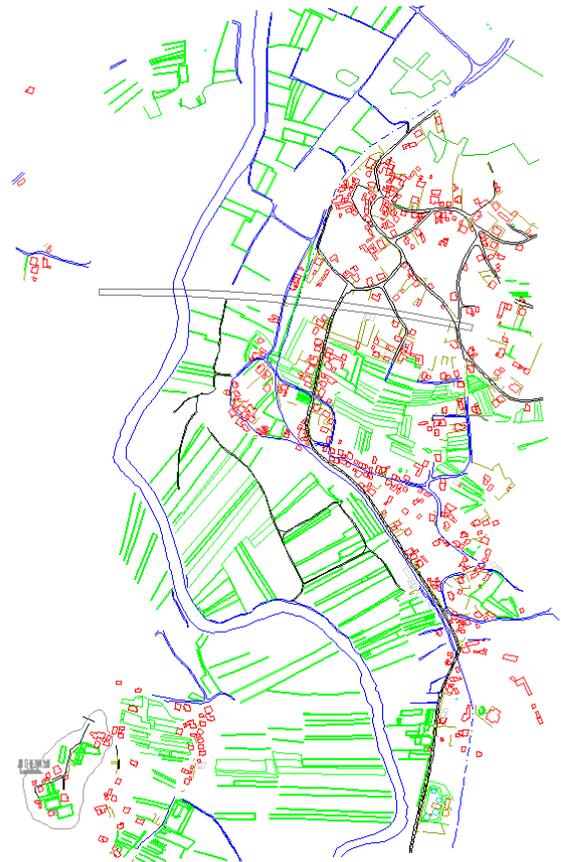


Figure 6. Partial restitution of a model for a topographic map at scale 1:2.000

To conclude, we want to point out a number of specific topics that present important challenges for the future of PBL at ESTGA:

- the integration of all the facets of the pedagogic model;
- the evaluation of the model and its results, as different from the evaluation of individual staff members;
- the development of a “culture of institution” that avoids a return to the traditional pedagogic model;
- the implementation of measures to stimulate and duly reward staff members for a demanding involvement in pedagogic activities.

With respect to the Photogrammetric Restitution theme in particular, the reaction of the students is enthusiastic. They learn all the photogrammetric process in an integrated manner starting with planning, passing by measuring of control points and finishing with extraction of the geo-information, according to specifications. At the end of the semester, the students are equipped with the skills necessary to work in a production environment, except for, in the majority of cases, precise measuring in stereo which requires hard training.

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