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## The role of four-hour blocks in promoting active learning strategies: The impressions of Students and Teachers

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### INTRODUCTION

The technological degrees offered at the Polytechnic School of Águeda (ESTGA) – University of Aveiro have been organized, since 2001, around a project-based learning environment [1]. One of the features of the curriculum implementation is that courses' contact hours are not divided in several types of classes, as in traditional learning environments. Following an idea adapted from the Aalborg model [2], all courses are taught in four-hour blocks that can be organized differently according to the course, or the learning needs at any stage of the process, thus enhancing flexibility and allowing for reorganization of the provision for teaching according to students' needs. This format was also meant to encourage the adoption of active learning strategies within the classroom, since traditional lectures in such a format would be little less than excruciating.

This article describes an investigation into the “on the field” experience of both students and teachers with these four-hour blocks. The research questions were: How are four-hour classes being implemented “on the field”? What are the advantages and disadvantages of this format? Does the format actually foster the implementation of active learning strategies?

Discussion sessions on the four-hour blocks were organized for groups of students from the Electrical Engineering program. Written data on the most positive and least positive aspects of the four-hour blocks class format was also gathered from both students and teachers. The data was qualitatively analysed to answer the research questions. A detailed description of the data collection procedures and of the analysis methodology will be offered later in the text.

This article will start with a brief description of the ESTGA PBL implementation, thus setting the scene and providing context for the investigation it addresses. It will then proceed to detail the data collection procedures and analysis methodologies, and discuss the results of that

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analysis. As conclusions, the article will offer tentative answers to the research questions enunciated earlier in this section.

## 1 THE PROJECT-BASED LEARNING ENVIRONMENT AT ESTGA

In project-based learning (PBL) environments, learning is triggered by real-life problems, which are usually complex, multidisciplinary and open-ended, in the sense that there may be more than one possible solution [3]. The learning process unfolds while students attempt to solve those problems, in a self-directed effort, which is necessarily different from a path pre-defined by the teacher. Students assume responsibility for their learning, thus defining their own learning needs, at their own pace [4]. This type of setting also creates the necessary environment for the development of personal and professional capabilities [5,6]: students work in small groups, plan their own tasks, search for information autonomously, in a context which is close to the requirements of the market place.

ESTGA currently offers two distinctly technological programmes: Electrical Engineering and Information Technology, both organized around the PBL paradigm. *Fig. 1.* presents the curricular plan for the Electrical Engineering programme, which sets the scene for the investigation being discussed in this article.

Electrical Engineering								
1 <sup>st</sup> Semester				2 <sup>nd</sup> Semester				
Area	Course	H/smt TP TO	ECTS	Area	Course	H/smt TP TO	ECTS	
1 <sup>st</sup> Year	M	Mathematics I	80 0	8,0	M	Mathematics II	60 0	6,0
	F	Physics	60 0	6,0	M	Applied Mathematics	60 0	6,0
	Ph	Elements of Electromagnetism	50 0	4,0	Ph	Elements of Thermodynamics	50 0	6,0
	I	Them. Proj.: Applied Informatics	0 20	12,0	EL	Them. Proj.: Electrical Circuits	0 30	12,0
	I	PC: Informatics and Programming	60 0		EL	PC: Circuit Analysis	50 0	
	MNG	Project Methodologies and Management	30 0		L	Technical English	40 0	
<b>Total</b>		300		<b>Total</b>		290 30,0		
2 <sup>nd</sup> Year	EL	Them. Proj.: Analog Electronic Systems	0 30	12,0	EL	Them. Proj.: Industrial Instrumentation	0 30	12,0
	EL	PC: Semiconductors - Devices and Applications	50 0		PC:	Industrial Electronics	50 0	
	EL	Electronic Systems	50 0		EL	Instrumentation and Measurements	50 0	
	EL	GC: Option I	50 0	6,0	GC:	Option II	50 0	6,0
	EL	Them. Proj.: Digital Electronic Systems	0 30	12,0	EL	Them. Proj.: Electrical Technology	0 30	12,0
	EL	PC: Microprocessors and Microcontrollers	50 0		EL	PC: Electrical Machines	50 0	
EL	Digital Systems	40 0		EL	Applied Electrotechny	50 0		
<b>Total</b>		300		<b>Total</b>		310 30,0		
<b>Branch: Electrical Installations</b>								
3 <sup>rd</sup> Year	EL	Them. Proj.: Energy Distribution and Usage	0 30	12,0	EL/ME	Them. Proj.: Industrial Automation	0 30	12,0
	EL	PC: Energy Transport, Usage and Management	40 0		EL	PC: Automation	60 0	
	EL	Electrical Machines, Actining and Protections	50 0		ME	Hdraulics e Pneumatics	60 0	
	EL	GC: Electrical Apparatus	40 0	4,0	GC:	Option III	50 0	6,0
	EL	Them. Proj.: Electrical Energy Installations Project	0 60	14,0	EL	Them. Proj.: Special Installations Project	0 45	12,0
	EL	PC: Electrical Installations I	80 0		EL	PC: Electrical Installations II	40 0	
<b>Total</b>		300		<b>Total</b>		285 30,0		
<b>Branch: Mechatronics</b>								
3 <sup>rd</sup> Year	ME	Them. Proj.: Thermodynamics and Fluid Dynamics	0 30	12,0	ME	Them. Proj.: Computer Assisted Machining	0 20	10,0
	ME	PC: Fluid Mechanics	40 0		PC:	Computer Assisted Production	30 0	
	ME	Thermal Machines and Heat Transfer	50 0		ME	Technical Drawing	50 0	
	ME	GC: Materials Resistance and Mechanics	60 0	6,0	ME	GC: Hydraulics e Pneumatics	60 0	4,0
	ME	Them. Proj.: Materials Technology and Processes	0 30	12,0	EL/ME	Them. Proj.: Mechatronics Project	0 60	16,0
	ME	PC: Technological Processes	50 0		PC:	Automation	60 0	
ME	Materials	50 0		ME	Elements of Mechanical Systems	50 0		
<b>Total</b>		310		<b>Total</b>		330 30,0		

Remark: The shadowed areas represent a module of a Project + Project Courses.

Abbreviations:

Them. Proj.: Thematic Project  
 PC: Project Courses  
 GC: General Courses  
 TP: Theoretic and Practice  
 TO: Tutrial Orientation  
 TH: Total Hours

*Fig. 1.* Curriculum Plan for the Electrical Engineering Programme

The curriculum is organized around aggregate curricular units, each corresponding to an important goal theme addressed by the programme. These aggregate units materialize into Thematic Modules (TM), which consist of a project and a set of supporting courses. The idea behind these modules is to concentrate the delivery for the goal themes in the same semester, instead of spreading them out along the programme, as is usual in traditional engineering

degrees. This structure follows the Aalborg model [7] and besides the obvious focus on a particular subject area, allows for closer to reality projects. In *Fig. 1.*, the shaded areas represent TMs; courses not included in the shaded areas are dedicated to general complementary subjects, not directly related to any of the themes, and are called Autonomous Courses.

Projects are developed in small groups of students, which are assigned a small physical space to meet and work. Students are also granted extended access to laboratories, evenings and weekends included. Each group has a supervisor for every project being carried out. The supervisor's role is to facilitate students' progression, to guide without disclosing the solution, to help by asking meaningful directing questions. Projects are assessed through a written report and a public presentation before a jury, in which one of the members is the project supervisor. The presentation is followed by a period of discussion, in which students may be individually requested to answer different questions. It is common practice to invite individuals from other HE institutions or from industry to sit as members of the jury, allowing students to gain different perspectives on their work. Complementarily, self and peer assessment strategies are strongly advised and have become common practice for most projects.

Adapting an idea of the Aalborg model, semesters are organized into three five-week periods, allowing classes to be concentrated at the beginning of the semester; the end of semester is for the most part devoted to project work. At the end of each five-week period there is a week without classes, dedicated to various assessment activities. For the assessment of projects, there is a more extended assessment period at the end of the semester.

This approach has been on the field since 2001 [8]. One of its most distinctive features relates to the fact that, as mentioned earlier in this article, all courses are taught in four-hour blocks that can be organized differently according to the course, or the learning needs at any stage of the process, thus enhancing flexibility and allowing for reorganization of the provision for teaching according to students' needs. The idea was inspired by the Aalborg model, as described in [7], but it was adapted to a format in which students stay within the same classroom, with the same teacher(s) for the entire four-hour block. This format means to encourage the adoption of active learning strategies within the classroom, which sometimes is rather difficult within the context of classes lasting shorter periods of time [9]. On the other hand, a four-hour long traditional lecture would be little less than excruciating, and therefore the format is also regarded as a way of driving teachers away from the temptation of just lecturing without involving the students in the learning process. Furthermore, this structure also allows for a better articulation with the thematic projects.

Within the four-hour blocks, it is expected that the learning activities proposed to the students are very diverse and flexible, depending on the course and the subjects being discussed: visits to industrial plants, laboratory work, debates, talks from recognized experts, student presentations, group work and all the range of active learning activities described in the literature [10] are admissible, even encouraged.

As we all know, however, there is usually a distance between the intended goals and the "on the field" implementation results of any curricular development. It is the purpose of this article to shed some light onto the actual implementation of four-hours blocks and their expected role in promoting the adoption of active learning strategies within the classroom.

## **2 DATA COLLECTION AND ANALYSIS METHODOLOGY**

For the purpose of this research project, discussion sessions were organized for three groups of students, one for each of the academic years of the Electrical Engineering programme, in the middle of the spring semester of 2012. The students were given the remit to identify, on

their own, the various categories of four-hour classes to which they had been exposed so far in the programme. After a short introduction by the Author explaining the goal of the session, each group of students elected a “secretary” and were left alone to discuss for about thirty minutes, after which the Author re-entered the room and discussed with the students any issues in need of clarification. The investigator also took brief observation notes after each session, on which a few contextualization remarks used in the discussion of the results, in Section 3, will be based.

The sessions’ outcome is therefore a list of the categories of the ways in which four-hour blocks are organized in the different courses. This list will be described in the next subsection. As may be easily noted, this categorization represents, in itself, a major step in the qualitative content analysis of the student sessions, thus making the analysis of its outcomes quite straightforward. Ten students attended the session organised for the third-year of the Electrical Engineering programme, whereas fifteen students attended the second-year session and thirty students were present in the first-year session.

After the discussion sessions, each of the participating students was asked to list, in writing, the three most positive and the three least positive aspects of each of the blocks’ categories identified earlier, using a formative illuminative activity described in [11].

In addition, and in order to gather data on the teachers’ perspectives on the subject, all teachers involved in the programme were also asked to list, in writing, the three most positive and the three least positive aspects of teaching in four-hour blocks. Of the sixteen teachers involved in the programme, thirteen responded to the challenge.

The lists of most positive and least positive aspects, for both teachers and students, were then qualitatively analysed, using content analysis, and a set of categories for both of these aspects was developed. These categories will be described in subsection 3.2.

### **3 RESULTS AND DISCUSSION**

In this section, the results of the analysis described in Section 2 will be presented and discussed. Subsection 3.1 will be devoted to the outcomes of the students’ discussion sessions on the various categories of four-hour block classes. Subsection 3.2 will be devoted to the results of the analysis of the lists of the most positive and least positive aspects of the four-hour blocks, both from the students’ perspectives, and from the teachers’ perspectives.

#### **3.1 Results of the student discussion sessions**

The results of the investigation show that students identify four types of classes, ranging from more traditional approaches, to very engaging active-learning organized sessions. *Table 1.* summarizes these findings. Note that the names of the categories were chosen by the investigator, based on the clarification discussions at the end of the student sessions. In the discussion sessions, students were also asked to rate the categories according to their frequency of occurrence, given their experience with the programme. These ratings are shown in the third column of *Table 1.*, for each of the academic years’ sessions.

As can be noted from the analysis of *Table 1.*, there are no courses in which the “Full lecture” mode is used in the first academic year. Apart from that fact, there is a common agreement between the students that the most common type of classes follows the “Tutorial-like organisation” category, which is a rather “softer” version of the somewhat more radical “Active learning sessions” type of classes that come in third place. The “Traditional layout” category still comes in second place, possibly denoting difficulties in abandoning the more traditional framework, in which most teachers were themselves educated.

Table 1. Categories of four-hour block classes.

Categories	Description	Student Sessions		
		S 1 <sup>st</sup>	S 2 <sup>nd</sup>	S 3 <sup>rd</sup>
<b>Full lecture</b>	Classes are organised as traditional lectures (4h long), with very little student interaction. Eventually, the teacher discusses some example problems. Student interaction is usually restricted to posing questions.	0	4	4
<b>Traditional layout</b>	Classes are organised as in traditional environments, starting with a lecturing period that can last up to 2h, followed by problem-solving sessions, in which students may be asked to interact by answering questions posed by the teacher while solving the problems. Due to the length of the class, it is not unusual for students to be asked to “come to the board” and solve problems with the help of the teacher.	2	2	2
<b>Tutorial-like organisation</b>	Classes are much more flexible, with short periods of explanation by the teacher (usually introducing new subject matters or making end-of-chapter summaries), intertwined with problem solving activities, in most cases involving students’ active work. Teachers may sum up the resolution of some of the problems or ask a student to show their colleagues his solution to the problems.	1	1	1
<b>Active learning sessions</b>	Classes which are much less teacher-driven and in which a range of active learning activities, made possible by the duration of the class, are proposed as challenges to the students, which usually address those challenges in groups. Student presentations, debates and overall discussion of subject matter are frequent, usually mediated by the teacher, who may take the opportunities to “wrap up” the subject matters.	3	3	3

These results hint that four-hour blocks may contribute to the use of strategies that tend to be more student-centred, since the use of the more traditional lecturing modes do not adjust easily to the length and flexibility required by four-hour blocks. This outcome may be confirmed by the results presented in section 3.2, in which the individual lists of the most positive and the least positive aspects of each category of classes are detailed.

### 3.2 Results of the written lists for the most positive and the least positive aspects

Tables 2. to 5. present the results of the analysis of the lists of the most positive and the least positive aspects of each category of four-hour blocks described in the previous section.

Table 2. Results of the written lists for the category: “Full lecture”.

Full lecture	Description	S 2 <sup>nd</sup>	S 3 <sup>rd</sup>
		(N=15)	(N=10)
+	Systematic organisation of the subject matter.	7	5
	Examples tend to be similar to exam problems.	4	2
	No indication of positive aspects	8	5
-	Tiring and boring.	12	9
	Large volume of subject matters addressed.	10	7
	Inability to follow the teachers’ reasoning for such a long time.	7	6
	Lack of link to reality (and project work).	4	2
	No opportunities to get “hands on” experience.	8	7

Table 3. Results of written lists for the category: “Traditional layout”.

Traditional layout	Description		S 1 <sup>st</sup> (N=30)	S 2 <sup>nd</sup> (N=15)	S 3 <sup>rd</sup> (N=10)
	+	Students end up with quite a lot of solved “typical” problems.		22	10
Structured approach to subject matters.		18	7	4	
Students get to see “the way teachers solve problems”.		23	8	3	
Good “coverage” of the syllabus.		5	4	2	
-	Long lectures are hard to follow.		20	10	8
	Four-hours on a single subject can be tiring and boring (due to lack of engagement).		23	12	8
	Articulation with project work is not obvious, in a large number of cases.		3	5	5
	The pace at which subject matters are addresses is sometimes “too fast”		20	10	6

Table 4. Results of the written lists for the category: “Tutorial-like organisation”.

Tutorial-like organisation	Description		S 1 <sup>st</sup> (N=30)	S 2 <sup>nd</sup> (N=15)	S 3 <sup>rd</sup> (N=10)
	+	Allows for “hands-on” problem solving.		20	12
Feedback on the students’ work is available almost “on-line”.		10	6	5	
Students are involved in the classroom activities		22	10	7	
Teacher helps students organize their reasoning.		8	6	5	
Students’ engagement makes classes more interesting		15	10	6	
-	Students feel exposed when they are asked to solve problems “on the board”.		14	4	2
	Students end up with fewer problems solved “by the teacher”.		17	8	3
	Four-hour blocks can be quite tiring, since students “work a lot”.		28	6	3

Table 5. Results of the written lists for the category: “Active learning sessions”.

Active learning sessions	Description		S 1 <sup>st</sup> (N=30)	S 2 <sup>nd</sup> (N=15)	S 3 <sup>rd</sup> (N=10)
	+	Students are fully engaged in the learning activities.		12	10
Classes are “more fun” and time “goes by quickly”.		15	12	7	
Group work helps students get a deeper understanding of subject matters, since “they teach each other”.		5	5	4	
Usually, assessment strategies involve different activities, and not only exams and tests, which is viewed by the students as positive, and helpful in achieving academic success.		17	7	6	
The teacher helps students to see different perspectives on subject matters.		6	8	7	
Articulation with project work is usually much more explicit.		5	7	8	
-		It is difficult to get a “structure” for the subject matters solely from the classes. The word “fuzzy” appears repeatedly in the students discourse.		20	12
	Students seldom get to see how the “teacher would solve the problems”.		25	10	3
	Students have to work quite a lot, both within the classroom and outside of the classroom.		10	6	8
	There is little contact with “typical” exam problems, which are usually also more difficult to typify.		22	8	4
	The frequent use of continuous assessment represents a constant pressure.		15	5	4

An overall analysis of these tables shows that students value their engagement in the learning activities and process, which is fostered by the four-hour blocks, but it also shows that students also feel the need for the “safety networks” that more structured, syllabus oriented and teacher-centred organised categories of classes provide. This aspect becomes less evident as students progress along the programme, probably because they become more aware of the value of the less traditional categories of classes, also probably reflecting the effect of their further exposure to the PBL model.

*Table 6.* reflects the inputs gathered from the teachers. Generally, the positive aspects tend to be more related to the learning process and the negative aspects are more related to organisational aspects. This result may hint a general acceptance of the value of the four-hour block class structure. In fact, two of the teachers involved in this study made a point of writing in the list sheets that they would not even consider going back to the more traditional structure of separate lectures-tutorials-labs classes.

*Table 6.* Results of the written lists from the teachers.

		Description	Frequency (N=13)
Teachers' Perspectives	+	Learning activities can be organized in a more comprehensive and complete way, given the amount of time available.	8
		It is easier to adapt the delivery to the students' learning needs, sometimes “on-line”. Flexibility is the keyword.	6
		Articulation with project work may be incorporated more easily.	4
		It is possible to use a larger variety of learning activities, which would be impossible to use in traditional environments.	6
		Directly supporting students is possible and easier. It is also easier to become aware of students' difficulties.	6
	-	Usually, four-hour blocks mean that teachers only have contact with students once a week, which usually means that longer “recap” periods are needed at the beginning of each class.	9
		Classes may be very tiring for both students and teachers.	4
		Keeping students' attention may be difficult.	3
		When holidays coincide with classes, there can be longer periods between classes, which make it difficult to keep the pace.	12

#### 4 CONCLUSIONS

From the analysis of the results presented in the previous section, it is possible to hint that the four-hour format pressures teachers to engage in less traditionally organized classes. Students also value more engaging learning environments, which are fostered by this format of classes. This trend becomes more apparent for students in more advanced stages of the programme, which may reflect their greater exposure to the PBL environment and also their increased maturity. However, students also value the formal structure provided by more traditional environments, possibly a consequence of their previous learning experiences and study habits.

Naturally, further research into these findings is needed in order to get a better grasp of the dynamics of four-hour blocks and their role in ESTGA's PBL environment. The results of this study will guide that research, establishing the general lines on which to pursue further enquiries.

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