IPS' Technology and Industrial Management graduate course: A curriculum **follow-up analysis**

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Abstract

The Technology and Industrial Management (T&IM) course of the Polytechnic Institute of Setúbal (IPS), Portugal, is a four year graduate course organized in trimesters with three course units per trimester [quarter]. In the last two trimesters [quarters] internships or real context projects prepare students for a smoother integration in the professional activity. From its beginning, in 2007, T&IM was designed for adults who develop a full-time professional activity in industrial companies, and needed to supplement their skills with those typical of managers and engineers. The b-learning methodology was adopted since it enabled the targeted students to better reconcile their academic, professional and family responsibilities. In 2010-2011 the first T&IM students concluded their graduate studies and, within IPS' Integrated Management System, it was decided to monitor the suitability of the T&IM course curriculum. The following activities were undertaken: (a) data analysis, (b) satisfaction survey to current and graduate students, and (c) focus groups with graduate students that had finished the course in 2010-2011. The data showed lower dropout numbers than those of IPS' engineering courses. The survey showed good levels of satisfaction. Student satisfaction is high for curriculum related topics such as: (1) the course's ability to develop transversal skills and (2) the course teaching methodology. Comparing graduate and current students survey results, the former group declares a higher overall satisfaction with the course. These results are consistent with those gathered from the focus group. During the focus group graduate students added that the skills acquired were comprehensive and appropriate to their understanding of how organizations actually operate. From the gathered results it is concluded that there is a good level of curriculum adequacy and student satisfaction, although there are "problem areas" and topics requiring further research.

Keywords: adult learners; curriculum adequacy; student satisfaction; b-learning

1   Introduction

In spite of the improvements in the rate of students enrolled at all education levels and of the resulting population qualification increase (see Silva & Nascimento, 2010), Portugal still lags behind Europe average population qualifications. According to CNE (2011), in 2010 only 15.4% of the Portuguese had completed their graduate studies; the European average was 25.9%. The difference is even higher for secondary education; in 2010 only 31.9% of the Portuguese population between 25 and 64 years had completed this education level (12th grade) while the European average was 72.7%.

A contribution to the reduction of the Portuguese population qualification problem lies on the development of the lifelong learning concept and on more flexible access to all levels of education, including tertiary education. In 2006 Portugal issued legislation specific for the access of adult students to higher education, with the responsibility for adult student selection left to Higher Education Institutions (HEIs) (Portuguese Law No. 49/2005 and Decree-Law 64/2006). With this legislation non-formal experience gathered by candidates outside the education system started being valued and used in support of the candidates' "ability to attend" graduate degree courses.

According to Pires (2009), along with the improvement of the Portuguese population qualification, lifelong learning promoted the democratization of the access to tertiary education. However, with this "democratization" came students carrying skills, expectations and motivations that differed from traditional student population, HEIs were accustomed

with. Adult students are often already integrated in the labor market and seek higher education not for "production of knowledge" but as a pragmatic and instrumental way of participating in projects, in society and for personal and professional achievement (Gonçalves *et al.,* 2011, p.4692). Pires (2009) argues that HEIs are still insufficiently prepared for these new audiences, and still trying to find their own roles, strategies and practices as providers of multiple and diverse opportunities for adult learning. In the same line of thought Correia & Mesquita (2005) express their concern with HEIs "passivity" regarding the specific needs of these new audiences, and reinforce the importance of knowing these adult students specific characteristics before designing the appropriate responses.

Silva & Nascimento (2010, p.80) emphasize the importance of modifying the syllabus that is traditionally used in higher education classes and adapt it to adult learners; for these students the educational attitude should not be to teach "in the traditional sense, but rather to promote knowledge construction processes and especially the acquisition of skills to enable the learner autonomous access to knowledge" (Quintas, 2008, p. 39, in Silva & Nascimento, 2010, p.80). It is also in this same line of thought that Alves *et al.* (2009) support "a paradigm of teaching and learning that promotes curriculum flexibility, the development of skills and curriculum articulation " (Alves *et al.,* 2009, p.3).

In 2006, at the engineering college of Polytechnic Institute of Setúbal (IPS), a new graduate course was conceived according to the standards of the Bologna agreement. The course curriculum and the teaching and learning methodologies were designed to suit adult students with a full-time job. Since its conception the course adopted solutions that were different from what was (and still is) traditional at IPS and at most Portuguese public HEIs. The purpose of the study that supports this paper was to evaluate the solutions that were adopted using data gathered from the students enrolled in the 2011-2012 academic year and from alumni that had graduated in 2010-2011, four years after the start of the course in 2007-2008.

2 IPS' Technology and Industrial Management graduate course

The Technology and Industrial Management (T&IM) course was designed for adult workers developing their professional activities in industrial companies located at Setúbal and nearby districts and sought to complement these workers technical skills with expertise typical in business management and in engineering. The objectives of the course were: (a) Acquisition of basic engineering knowledge for understanding the key industrial technologies; (b) Acquisition of basic business management knowledge to allow better performance in the professional activity; (c) Contribution to career advancement; and (d) Encouragement of innovative and entrepreneurial spirit, a vehicle for organizational change and business creation.

2.1 Curricular structure

Taking into account the needs of the targeted public (adults with full-time jobs) the course classes are scheduled at night and a reduced workload of three course units per trimester is considered. The curriculum was designed for a total course duration of four years. With a total number of ECTS equal to that of Bologna graduate degrees, each trimester has a total of 15 ECTS, which amounts to 45 ECTS per year and 180 credits in four years. The course curriculum is divided in equal parts between course units from management science and course units from engineering, each representing 43% of the total ECTS. The remaining 14% is divided between course units from mathematical sciences (4%) and project/internship (10%). The project/internship takes place during the two last trimesters of the course. The internship is primarily for students who do not have a job, while students who already have a job typically address project topics related to their professional activity.

2.2 B-learning

The T&IM course implements a b-learning methodology, blending conventional face-to-face classes with e-learning (online autonomous learning). Half of each course unit hours are taught at a classroom, with the presence of colleagues and teacher. The other half takes place with the help of an e-learning environment where the students can develop their work independently. Laboratory classes are always face-to-face. The e-learning activities can be synchronous or asynchronous; regardless of their type, these online activities (project, chats, forum, shared work, self-test, conference–video, etc.) are designed to promote independent learning.

While designing the T&IM course a great deal of thought was given to the teaching and learning methodology that better suited the needs of adult students with full-time jobs. The decision to use the b-learning methodology presented the disadvantage of less face-to-face contact hours between student, faculty and peers. According to Tinto (1975) student integration in the academic environment plays an important role in academic achievement and dropout, especially for traditional students and residential HEIs. However, with b-learning students had the chance to better reconcile professional, family and academic responsibilities. Having two or three days of face-to-face classes per week meant that students (often working shifts) could better manage the time spared from work and family, and perform the required independent e-learning activities. On the other hand, Bean (1985) and Tharp (1998) report that for adult students and commuter HEIs, academic integration plays a less important role in student academic achievement and in dropout.

In spite of the risk it represented, it was assumed that the online component of the b-learning methodology could ensure that student's independent work was being followed by teachers, and could also ensure the strengthening of social ties between students, reinforcing the willingness to use and study with the e-learning component. At the beginning of each trimester faculty that taught classes at the T&IM for the first time had to complete a fixed amount of training on e-learning best practices.

3   Curriculum analysis

With the graduation of the first T&IM students in 2010-2011, a four years study cycle became completed. Within IPS' Integrated Management System (Ramos-Pires, 2010) it was decided to gather the data necessary to evaluate the T&IM curriculum design and the teaching and learning methodology in use.

3.1   Research design

Three research instruments were used in the evaluation of the T&IM curriculum:

a)   focus groups with graduate students that had finished the course in 2010-2011;

b)   satisfaction survey to current and graduate students;

c)   form for the collection of administrative student data.

The focus group was used to assess the curriculum related subjects that where important for students and confirm that the satisfaction survey was in tune with student's major concerns. A factor analysis was made with data gathered from the satisfaction survey in order to correlate the variables considered and find factors that contributed to the interpretation of the survey results. Data collected from administrative records was used to assess dropout and number of enrolments until graduation in T&IM and in IPS' engineering courses.

3.2   Analysis

3.2.1   Dropout Rates
Figure 1 compares T&IM dropout rates from 2008/2009 to 2011/2012 with the corresponding averages for IPS' engineering courses.
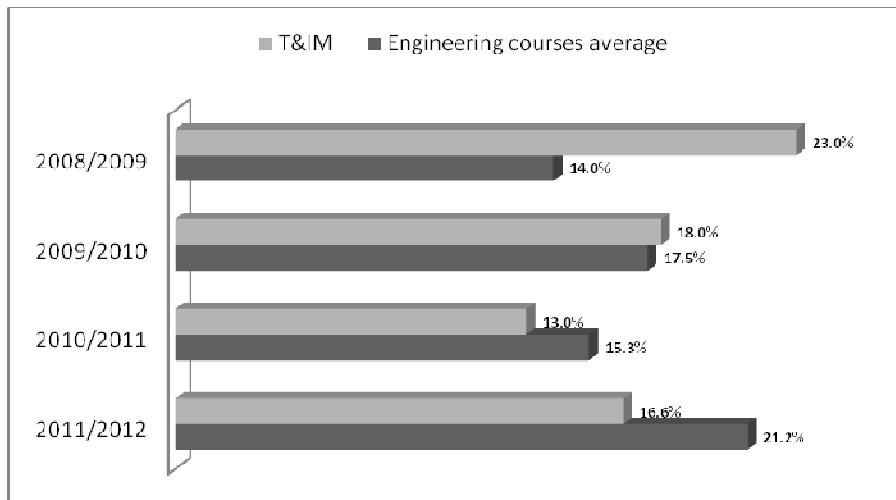
Figure 1: T&IM dropout rates compared with the corresponding averages for IPS' engineering courses.

Figure 1 shows a significant decrease in T&IM dropout from 2008/2009 to 2010/2011 followed by a slight increase between 2010/2011 and 2011/2012. Comparing T&IM dropout with the corresponding average for IPS' engineering courses, it is possible to conclude that after an initial period that coincided with the start of the course, T&IM dropout rates soon became similar to those of the engineering courses and in the last couple of years T&IM has had a dropout rate lower (between 2.5 and 5%) than the average of IPS' engineering courses. A study that addresses reasons for dropout among IPS' students is currently underway. According to preliminary results from this study there is no significant link between dropout and T&IM curriculum design. Economic difficulties (55%) and personal or health problems (27%) appear as the main reasons used by T&IM students to justify their decision to dropout. Comparing these preliminary results with those from Ramos-Pires & Gonçalves (2011), who did an exploratory study on IPS' dropout in the academic year of 2008/2009, it is possible to conclude that between 2008/2009 and 2011/2012 the argument of "economic difficulties" more than doubled: In 2008/2009 only 22% of IPS' students justified their dropout with economic difficulties, at that time professional reasons were those more frequently used (29%). It is likely that economic difficulties are also behind the dropout increase in T&IM and in IPS' engineering courses in 2011/2012.

3.2.2   Number of enrolments until graduation

In 2010/2011 IPS issued the first T&IM graduate certificates. From the total 16 graduates, seven had enrolled four consecutive years and three, with validated previous skills, had enrolled only three consecutive years. In 2011/2012 the number of new graduated students increased to 38, 29 of these with four enrolments and three with three enrolments only. Figure 2 presents, for 2010/2011 and 2011/2012, the ratio between the number of students graduating with four or less enrolments on those years and total number the students enrolled in 2007/2008 and 2008/2009, respectively.
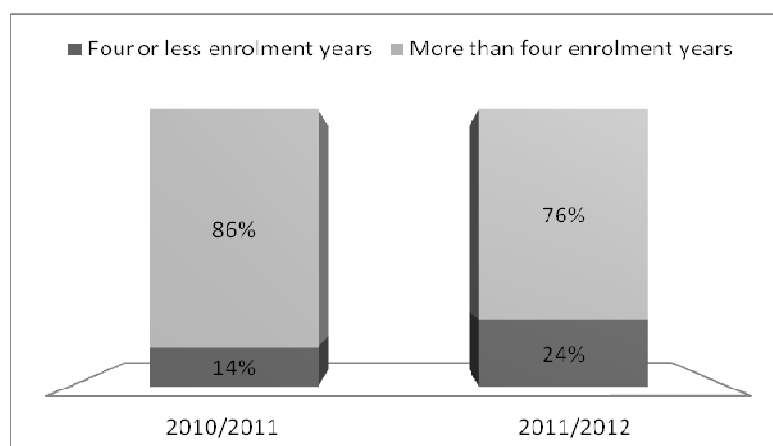

Figure 2: Percentage of students graduating with four or less enrolments.

From Figure 2 we conclude that the percentage of students graduating with four or less enrolments is low. Out of the total number of students that enrolled in 2008/2009 only 25% (approximately) managed to graduate in the expected period of time (four years). However, a large percentage of those that graduate needed only four or less years: (10/16=) 62.5% in 2010/2011 and (32/38=)84% in 2011/2012. These results suggest that for one fifth of the students (84% out of 25%, in 2011/2012) the curriculum design was adequate. For the remaining majority there is a chance that the curriculum was inadequate. Along with curriculum difficulties, economic, professional, health and family reasons can also justify the need T&IM students have for extra time to graduate (mostly adults with full-time jobs).

3.2.3 Analysis of the Satisfaction Survey

To assess the students satisfaction with the course curriculum the PEA - 1st Cycle (perceptions of teaching/learning) instrument from the University of Minho was used. Emphasis was given to the instrument's questions that were related to curriculum evaluation. Results from the focus group confirmed that the instrument was also appropriate for T&IM students.

The survey considered T&IM current students (those enrolled in 2011/2012) and alumni. A total of 42 answers were received; 18 of them from alumni, the remaining (24) from current students. This represents approximately 10% of the universe of current students and slightly more for the universe of alumni. From the answers it was possible to conclude that alumni showed more satisfaction than current students (average vote of 4.04 against 3.63, respectively, on a 6 point Likert item). Table 1 presents the three most positive and most negative factors according to alumni and current students.

Table 1: Most positive and most negative items for alumni and current students.

	Alumni		Current students	
	Item	Average vote	Item	Average vote
most positive	Development of soft skills (critical thinking, oral and written communication, time management and team work, etc.)	4.61	Adequate number of students in class.	4.07
	Laboratorial infrastructures.	4.11	Laboratorial infrastructures.	3.93
	Scheduling curricular activities (exams, works, class schedules)	4.06	Adequacy of the programs of the UC to the course objectives.	3.85
most negative	Classroom and self-study rooms.	3.89	Evaluation methods adopted.	3.37
	Adequate number of students in class.	3.67	Informatics infrastructures.	3.37
	Adequacy of the programs of the UC to the course objectives.	3.56	Classroom and self-study rooms.	3.30

Results from Table 1 should be interpreted while taking into consideration that T&IM students are mostly adults who already have a full-time job. Such students often have a clear idea about the outcomes they expect from course classes. Survey results for items like "adequacy of the programs of the UC to the course objectives" were considered equally relevant for alumni and current students.

Table 1 shows that:

- Current students have higher satisfaction regarding the adequacy between course unit (UC) programs and course objectives;

- Current students have higher satisfaction regarding the number of students in class;

- Both alumni and current students are satisfied with laboratorial infrastructures;

- Both alumni and current students report lower satisfaction regarding availability of self-study rooms;

- Alumni have higher satisfaction regarding the development of soft skills and the scheduling of curricular activities.

For a more in depth understanding of the data gathered with the satisfaction survey a factor analysis was made for the ensemble of the data gathered from alumni and current students surveys. This analysis showed that three factors explain

66% of the total information: (1) the **Planning** of the Teaching–Learning Process; (2) the **Implementation** of the Teaching–Learning Process; and (3) the **Resources** associated with the Teaching-Learning Process. From Figure 3 it is possible to conclude that satisfaction levels are acceptable for all factors and are very similar (averaging 3.86 using 6 point Likert items), however, the planning factor is the one that explains most of the sample results variance.
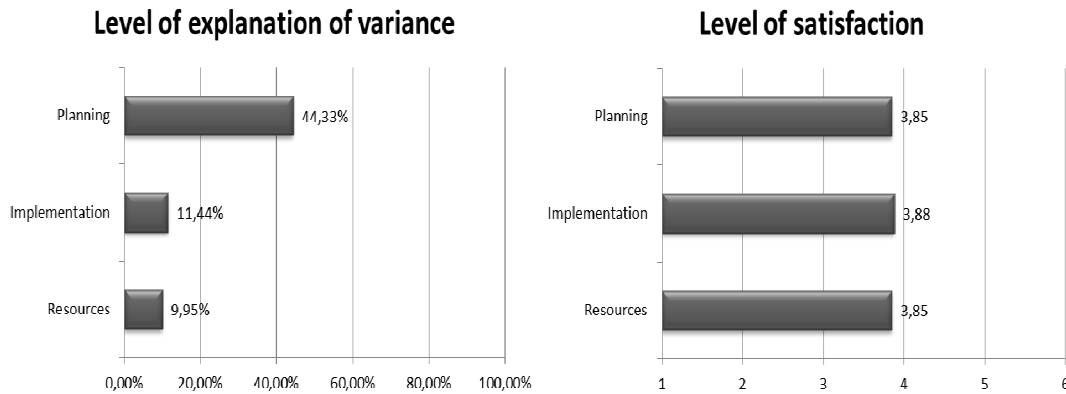

Figure 3: Variance explanation and satisfaction levels per factor.

Considering the items that made up the planning factor, the one associated with a higher student satisfaction was "scheduling curricular activities" (4.00); the item with lowest satisfaction was "correspondence between the workload and the number of credit units" (3.69). For the implementation factor the item that scored higher was "development of soft skills (critical thinking, oral and written communication, time management, teamwork, etc.)" (4.12) and the item that showed the lowest satisfaction was "coordination between the different modules/curricular units" (3.74). For the resources factor the item that scored higher was "laboratory infrastructure" (4.07), and the item where the level of satisfaction was lower was "classroom and self-study rooms" (3.57).

It is also important to mention that the item "teaching-learning adopted methodologies" is the only common to two factors (planning and implementation), a sign of the importance planning and implementing have in the teaching-learning process.

4   Conclusions

4.1   Global analysis

The rate of students graduating in four or less years is low. This may mean that in spite of the effort put into the design of the T&IM course curriculum, curriculum changes may still be needed. However, before any changes are made it is essential to identify the characteristics of the students that need more time to graduate.

Regarding the students' satisfaction with the teaching-learning process, the survey results show that improvements could be made on the "conditions of classrooms and self-study rooms", "evaluation methods adopted" and "computing infrastructure".

Regarding the results from the factor analysis results, all three factors presented a similar level of satisfaction. However the planning factor is responsible for explaining most of the survey results variance. For this planning factor the three variables with lower scores have all a direct impact on the students success: (1) "correspondence between the workload and the number of student credit units"; (2) "materials to support learning"; and (3) "assessment methods adopted (exams, papers)". To increase the number students that graduate in four years improvements should be made on these items.

4.2 Limitations and Future work

The number alumni at the focus group and the survey's response rate do not allow generalizations of the results from the present study. It would be important to repeat this study, periodically, not only to improve its statistical representativeness but also to understand the evolution of student satisfaction over time.

Since a graduate course is subject to constant changes, due to changes in students characteristics and in faculty, in the future the work described in this paper will continue, contributing to the implementation of a course monitoring system used by decision makers to justify curriculum changes and pedagogic alternatives.

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