

Vocational Education and Engineering Enrollment: a Case Study

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Abstract

This paper presents the case of an integrated program involving a network of higher education engineering institutions, K-12 (secondary technical schools and vocational training centers) and several economic sectors. The case is based on a Portuguese initiative that has been active for the past 7 years in the industrial district of Aveiro, Portugal. The main objectives of this initiative were to encourage student enrollment in post-secondary and higher education courses, favoring technical and engineering areas where the employment market exhibits chronic deficits of professionals prepared with the appropriate skills. This program also placed a special attention upon the implementation of a pedagogical approach compatible with the introduction in Portugal of the so called Bologna process. This created a new challenge and opportunity for the design and development of curricula and courseware where experimental, applied, vocational and training components have an increased role and where a strong appeal is made to autonomous work on the part of the learner. In addition, introductory, propaedeutic, specialized, applied and professionalizing subjects were subject to a “verticalization” along the curriculum time-plan as opposed to the “horizontal” layering of Classical Higher Education Models. The results of this initiative have been sufficiently encouraging to recommend its expansion at a national level which is currently happening under the leadership of Portuguese Ministry of Science, Technology and Higher Education.

I. BACKGROUND

Vocational Education and Training (VET) aims to provide people with skills and competences that can be used in the labour market [1]. During the last decade a shortage of vocational choices in the areas of sciences, technologies and engineering has been particularly dramatic in western countries. In addition, in some of these countries, the structure of their economies and industries requires different levels of specialization in the above fields, with particular relevance to intermediate degrees. The social image of these intermediate degrees is, with very few exceptions, not very positive. Therefore, the shortage of vocational choices in these areas is further aggravated by the fact that most of the students enrolled in higher education opt for advanced degrees for which the labour market, in many countries, does not offer enough job places, instead of opting for intermediate degrees where the labour market is particularly eager.

In the specific case of Portugal, and in addition to the picture presented above, there are several social barriers rooted for long years, affecting the whole range of technical and vocational education:

- The temptation for premature school drop-out in search of low qualified jobs that provide an immediate source of income;
- The (still) prevalent view that technical and vocational courses are less prestigious than studia generalia courses targeted at direct admission to University;
- The lack of sensibility of many industry leaders to promote continuous training and increase qualification of their staff, in order to assure competitiveness and sustainability in a high demanding world economy.

There are other explanations to the lack of investment in qualifications. A large amount of learners quit studying and feel poorly motivated to seek qualified and continuous education mainly due to two different causes. First, because of their limited real world experience, they have difficulty in understanding the practical applications of their studies. And second, as a direct consequence of the traditional universities and training institutions teaching methods, they receive tools for solving problems that they never faced before.

How to change this picture?

Possible answers to this question are the objective of the following sections.

II. APPROACH

In order to tackle the challenges above outlined the following approach have been developed in an integrated program involving a network of HE engineering institutions, K-12 (secondary technical schools and vocational training centers) and several economic sectors (shoe manufacturing, metallomechanics, cork production, information and communication technologies), that has been active for the past 7 years in the district of Aveiro, Portugal – Aveiro Norte Program.

- Employability as an argument for enrollment

It was found that the employability associated to courses and degrees was a major incentive for student enrollment. Therefore, employability and recognition by labour market has been used as the main drivers for promotion of the program.

- Comprehensive and regular analysis of labour market needs

The analysis of labour market needs, in terms of skills and competences, was carried out in two perspectives: territorial (district of Aveiro) and sector-based (dominant sectors in the region of Aveiro). This analysis was directed to the actual demands of economic and industrial partners, through the identification and characterization of labour needs and training opportunities of critical professional profiles vital to the region development. Furthermore, prospective analysis of economic and technological transformations that could have impact in labour stability and growth was carried out, in order to enhance proactive strategies of training and qualification.

- Cooperation of HE institutions and enterprises in competence-based curricula design

This cooperation was a valuable resource to match training and education with surveyed skills and competences.

- Promotion

Marketing initiatives were delivered by radio and cinema spots, conferences, meetings and job fairs, reaching a large audience and captivating interest about the program.

Typology of Courses

It turned out, from the continual interaction with the large number of enterprises and organizations enrolled in the skills surveys, that the type of course considered as more suitable to labour market demands was Technological Specialization Course (TSC), a post-secondary degree, highly focused on specific professional profiles. The experience gained in the first stages of the cooperation program demonstrated that these courses, if based on appropriate curricula design and operated via practical, hands-on, problem solving learning methodologies, could have very positive results:

- Student motivation was stimulated
- Acceptance by the associated industrial partners was high
- Student enrollment increased over time
- A significant number of students decided to continue their studies towards HE degrees, either immediately after graduating from their TSC, or after 2 or 3 years in the labour market.

III. POST-SECONDARY EDUCATION IN PORTUGAL : THE CASE OF AVEIRO NORTE PROGRAM

Post-secondary education courses in Portugal straddle the boundary between upper secondary and tertiary education, being mostly focused on technical and vocational areas. However, they do not confer, on their own, a tertiary degree [1]. Aveiro University together with their industrial partners identified as a priority the training of intermediate degrees. The following courses were delivered: Industrial Automation, Industrial and Creative Design, Logistics, Mechatronics, Development of Multimedia Products, Networking, Data Bases and Web Technologies.

The main goal of these courses was to prepare students to play the roles that industry expects from them, improving their knowledge and practical skills. In TSC's teaching and learning approach had a substantial amount of problem-

solving type classes, and learning materials were strongly linked to real-world professional situations and tasks. These short duration post-secondary programs brought a new solution to urgent technological demands in Aveiro Norte labour market. In other hand, these programs were also promoters of educational inclusion, combating the premature school drop-out and encouraging continuous learning. A key factor to the success of TSC's was its pedagogical methodology where experimental, applied, vocational and training components have an increased role and where a strong appeal is made to autonomous work on the part of the learner [2], [3]. This approach required the development of curricula and courseware that are quite compatible with the so called Bologna process mission [4].

IV. CURRICULA DESIGN: THE RELATION WITH BOLONHA

The rapid access to information, the ability to transform it in meaningful knowledge [5] and perform it in real life situations is central to economic competitiveness of industries and to personal development of individuals [6]. The new education and training challenges, caused by a high demanding world economy and society, urges the shift from knowledge, as the organizer of learning, to competency, as the capacity to mobilize know-how [3], [7]. Competence is defined as the ability of a person to perform an action, knowing what to do and when, selecting, combining and mobilizing resources [3].

The Bologna process is an intergovernmental initiative that was launched in 1999 and aims to create a European Higher Education Area (EHEA) by 2010. The main objective of Bologna process is to establish a common structure of HE systems across Europe, supported by the European Qualification Framework (EQF). This framework is a central political instrument that relates different countries qualifications systems to a common reference framework levels on how to describe learner' learning outcomes in terms of what he or she knows, understands and is able to do. The EQF applies to all types of education, training and qualifications, from school education to academic, professional and vocational. It also encourages lifelong learning by promoting the validation of non-formal and informal learning.

The introduction of the Bologna process creates new challenges and opportunities, in particular in the areas of engineering and technical degrees [8]. In these areas, conventional academic curricula are undergoing profound modifications, giving rise to leaning architectures where the vocational and training components have an increased role and where a strong appeal is made to autonomous work on the part of the learner. A possible approach towards the implementation of the Bologna process is based on the implementation of a problem solving or project led type of learning also known as the Aalborg Model [2], [4], [8]. The Higher Education Classical Model and the Aalborg Model are illustrated by the following table (Table 1). This table illustrates the fact that, in a competence development context, the professional or vocational components of the learning process go hand-in-hand with the academic components throughout a course or training roadmap. This is an opposition to the conventional, classical model where subject based learning was major in most of the course structure, and where professional or vocational components only appeared in its latter stages. Features like team work, multidisciplinary knowledge management and concurrent learning are some of the requirements imposed to learning initiatives used in the context of a problem solving or project led type of education and training, targeted at competences development.

Table 1. HE Classical Model vs. Aalborg Model, according to curriculum relevance

CLASSICAL MODEL			AALBORG MODEL			
A	S	PROF	P	S	A	PROF
P	S		P	S	A	
P	S		P	S	A	

Applied (A), Specialized (S), Propaedeutic (P), Professional (PROF)

V. CURRENT AND FUTURE CHALLENGES

The "Knowledge Society" creates, more than never, the need for constantly developing and upgrading knowledge, skills and abilities in order to face labor market demands and changes. This also poses enormous challenges to training programs that increasingly must address competence-based curricula. However, whilst Bologna process is

formally inducing this new paradigm of HE, this change isn't being consistently reflected in pedagogical composition of graduation courses.

Thus, education and training programs should emphasize the acquisition of multiple resources – transversal competencies – and the ability to learn continuously – lifelong learning [9], which are essential assets of employability. Knowing what is expected to do and acting according to that facilitates learning integration and organization of knowledge. Universities and VET institutions should prepare their students to deal with diverse and unexpected professional situations, mobilizing combinations of resources, so that learners could act with competence and not only with theoretic knowledge. The design of professional pathways based on learners previous formal and informal skills and knowledge, could be an interesting strategy to enhance learners autonomy and significative learning.

The actualisation and development of curricula in public and vocational education is often too slow and complicated process, in comparison with the rapid change of job market demands. An interactive ICT system for dynamically creating, combining, and evaluating curricula has to be developed, to support competency-based curricula and e-learning initiatives [10].

In addition to the challenges of curricular development based in competences, and the empirical contributes of Aveiro Norte Program to these questions, we conclude that post-secondary education programs could also be considered as making part of Bologna's First Cycle (Bachelor's Program), and students that complete these programs should be able to continue education along Bologna structure. The descriptor for the HE short cycle (within or linked to the first cycle), developed by the Joint Quality Initiative as part of the Bologna process, corresponds to the learning outcomes for EQF level 5, and matches to the Portuguese Qualification System level 4, where TSC's are included. The learning outcomes relevant to Level 5 are "comprehensive, specialized, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge". TSC's are three semester programs, with 60 to 90 ECTS (European Credit Transfer and Accumulation System). Bachelor's Degrees are six semester programs, with 180 to 240 ECTS. In fact, TSC's correspond to higher level technical training that includes knowledge and abilities of a HE level [2]. These courses are, in practice, shorter cycles of HE programs that could, and should, be integrated in Bologna Process (see grey shadow in Table 1).

VI. CONCLUSIONS

With a global economy that interconnects every country around the world, the demand for qualified professionals' increases. Attracting students into and graduating students from engineering degree programmes is a growing challenge. Evidence is emerging that competence-based teaching, combined with a strong connection to business sectors, can positively impact student academic outcomes. One of the missions of Universities and VET institutions is to guide and promote students professional integration [9]. Thus, formal education programmes should prepare students and train mature workers according to the labour market demands and technological evolution, focusing teaching on competences, in order to face the economic and social challenges ahead. On the other hand, the involvement of enterprises and industry is crucial and should be made in different aspects: curricula design; interchange of students, organization of study visits and bringing professional to schools; quality assessment and regular feedback. Vocational guidance and motivation must start at secondary level, and hands-on approaches should start as early as possible, preferably complemented with real world situations.

Post-secondary education programs, as we have seen with the case of Aveiro Norte Program, could work as a valuable start point to academic graduation, attracting and motivating students to electronic engineering and other critic areas to Portuguese, and worldwide, economy. Despite allowing a rapid entry in labour market, these courses can support adaptability strategies for facing organizational changes that every active worker will be exposed to.

The main results of this initiative have been sufficiently encouraging to recommend its expansion at a national level and the author of this paper is currently in charge of coordinating this development under the Portuguese Ministry of Science, Technology and Higher Education.

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