

Integrated education practice in an accelerated world

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Abstract -This practice work in progress presents the perception of employers regarding the skills graduates bring to the labor market and the strategies they implement to cope with soft skill problems. It draws on an original qualitative data gathered from interviews with human resources managers of 20 firms located in the North of Portugal, a region that has been engaged in a public initiative that attempts to solve skill gaps and deficits. The findings show that employers complain about soft skills and blame higher education institutions for their skill problems. The type of soft skills required by employers reveals different strategies. The employers sampled implement remedial strategies and turn to the expertise of consultancy and other specialized services to provide training for their recent graduates. Sometimes, higher education appears as a partner for critical knowledge development. Insisting on the need to strengthening the links between different institutions in Portugal, the text underlines the assumption that a multidisciplinary approach joining social sciences and humanities with technical fields of education should be fostered as one of the solutions to cope with soft skills gaps.

Keywords— employers perception skills, expertise, critical knowledge development

I. INTRODUCTION

The changing nature of the labor market and the role of higher education (HE) are widely discussed in the literature. While individuals must cope with employability issues [1] firms are facing increasing uncertainty and volatility of their markets in a technologically advanced world [2]. Higher Education institutions are also struggling for keeping up with the pressures to respond to labor market needs. Technical fields of education that include science, technology, engineering, and mathematics (STEM) courses are expected to answer to the range of changes that occurs in different labor markets [3,4], and which are particularly vulnerable in small open economies like Portugal's. Additionally, HE is revealing increasing difficulties in dealing with the role of social sciences and humanities and develop a plausible prospect for their development within a broader national and regional collaborative skill-oriented policy. One of the major complaints of employers concerns the soft skills HE graduates bring to the labor market. Many believe that technical skills are well developed but the behavioral and social skills are lacking and HE institutions are failing in their mission of developing them in STEM [5,

6, 7]. Portuguese labor market has been an interesting case study of HE expansion and reforms, but the link with employers is still missing from the analysis. Contrary to other countries (e.g. UK) in Portugal, the engagement of employers is strongly underdeveloped, what prevents HE to access quality information on market skills' needs, as well as to collaborative training solutions with positive impact on soft skills gaps. Therefore, this paper underpins the need to address the questions about how institutions are dealing with these gaps, who is responsible for developing such skills, and how can it be done counting with a multidisciplinary policy which approximates social sciences and humanities from engineering education in a systematic, and robust way. The empirical analysis draws on qualitative data gathered in 2019 through interviews with employers (n=20) from an industrial region in the north of Portugal (*Vale do Ave*). This is a region strongly industrialized (textile, food, and metalworking) which is going through a process of expansion, giving signs of several skill shortages as well as skill gaps. The paper allows to show some of the main challenges that HE in Portugal are still facing as regards these skill problems and propose some relevant practical and policy measures with potential to be undertaken by firms and HE, in a collaborative mode.

II. THEORY

Literature shows employers' concerns over the mix of hard and soft skills business graduates [6]; or engineers [3, 5] bring to the labor market. The skill mismatch is widely mentioned as an outcome of HE institutions failure to provide graduates with suitable skills [e.g. 6, 5], including those labeled as soft [7,8]. These commonly involve a plethora of attributes notably teamwork; leadership; responsibility; self-directed learning; ethical and professional moral; project management; planning; negotiation; oral communication; interpersonal skills with colleagues and clients; written communication; creativity; ability to apply knowledge in the workspace; capacity to learn new skills; critical thinking and problem solving; lifelong learning and information management; entrepreneurship [9].

Employers are critical about soft skills of engineers, notably reporting that they lack emotional maturity [5]. This

requirement emerges not only with the globalization of markets, but also because engineers are often taking jobs not only as engineers [10, 11, 12,13] but are assigned to managing positions too, as [8] acknowledge.

Facing such constraints employers develop anticipative and remedial strategies to overcome skill gaps. [13,14] suggests that the development of soft skills involves lectures but also real world-work practices. [6,7] report a combination of academic staff and consulting companies to teach soft skills but underscore that these skills are hard to teach. In fact, consulting companies are the major providers of training to solve skill problems [6,7], as also reported by [8] regarding the teaching of soft skills to engineers. It is argued that engineering graduates should be provided with soft skills in addition to the technical ones [10]. HE institutions are therefore under pressure to teach soft skills to engineering students [6,7]. However, Literature indicates that there is no single best way to teach/develop soft skills, and it seems that it should not be confined to HE institutions.

For some, the development of soft skills involves different strategies, formal and informal activities, embedding it in existing courses [9,10] and which often include problem-based and project-based learning [14]. Literature asserts that multidisciplinary approaches to education in engineering can help anticipate and to solve soft skills problems of engineers [e.g. 15,16, 17, 18]. The collaboration with social sciences is timidly pointed out as a fruitful way for developing soft skills [15,18] as it raises engineers' awareness of social and ethical issues [8] which are increasingly considered fundamental for engineers to respond to sustainable projects [8,14]. The few available about the Portuguese case indicate that employers' engagement is almost restricted to recruitment of best students [5]. In fact, further elaboration is needed as Portugal is an interesting case study since it has implemented Bologna reforms in 2006/2007 with considerable, HE expansion since 1990s, what demanded increased challenges to engineering education [15].

III. METHOD

The data analyzed in this paper are provided by an ongoing study undertaken in Portugal with the goal of mapping and foreseeing what strategies can be developed to bring employers and higher education institutions together, for the reduction of the persistent skill mismatch, across all areas. The empirical analysis draws on qualitative data collected in 2019 through semi-structured face-to-face interviews to 20 owners and human resource managers of firms in the northern region of Portugal (county of V.N. Famalicão).

This study is regional-based and focuses on firms that have participated in an interface program that helps to solve skill and employment problems, known as *Famalicao Made In*¹. A variety of local stakeholders from this county were engaged to promote education and training, entrepreneurship, and innovation processes in the region. This region is mostly industry-based, and our sample comprises firms from the most representative sectors

(textiles, metallurgy, and agri-food), of varying size and age. The firms have been actively recruiting graduates in recent years, notably engineers, ICT professionals, and in some cases graduates from management or product design. The interviews were subjected to content analysis to answer the questions raised in this paper regarding the perceptions of local employers on HE graduates' skill gaps and deficits and the strategies they develop to solve skill problems. The content analysis provided context to rethink these data in the light of more recent discussions about the relevance of social sciences and humanities for research and education in STEM.

IV. FINDINGS

A. Employers' perceptions of graduates' skill gaps

Table 1 summarizes the main skill gaps faced by the employers in our sample. The interviews show that the set of employers are in fact unsatisfied with the soft skills graduates bring to the labor market:

“What we generically feel is that engineering students come well prepared in terms of hard skills (...). But they are not so well prepared, because the degrees are focused on technical subjects, disregarding soft skills” (Firm 6).

TABLE I. EMPLOYERS' PERCEPTIONS OF SKILL GAPS

Type of skill gaps	Number of firms mentioning this gap. N=20
Soft skills in general	11
Communication	8
Problem solving	5
Teamwork	8
Work attitudes / lack of commitment	13
Maturity	8

Most (13/20) of the employers sampled specify the deficit, notably of work attitudes and commitment with organization, while a large proportion (11/20) emphasize the lack of general soft skills:

“In terms of technical skills, I believe that is the case, they are better prepared but what they lack is in some behavioral and social skills” (Firm 2).

Additionally, communication skills, team working, and maturity are identified as skill gaps for a non-negligible number of employers (8):

“They [graduates] have difficulties in interaction and communication (...) but I don't see the universities addressing this issue of soft skills” (Firm 10).

Regarding work attitudes, employers indicate that: ... *Some are even intellectually well equipped, right? But they are not ready to listen, or to talk and so they come here and stay for a month or so but since they did not interact with anybody after half a dozen days, they are not part of the*

¹ <https://www.famalicaomadein.pt/>

team and then they disappear from here...and that has happened a lot. (Firm 3).

Furthermore, employers point out a generational gap among graduates. Younger generations are seen as much more prone to change jobs and enjoy the benefits of mobility. A lower commitment and turnover poses serious problems to human resource managers of the firms sampled: *I believe that nowadays there is less commitment to work and to firms.* (Firm 14)

The evidence reported until now corroborates previous research on the Portuguese labor market [1] and that of other countries [2]. There is a widespread perception that graduates are well equipped with technical/hard skills, but the major issue of concern is the soft skills that facilitate commitment, interaction, and responsibility, which are crucial for being on the track with the globalized world. The question now is how this soft skills gap is being addressed. As noted by the spokesperson of firm 8, employers blame HE institutions for the soft skills gaps they are facing. The next section explores employers' strategies to obtain the mix of skills desired.

B. Employers' solutions to address graduates' skill gaps

The empirical evidence indicates that a strong interaction between HE institutions and employers is still missing in Portugal. Although benefiting from a local joint initiative to tackle education and training (*Made In*), employers use HE institutions mostly as a recruitment channel (Table 2).

TABLE II. EMPLOYERS' SOLUTIONS

<i>Solutions to address skill gaps</i>	<i>Number of firms mentioning this solution N=20</i>
In company training	19
Training outsourcing	9
Search for good candidates	11
Information on candidates	9
Assessment of students by firm	2
Accreditation of training of firm	1
Teaching at HE	1
Course co-design	1
Member of HE governance	2
Collaboration in R&D	8
Internships	19

Employers draw on HE to find information on prospective job candidates (9/20) or search for candidates (11/20). However, almost all participate in internship programs providing graduates an opportunity for real-world training (19/20). Internships help them to collect information as well, and to select new hires following the training period.

In-company training appears as a key solution to cope with skill problems (Table 2). Although employers have acknowledged good preparation in technical skills, they invest in the acquisition of very specific skills, those linked

to their production systems, and especially in soft skills. Often employers recognize that they are unable to properly prepare graduates, and seek the expertise of consultancy companies, specialized training companies, and sometimes HE institutions. There is a widespread perception that the range of skills to be developed involves different disciplinary fields and may be unrelated to the world of work, at least directly:

We supply different types of training, even training which is not at all directed to the firm's activities. We provide ballet, posture, yoga [...] to us this is also training and sometimes it is more important than the technical training. (Firm 7)

The examples of strategies to cope with skill problems suggest that the employers in our sample implement passive strategies, notably using HE as a recruitment channel, rather than more active strategies that will help them to influence the supply of skills [5]. Furthermore, the major solution is in-company training; this is to say that the employers interviewed have to make (train) their graduates rather than buy (hire) fully prepared candidates in the labor market [5]. In such a context, remedial strategies [6,10] emerge as the best solution to solve soft skill problems. This solution involves costs. The firms must recruit experts for training, notably consultancy companies [6, 15,17], but some are willing to go further and provide training outside firms' core activities. The underlying assumption is that activities outside the box are relevant for the firm's success; they are often even more important than technical skills according to Firm 7. These examples illustrate that the training of soft skills involves different disciplinary fields, i.e. calls for a multidisciplinary approach [12, 18,19, 20,21,22].

V. CONCLUSION

This ongoing research illustrates the variety of skill gaps and the solutions to tackle those gaps implemented by a set of firms. The major concern of employers regards the lack of soft skills, with a special focus on work attitudes and commitment to the organization. Other skills gaps include communication and team working, i.e. interpersonal skills, and maturity. The solutions adopted to reduce skill gaps reveal risk-taking behavior on the part of the employers sampled. In-company training emerged as the key solution for skill problems. Employers bear the costs of recruiting experts from consultancy companies and other specialized firms. Sometimes they seek such services from HE institutions, notably with business schools, for non-technical training, while others interact with HE for very cross-cutting skills and probably for newly emerging technologies. One can put forward that engineering education can gain substantially from a closer relationship and pedagogical collaboration with social sciences and humanities for the improvement of soft skills. This means to adopt a multidisciplinary approach but also appropriate learning methodologies. This should be based on management expertise to prepare engineers for non-engineering jobs, to create a mix of hard and soft skills for any job that involves creativity, the ability to deal with risk, and to consider several socio-cultural factors that affect the practice engineering [12, 19, 20, 21,22].

Literature shows that HE institutions should understand that learning goes beyond technical acquisition and transfer of knowledge [23, 24,25]; it comprises a bundle of activities, some traditional, but most of them unknown. STEM graduates should be prepared for an uncertain world and be endowed with the mix of skills that prepares them for multitasking, interacting with different social groups, taking risks, and innovating constantly. Our research suggests the need to reinforce the interaction between HE and firms in order to ameliorate the communication channels between the institutions and foster collaboration in training and curriculum improvement. Pedagogical strategies such as project-based learning [14,19,20,21,] role-play exercises, industry-problem-solving and teaching-training industry oriented are to be considered. The engineering courses are more demanding, especially in the context of fast technological advances. Stakeholders from HE and employers must interact and tackle this challenge together. As noticed, no single response exists for skill problems. While the lack of maturity involves learning-by-doing and experience of the real world, other gaps involve particular pedagogical methods, more communication between hard and soft sciences, and more importantly the awareness that this is only possible with a shared responsibility of all stakeholders interested in solving skill problems.

In this context, the integration of social sciences and education within engineering programs appears to be a solution that is gaining momentum, especially in the context of the ethical and legal implications of technological advances and sustainability [8,16,17,19,22,25,27].

Nevertheless, in Portugal further research is required to properly understand whether HE institutions are working on the soft skills of graduates from technical fields of education and whether they are implementing suitable learning methods. These arguments are well-founded for research and development, teaching, and course design.

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