ARE INDUSTRIAL DOCTORATES CAPABLE OF OVERCOMING SKILLS MISMATCH?

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Abstract

This study aims to explore whether doctoral students enrolled in industrial doctorates consider that they acquire generic skills which literature suggests are valued by employers. It relies on information gathered in 2018 through six focus groups discussions with students (N=30) enrolled in all the six industrial doctorates offered by Portuguese universities, funded jointly by the Portuguese foundation for science and technology and by private companies.

Doctoral students think they are acquiring generic skills which could be relevant for a wide range of different jobs and industries. These skills include networking, communication, negotiation, teamwork and, with less emphasis, flexibility, writing skills and autonomy. Therefore, according to doctoral students, the competences gained during their degree have the potential to close the gap between employers expectations and higher education supply because these skills are fully aligned with those described in the literature and which are related to the business environment and its goals, tight deadlines, teamwork and multi-tasking.

Keywords: Drop-out; completion; socioeconomic background; higher education.

1 INTRODUCTION

In the context of higher education, skills mismatch refers to the gap between the skills which graduates possess and the skills demanded by hiring industries. Several changes have been contributing to this mismatch. On the one hand, the labour market has been through a fast technological change and has become more volatile, which in turn has led to the emergence of new professional profiles [1]. According to the literature [2], generic skills have gained more value for employers. However, a question remains whether graduates are capable of applying the generic skills acquired in higher education in a real work context [3]. On the other hand, higher education has also undergone significant changes – massification and diversification of the student body – which made it increasingly difficult for potential employers to assess the skills match in such a wide pool of candidates.

Higher education has been accused of being distant from the labour market needs and of being incapable of keeping up with changes and demand, particularly because of a poor focus on generic competences and of a lack of practical orientation [1], [4]. Among the skills that employers often refer to as missing are generic skills such as problem-solving, oral and written communication, teamwork, decision-making, negotiation, time management and business awareness [2], [4]–[7]. Assuming that higher education is partly responsible for overcoming the skills mismatch, a number of approaches have been suggested in the literature [4], [8] collaboration with business and industry in day-to-day practices of teaching and research, such as work integrated learning programmes or internships, and external collaboration in the curricular design.

Industrial doctorates are a relatively recent approach which aims to bring together academia and industry, thus presenting a high potential of closing the gap between the supply and the demand of graduate competences. Industrial doctorates are carried out in interaction between a university, a company and a doctoral candidate. In this kind of doctorates, industry experts have participated in various ways: are part of the supervisory committee, officially or informally [9] and may participate in the recruitment and selection of candidates, etc. [10]. These doctorates intend to ensure that doctorate holders have wider career prospects, as academia cannot absorb increasing numbers of doctoral graduates [11]–[13]. Therefore, these degrees are meant to prepare a new generation of researchers with ties to and competences relevant for other sectors and professions beyond academia [9]. This implies the acquisition of a different set of skills, beyond the academic skills developed in a traditional doctorate.
In their interaction with industry, doctoral students in industrial doctorates have a different training experience than those in traditional doctorates [14], which leads to differences in the skills and competences the former develop [12], [15]. Indeed, the skills tend to be more wide-ranging and more in tune with activities of commercialisation and knowledge application. Lee, Miozzo, and Laredo [16] emphasise the features of the business environment, which require teamwork and involvement in several projects simultaneously. At the same time, research projects of doctoral students attempt to solve specific technical problems or develop prototypes or specifications. Doctoral students get familiar with working practices in the industrial environment [15]- Working with heterogeneous partners enriches students’ knowledge and puts them in contact with diverse values and practices [12]. They also develop entrepreneurial knowledge and skills and an ability to establish connections with the scientific community, integrating knowledge networks valuable for businesses [17]. Lee [18] also found that industry-based experiential learning enables students to acquire negotiation skills, management and leadership skills, financial management, and the ability to take initiative and to socialise with other professionals.

In Portugal, too, improving graduates’ employability outside academia is one of the main motivations behind the creation of industrial doctorates. Portugal is among the European countries with the highest proportions of doctorate holders working in the higher education sector (83.2%) and a lower presence in the private industry sector [19]- The public funding body which supports doctoral education is the Foundation for Science and Technology (FCT), which finances doctoral programmes and individual doctoral scholarships. Out of the 96 doctoral programmes funded to date, six are industrial doctoral programmes [20] and count with a participation of 25% by companies. The responsibility for these doctoral programmes is shared by at least one university or a Portuguese university institute, a Portuguese R&D unit recognised by the FCT and a company with significant R&D activity [20]- Industrial doctorates have the same duration as research doctorates (PhD) (about four academic years). Supervision can be conducted jointly between an academic supervisor(s) and an industry representative.

This study focuses on the competences acquired by students in industrial doctorates in Portugal, a country where most doctoral programmes are traditional research doctorates. Developing a wider range of skills for doctoral graduates may increase their attractiveness for private companies. Therefore, the study aims to explore whether doctoral students enrolled in industrial doctorates in Portugal consider that they acquire generic skills which are considered in the literature as valued by employers of the private sector. Hence, the research question which guided this study is: according to doctoral students, are industrial doctorates capable of overcoming skills mismatches reported by non-academic employers?

2 METHODOLOGY

Six focus groups (FG) were conducted with 30 industrial doctorate students enrolled in the six doctoral programmes funded both by the FCT and industry. Each group corresponded to one programme and comprised students in different years of their doctoral trajectory (see Table 1 for the characteristics of the participants). These programmes fall into two main disciplines: Engineering (Refining, Petrochemical and Chemical Engineering, Advanced Engineering Systems and Biomedical Engineering) and Health and Medical Sciences (Animal Science, Health Sciences, and Pharmaceutical Sciences). All but one were full-time students and most of them had previous professional experience (70%).

All doctorates were running partnership with companies, ranging from big international/national firms to small and medium enterprises, some of them spin-offs of the research labs of the university. All programmes partnered with at least one major company. University and industry representatives shared supervision in most cases, with an academic and an industrial supervisor.
Table 1. Characteristics of the participants

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<th>FG 1 (n = 6)</th>
<th>FG 2 (n = 4)</th>
<th>FG 3 (n = 6)</th>
<th>FG 4 (n = 6)</th>
<th>FG 5 (n = 3)</th>
<th>FG 6 (n = 5)</th>
<th>Total (n = 30)</th>
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<td>Male</td>
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<td>Female</td>
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<td>15 (50%)</td>
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<td>Mean Age (years)</td>
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<td>Discipline</td>
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<td>Health and Medical Sciences (Health Sciences)</td>
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<td>Full-time student</td>
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<td>5</td>
<td>6</td>
<td>3</td>
<td>5</td>
<td>29 (96.7%)</td>
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<tr>
<td>Previous professional experience</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>21 (70%)</td>
</tr>
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</table>

Focus groups were conducted in 2018 and approached a wide range of topics about students’ experiences and challenges, from the moment of application up to the point of the focus group. In this study, the focus lies on the generic competences and skills they considered to be acquiring.

The transcriptions of the focus group were analysed using the MAXQDA software [21]. The analysis used both a deductive approach, based on the literature review, and an inductive analysis approach [22], [23]. Each transcription was coded to identify themes that were acknowledged in the literature review as key competences/skills of industrial doctoral students. The analysis also identified new themes, according to insights that emerged from the transcripts.

3 RESULTS

The students thought that their programme helped them to acquire and develop the competences identified by employers as underdeveloped and highlighted in the literature. In descending order of frequency, these were: business awareness, problem-solving, networking, communication, time management, teamwork, decision-making and negotiation.

The competence that emerged as the most prominent was business awareness, a term which, for students, includes learning about the working environment and practices in a company, sensitivity to companies’ interest in commercialisation of knowledge and the perception that research outputs must have practical applications and be profitable. Additionally, business awareness implies an entrepreneurial mind-set, which is mentioned by students as a competence acquired during the engagement with the dual culture of universities and industry. In relation to knowledge commercialisation and the disposition for setting up an own company, the following statements are illustrative:

*I am developing a device. The objective of my PhD is to validate it and put it on the market, therefore we need to get an idea of what the market demands are, of certifications, everything that is needed to get the product ready for sale. And this gives us more experience to join afterwards a company which makes medical devices...Because we are not only doing research, we produce something to be commercialised (FG4).*

*I'm going to be honest, I am fully satisfied, I am really happy where I am. I have no clue what the future brings, but I'm not scared. I honestly don't know whether I am going to work in the companies I am currently with or in others or if I will have a company of my own. It’s not something I leave out (FG3).*
The second most important acquired competence referred to by students is problem-solving, which is tightly related to the nature of the programme where research is driven by concrete problems that industrial partners expect candidates to solve. For example, according to one student:

I think we gain practice, at least I feel that, because we need to solve problems with tight deadlines. That problem is there and we have to solve it because the company won’t wait. I am being a bit extreme, but I think it’s a bit like this. We have knowledge of the problem, we have the theoretical basis to solve it and we put it in practice (FG 5).

Networking and communication appeared as competences with similar weights. While the programme offered opportunities for networking, seen as developing a wide range of contacts both in academia and in industry, in terms of communication, the students said that during the programme they learnt how to present scientific results, how to talk to people of other disciplinary backgrounds, how to “sell” and to justify their ideas, and how to act as a bridge between industry and academia. Two students expressed these ideas as follows:

This issue of contacts is something rather important, not only with the company with which we work, but also with others. I have been going to exhibitions, fairs, in my case I am working with cat and dog food, there is this kind of events and since I am working in a company I also get to reach people and talk to them, and this is important (FG 3).

How to communicate in science, how to write an article, how to speak with a journalist in an interview, how to make a presentation, these are all transferable competences which I have learnt, but did not believe I would acquire (FG4).

The competences that students believed to be developing, but to a lesser extent, were: time management, especially because of the difference between the value and cost of time in industry as opposed to in academia, requiring precise timelines and strict deadlines; teamwork, given the collaborative nature of the programme and the insertion in a company; negotiation, that is the ability to reconcile different and, in some cases, conflicting interests; and decision making, which is informed by research evidence obtained in the doctorate. The following transcript is representative of negotiation skills to ensure that the tasks during the doctoral research were more aligned with the objectives and nature of the industrial doctorates:

We have learnt to negotiate the deadlines with supervisors and getting out of this comfort zone is important. Before, what professors said used to be law, then it became less and now they no longer have that power. The practical example comes from a course in which we were asked to do a monography. We said “For God’s sake, no!” The task ended up being something completely different, working with a robot. It totally changed because we said no “ask us to work with something else, but please do not make us write again” (FG1).

These transferrable skills, which students deem to develop during industrial doctorates, reflect those described in the literature as valued by employers and which are associated with the business environment and its goals, tight deadlines, multi-tasking and teamwork required by the engagement with several actors [16]. Actually, these skills are, as argued [12], broader and more aligned with industrial activities of commercialisation and application of knowledge. It seems, therefore, that doctoral students enrolled in industrial doctorates in Portugal consider that they acquire generic skills which literature suggests are valuable in the private sector.

4 CONCLUSION

Higher education has been accused of being distant from the labour market needs with regard to the competences students develop during their studies. Most criticisms address the poor preparation in generic skills and students’ unawareness of work and business practices. Nevertheless, at least in Portugal industrial doctorates seem to represent a step in the direction of closing the gap, shortening the distance between education and the world of work. This evidences that higher education is assuming its responsibility towards the society and the economy, opening up and collaborating with private businesses [10]. Industrial doctorates reframe doctoral education as they train students to be able to fulfil roles outside academia.

According to our findings, the students enrolled in industrial doctorates are of the opinion that they are acquiring the skills highlighted as wanting in the world of work. Since generic skills are precisely those where mismatch is claimed to exist, and since industrial doctorates appear to be a means of
developing these skills, these programmes arguably have the potential to overcome the skills gap reported by non-academic employers. These findings would gather even more strength if supported by the perspective of employers. Future research could investigate whether the companies which host students enrolled in industrial doctorates also agree that these students develop the expected generic skills during their degree.

If we understand the purpose of higher education as training students to be future employees “ready-to-work” [6], then it would make sense to intensify the investment in the provision of higher education closely aligned with labour market needs. Nonetheless, one must bear in mind the wider purpose of higher education beyond graduates’ immediate employability. Higher education strives towards sustainable employability [24] which enables “ready-to-learn” [6] graduates who possess the capacity of adaptation, flexibility and life-long learning, especially because the labour market needs are in constant change. In this case, employers also have to acknowledge their responsibility for the on-the-job training of graduates.

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