



Let's Talk About Doctoral Education. A Reflection Regarding the Changes on it

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ABSTRACT

Doctoral education is the link between research and higher education, being a hybrid area. In this context, the doctoral research project must correspond to the demands of both areas. The PhD supervisor must be a team leader and, at some time, a doctorate guide, and a teacher. The PhD students must learn how to be a part of the research team, and simultaneously develop their research skills and knowledge. But PhD continues to be an individual and solitary journey, being the justification for it, the originality of knowledge created during the PhD. In the last years, in Portugal, PhD students and PhD supervisors were auscultated. The supervisors' rules were captured, doctorate experiences were collected, and supervision processes were analysed and deepened knowledge about doctoral education. But still, this vision is incomplete not only because few supervisors took part in the research (first because the sample population were limited to one Portuguese University (NOVA Lisbon University) and secondly, because most of the PhD supervisors didn't respond to the surveys. The data presented in this paper is part of a larger study that started at UNL before the pandemic. It examines the supervisor's opinion regarding the PhD curriculum, constraints faced in day-to-day supervisor life, changes that may improve doctoral education (completion rates, decrease in attrition, curriculum, team supervision). But he also captures the doctorate perceptions regarding the doctoral research monitorization activities and instruments, constraints, and positive aspects during the PhD journey and, changes to be made in the PhD curriculum.

Keywords: Supervision; doctorate; doctoral curriculum; team supervision

INTRODUCTION

The doctoral population is diverse in age, life experience and background, expectations, and objectives. The university must respond to their needs and allow them to complete their PhD journey with success.

Doctoral education is an area with an impact on universities internationalization, as it allows partnerships with other higher education institutions, through PhDs and research projects, being essential to capture national and international students and foster excellence in academia.

If on one hand, attracting students to enrol in doctoral degree will benefit from consistent teaching and, from researchers who can bring innovation to the industry by creating links with

the university (which may bring funding and patrons), but also by developing so-called fundamental research (at the service of science) and so-called applied research (at the service of society). On the other hand, doctoral education is linked to research development, scientific dissemination (publication of articles, books, participation in congresses, colloquia, seminars, among other activities) and, a bridge to the research area. The research area is also relevant, not only to produce knowledge but also for the business/entrepreneurial dynamics that it has underlying.

Doctoral supervision is one of the activities carried out by university professors, and researchers, which requires more personal effort. Not only because it has inherent to it, the almost daily updating of knowledge and techniques, but also because it requires them to have team leadership and interpersonal and communication competencies. Like other teaching activities, doctoral guidance and supervision have institutional rules that fit it into a legal regime, at the institutional (related to university autonomy), national and international level. Understanding the laws and legal framework of the various actors in doctoral education (institutions, doctoral students, supervisor, partnership) will help to understand and establish a general framework. Knowing which goals underlie the doctoral degree, the profile of the doctorate at the end of the process, as well as what type of supervision are (or does not) underpinning the legislation, is relevant to understanding the supervisory activity.

But what is an advisor /supervisor? Is someone who supervises and guide the student? someone who accompanies the student? Someone who teaches (teacher)? or someone who walks, sometimes ahead (to "pull"/ encourage and show the way!), other times next to (to follow) and who sometimes stays behind (to see which way the student will take)? Maybe it's a little bit of everything, a teacher, a companion, a discoverer. In this sense, guiding a student is more than teaching and giving tools, is motivating, and reflecting together, is seeking the (im)possible... on a path to discover, create and construct original knowledge.

If education is defined as a process of socialization of individuals that implies the assimilation and acquisition of knowledge that enable its integration into society, doctoral education is the development of research skills, socialization, and enculturation of PhD students in a research field, academia and, in a scientific culture.

Doctoral degree

PhD journey is a period during which, a student learns to do research, the ethics of research, the intellectual rigour required of a researcher, how to put and frame research questions and to follow a clue but also learn how to pursue research and create and construct knowledge, mould and adapt the research question, and finally complete a piece of original research.

But the knowledge produced during this time should benefit society. This designation that began in the mid-nineties of the twentieth century implicitly reflects a paradigm shift of what a doctorate is and what its function is. The change in the paradigm (This change, i.e. shifting from programmes focused on content acquisition to skills-centred programmes covering all teaching cycles.), i.e the change in the perspective of the objective of the production of knowledge and the transition from content-focused doctorates to PhD programs focused on skills was based on the need for doctoral candidates to develop transferable skills, but also research skills and was evidenced and evidenced in specific doctoral programs, structured and directed to the

needs of society, namely potential employers, universities and foundations that finance scientific research (Huisman, from Weert & Bartelse, 2002; Keeling, 2006).

This rethinking (for instance, in Great Britain and Australia, the binary system in higher education was abolished, which favoured the implementation of professional doctorates (Neumann, 2005)) in key areas such as science, technology, economics and education took a new concept of doctorate- professional doctorate (PD). This new PhD design has characteristics that distinguish it from traditional doctorates, PhD (doctorate in philosophy), which is characterized by the investigative nature and development of academic knowledge, but also have points in common.

The profiles of both doctorates imply creativity and originality, nonetheless, traditional PhD is based on research, with a degree of expertise and high knowledge in a specific knowledge area, while professional doctorates are associated with the acquisition of professional knowledge and research skills, to develop or improve professional practice ((Evans, 2002; Lee, 2009^a; Boud & Tennant, 2006). As a result of the different proposals and purposes, the supervisory process during the doctoral program should also have different characteristics (Radloff & Styles, 2001; Lee, 2009b; Maxwell & Smyth, 2011; Baptista, 2015). The doctorate, PhD or professional doctorate comprises, "... mastery of the subject; mastery of analytical breadth (where methods, techniques, contexts, and data are concerned) and mastery of depth (the contribution itself, judged to be competent and original and of high quality)." (UK Council for Graduate Education (1997:11)). This is recognised by supervisors and doctoral candidates of both types of PhD (Boud & Tennant, 2006).

Some researchers have analysed the process of doctoral supervision from the point of view of institutions (institution and student funding, student support, socialization process, resources available to them, facilities, among others) (Kyvik & Smeby, 1994; Golde 1998; Gardner, 2006, 2007 e 2008; Wao & Onwuegbuzie, 2011; Mello, Fleisher & Woehr, 2015; castelló, Pardo, Sala-Bubaré & Suñe-Soler, 2017), from the point of view of students (their socialization, how they feel in the academy, main difficulties encountered, blockages, help, personal process, completion times) (Kiley, 2015; Lindsay, 2015; Woolderink, Putnik, van der Boom & Klabbers, 2015; Ayers, Kiley, McDermott & Hawkins, 2016; Hunter & Devine, 2017; Bastalich, 2017; Cornér, Löfström, Pyhältö, 2017; Spronken-Smith, Cameron & Quigg, 2018), from the supervisor's point of view (available time, funding, project, publications, impact on your career, your availability for supervision, the meaning of what supervision is, what doctoral research is for you, among others) (Watts, 2008; Deuchar, 2008; McCallin & Nayar, 2012; Bøgelung, 2015; Delvos, Van der Linden, Boudrenghien, Azzi, Galand & Klein, 2015, Benmore, 2016) but also from the point of view of society (how the funding of doctorates is used, what are the benefits or disadvantages of research, what interaction is academy/labour market, what is its impact on social well-being, research ethics, etc.) (Lafont, 2014; Titus & Ballou, 2014; Bøgelung, 2015). These perspectives have allowed an informed and conscious reflection of doctoral education in its various facets and on the process of supervision.

Supervision process, product, and nature

The thesis is the product of a PhD journey. As Park (2005) emphasize, "Typically, a PhD thesis is expected to embody independent research carried out by the author, and through that to demonstrate that the student has located the research within a discipline or an interdisciplinary

context, has shown an ability to carry out independent research as an autonomous practitioner, and has made a substantial contribution to knowledge and advanced understanding.” But this assumption is not the traditional one which “privilege the creation of new knowledge over the application, extension, interpretation or questioning of existing knowledge” (Park, 2005). But the formation of the researcher is also a product of a PhD and to this contributes the process inherent to it. The PhD process involves the transition to a new culture and context within higher education (Park, 2005; Christensen & Lund, 2014), which involves a process of socialization that can be difficult without the support of a supervisor (Gardner, 2007 and 2008; Mainhard et al, 2009; Halse 2011).

Currently, in universities, as important as teaching and learning activities, in the first and second cycle, is the supervisory work of PhD students. Supervision cannot be reduced to the way it is performed (activities, attributes, behaviours), but should also include what it means for the supervisor (what it means for the supervisor) and the PhD student.

Wright, Murry and Geale (2007) considered that "(...) the meaning of supervision is not fixed or constant but is socially constructed by, and between, supervisor, students, and other members of the academic community based on their lived experiences" (Wright, Murry & Geale, 2007).

Supervision is related to the supervisor, the doctoral, the nature of the research project, but also to the relationship established between supervisor and doctoral program, Fig. 1. During the doctorate emerges a dialogical teaching and learning process, not only between the supervisor and the PhD student but also a creative and transformative process, which should be contextualized and related to the educational policies of the institution where it occurs.

Doctoral supervision has four pillars, the PhD students, the supervisors, the institution, and the research project, Fig.1. The project research development depends on the physical resources (equipment, and apparatus, physical place/space provided by the institution) and financing conditions, supervisor guidance and students execution and planning but also of the supervisor and PhD student relationship. The supervision process depends directly on the supervisor background (experiences as a PhD student, personal research sign, doctoral meaning, interrelation competencies; emotional intelligence) their capability to guide the student during all PhD journey, and as, in a first moment leader the research project and in a second moment to pass this leadership for the doctoral candidate. But it also depends on the PhD student (personal beliefs, personal objectives, capacity, and competencies, meaning of research, meaning of doctorate), of the relationship established between supervisor and doctorate and the doctoral curriculum (support given by institution, and skills developed by the doctorate).

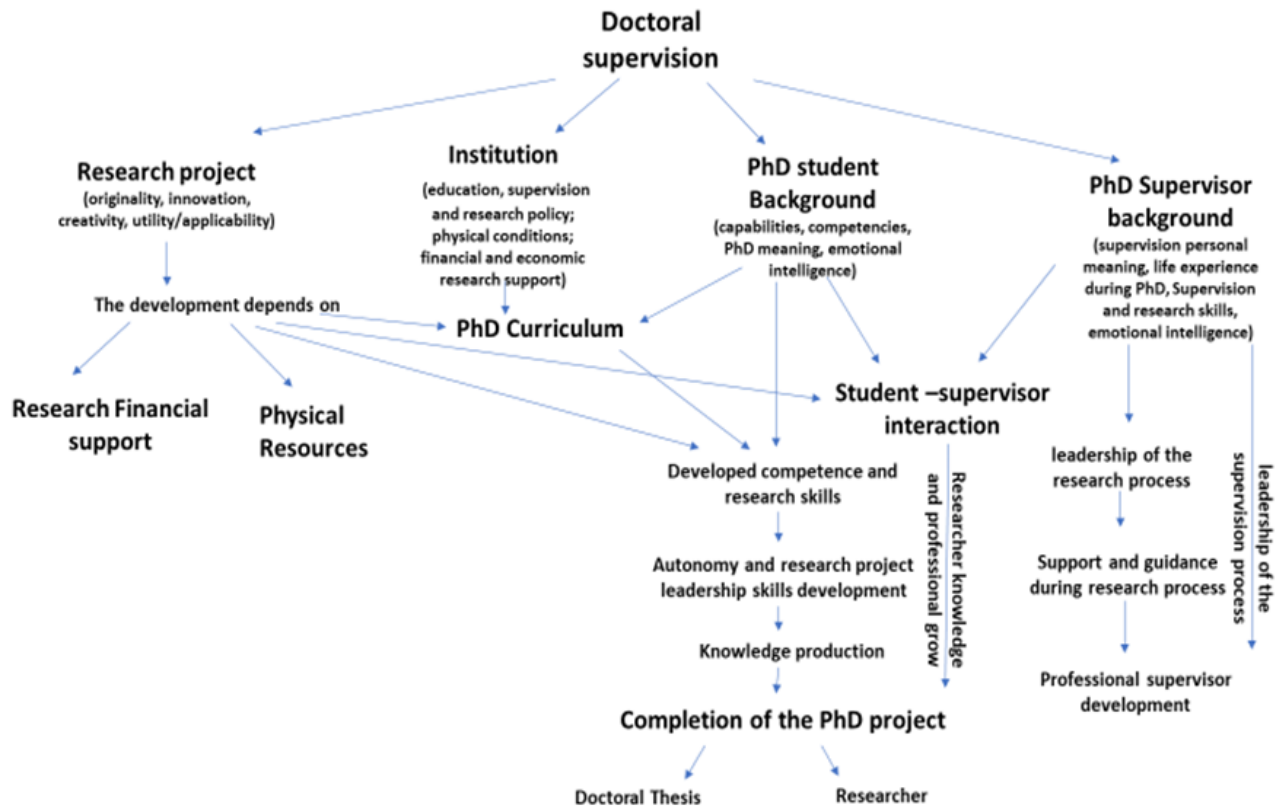


Figure 1. The various interrelationships in a process of doctoral supervision.

From the competencies developed by the PhD students, during the research process, emerge the doctorate research autonomy and research leadership skills, and the production of original knowledge that leads to research project completion.

The supervisory process is dialogical, creative, and transformative. The three elements' keys, in doctoral supervision, are the institution, the supervisor, and the PhD student. They all are connected by the doctoral program research. These three elements influence each other throughout the doctoral journey, allowing (or not) the completion of the doctoral project. If, on the one hand, the supervisor is one of the key players in completing the Doctorate, the doctoral student is the other. But, although doctoral students are adults with a wide range of skills, the doctoral process is unfamiliar to them, being a barrier or constraint to acquiring the doctoral degree. For a complete analysis of the supervisory process, one must look at each element involved in the supervision process, to understand how they interact, fit, and adjust. In this process, institutions play an important role since they give the social, physical, and political context to supervisory practices, but also the conditions of economic, financial support for it to occur.

Doctoral Education: past, present, and future

Worldwide, interest in doctoral education has emerged at the end of the twenty century and flourished in the twenty-one (Jones, 2013; Bastalich, 2017; Sverdlik, Hall, McAlpine & Hubbard, 2018). In Europe, with the Bologna Process and the Lisbon strategy approved in 2000, the importance of doctoral education was recognized as also the supervision process.

Armstrong, in a paper published in 2004 stated that “(...) supervision itself is often regarded as ‘the single most important variable affecting the success of the research process’ (ESRC 1991, p.8). Whilst there have been numerous testimonies to its critical importance, there have also been reports of its exceptional difficulty (Acker, Hill, & Black, 1994). It has been described as ‘probably the most responsible task undertaken by an academic’ (Burnett, 1977, 17), ‘the most complex and subtle form of teaching in which we engage’ (Brown & Atkins, 1988, 115), and ‘the most advanced level of teaching in our education system’ (Connell, 1985). As several authors have pointed out, however (Hill, Acker, & Black, 1994; Hoshmand, 1994), such observations seem curiously at odds with the general dearth of research on the detailed nature of supervision. (...)” (Armstrong, 2004).

The supervision of PhD students has been subject to research and analysis in several countries around the world, with the themes of these studies, doctoral teaching, the design of doctoral programs, writing and research during doctoral studies, employment and professional careers, the supervisor-student relationship, and the doctoral experiences of students (Jones, 2013). Bastalich (2017) also analysed papers related to doctoral education and, from the literature review, found major areas of analysis whose central themes were the contents and contexts of the production of knowledge during the doctorate. The areas identified were the improvement of supervision relationships, government regulations, the pedagogy of research, academic socialization, and subjectivity. In 2018, Sverdlik, Hall, McAlpine & Hubbard, published a review of the factors influencing doctoral students’ completions, achievements, and well-being. Which illustrates the importance of doctoral education in the last twenty years (Sverdlik, et al., 2018).

The Bologna Process and the Lisbon agenda (2000) where the European Commission highlighted the importance of higher education and its role in the Europe of knowledge, assumed that higher education is the key to improving citizenship and developing knowledge societies that promote welfare, equality, and social justice (Keeling, 2006; Alves et al., 2012). As Kehm points out, “Doctoral education is currently high on the higher education policy agenda in Europe. It does not only represent the most important interface between two major reform processes, the Bologna Process to create a European Higher Education Area and the Lisbon Strategy to create a European Area of Research and Innovation; it is also a focal point in national and regional policies vis-à-vis the emerging knowledge societies and economies” (Kehm, 2009: 229). In Bergen (2005) and Salzburg (2005), the qualification framework and the ten principles for the third cycle were approved, respectively, remain the guiding thread of the current educational policies of higher education institutions for this level of education.

The Bologna process, whose central objective is to establish a common, easily understandable, and comparable structure of academic degrees in higher education, initially focused on the first and second cycle. The objectives of the Bologna process expressed in the respective declaration are as follows: Adoption of a similar system of academic degrees; Adoption in higher education of a three-cycle system; Promoting mobility; establishment of a credit system; promoting European cooperation in the field of the quality of evaluation; Promoting the European dimension/vision at the level of higher education. If the Bologna declaration focused on the first two cycles of higher education, stating that the second cycle would lead to the attainment of the master's degree and the continuation of studies to obtain the doctor's degree in Berlin, the third cycle was defined as the doctoral programs /doctoral studies. In this context, only doctorates

retain their meaning (their definition/writing in the Law is not changed and, the degree of the requirement remains), although, some are now structured (students must attend classes/seminars, or doctoral courses a curricular component in the early years). The European higher education area is thus definitively structured in three cycles. Each level has the function of preparing students for entry into the labour market, being the basis not only for the subsequent development of skills but also for the construction of active citizenship.

With the Lisbon Strategy (2000) and the importance of the third cycle for Europe emphasized, a reflection among its objectives, what means to achieve them, emerge, as the notion that European Research Area is linked to higher education.

As the Bergen report (2005) refers to, it is possible to identify four main objectives of higher education: preparation for the labour market; training active citizens in democratic societies; promoting personal development; development and maintenance of an extended and advanced knowledge base (Bergen, 2005: 23). In this context, doctorates gain a new dimension and importance.

At the Berlin conference in 2003, for the first time, doctoral studies, and synergies between the European area of higher education and the European research area were the subjects of analysis and reflection. At this conference, these areas were considered the pillars of a knowledge society and it is stated that there is a need to create links between the two. As the document states: "Conscious of the need to promote closer links between the EHEA and the ERA in a Europe of Knowledge, and the importance of research as an integral part of higher education across Europe, Ministers consider it necessary to go beyond the present focus on two main cycles of higher education to include the doctoral level as the third cycle in the Bologna Process. They emphasize the importance of research and research training and the promotion of interdisciplinarity in maintaining and improving the quality of higher education and in enhancing the competitiveness of European higher education more generally. Ministers call for increased mobility at the doctoral and postdoctoral levels and encourage the institutions concerned to increase their cooperation in doctoral studies and the training of young researchers." (Berlin Ministerial Communiqué, 2003).

In 2005, at the ministerial meeting in Bergen, the qualifications framework for the European area of higher education was defined based on Dublin descriptors. In the same year in Salzburg (2005), the ten principles for the third cycle were approved, highlighting some issues of this level of qualification, and particularities of obtaining the doctor's degree. The third cycle includes a wide variety of doctorates, involving different models and structures and which can go from fully structured and educated doctorates, to partially structured and less educated doctorates or even unstructured doctorates.

These models have several implications not only regarding supervision, the responsibility of those involved in the process (institution, doctoral student, supervisors), the resources applied in the development of doctoral research, of the possibility of links between host institutions and companies or social organisations but also the status of doctoral candidates (part-time/full-time students, employed in institutions or researchers at an early stage of their career/young professionals). In this context, questions related to the aims of doing a doctorate, the structure was chosen for each doctorate arise, although a basic component of doctoral

training is the deepening and discovery of knowledge through original research. On the other hand, the need to meet the expectations of the labour market that is more comprehensive than the universe of academies and can also be one of the options at the end of the doctorate is also emphasized (Salzburg Principles, 2005). In the London Communiqué in 2007, it is stressed that the link between EHAE and ERA remains important, as well as the career prospects of doctoral students and the sharing of experiences between higher education institutions.

In 2012, in Bucharest, during the meeting of ministers with the higher education area, a document published that underlines the importance of quality doctoral education for all: "Doctoral Training, we will explore how to promote quality, transparency, employability and mobility in the third cycle, as the education and training of doctoral candidates has a particular role in bridging the European Higher Education Area (EHEA) and the European Research Area (ERA). Next to doctoral training, high-quality second cycle programs are a necessary precondition for the success of linking teaching, learning and research. Keeping wide diversity and simultaneously increasing readability, we might also explore further possible common principles for master programs in the EHEA, taking account of previous work. (...)." (Bucharest, 2012). It is here recognized the need to increase the master's degrees quality to allow the continuation of studies and the subsequent success of all students.

In 2015, a report entitled "The European Higher Education Area in 2015: Bologna process implementation report" was published, the development and implementation of the Bologna Process. By reading the document, it is possible to verify that Portugal has implemented all the guidelines emanating from the institutions that, its charge, its regulation, and implementation of the process (EHEA), incorporating them, when necessary, in its laws.

In the same year (2015), the "Standards and Guidelines for Quality Assurance in the European Higher Education Area" with standards and general guidelines were published, to ensure quality in higher education. This document contains the European standards and guidelines, for the internal quality assurance of higher education. It emphasises quality policies, programme and curriculum design, student-focused programmes, and education assessment. The admission, progression, recognition, and certification of students were focused on that document, as well as the teachers' profile, learning resources and student support, or information management, public information, monitoring and periodic review of higher education programmes.

Doctoral Education in Portugal

A brief contextualization of the rules that frame the doctoral education in Portugal at the national, will be presented.

The decree-law No. 216/92 of 13 October of the Portuguese Republic states that "The doctor's degree proves the achievement of an innovative and original contribution to the progress of knowledge, a high cultural level in a given area of knowledge and the aptitude to carry out independent scientific work" (Chapter III, Article 17, paragraph 1), in Decree-Law No. 74/2006 of 24 March (Chapter IV (PhD), Article 28 (Doctor's Degree)) the doctor's degree has a more comprehensive definition of what it means to obtain the doctor's degree reflecting already the Dublin descriptors approved in 2004.

In 2013, Decree-Law No. 115/2013 of August 7, which makes the third amendment to Decree-Law No. 74/2006 of March 24, states in Article 38 that: "The legal and statutory competent body of each university approves the rules relating to the following matters:

- (a) rules on admission to the study cycle, academic and curricular conditions, application rules and selection criteria.
- (b) the existence, duly justified, of a doctoral course and, where there is, the curricular structure and study plan and the conditions under which the respective frequency should be waived.
- (c) the procedure for appointing the advisor or advisors, conditions under which the co-orientation and rules to be observed in the guideline are allowed.

The objectives of obtaining the doctor's degree are revised in Article 31 of Decree-Law No 107/2008 of 25 June in paragraph 3: "The cycle of studies leading to the degree of doctor should primarily target the targeted learning of high-level research practice, and may, where appropriate, be included, where the respective regulatory standards justifiably so provide for it, the implementation of curricular units aimed at research training, the whole of which is called a doctoral course, in which case the conditions under which the frequency of that course should be waived."

In 2018 the Portuguese law had changed, and one of them is Article 31 (point 3) which states that "the cycle of studies leading to the doctorate must essentially aim to guided learning of high-level research and development practice, and may, exceptionally and when duly justified in the context of the accreditation process, integrate the realization of curricular units aimed at research training."

But although legislation changed, according to the international requirement, Portuguese Higher Education remains a field little known. In recent years, the number of publications (doctoral theses, papers), seminars, meetings, and congresses, regarding it, increased. But these was a consequence of the implementation of the Bologna Process (which led to changes in higher education structure, organization, curriculum and teaching practices and methodologies), not of reflection or analysis and assessment by institutions, supervisors, politicians, or society. Teaching now is seen not only as local but at an international level, as its quality is canvassed by national and international institutions.

Doctoral supervision in Portugal is little known and studied. The legislation of the Portuguese Republic that regulates the third cycle omitted regarding how supervision should be performed, the role of the supervisor and doctoral student, and attribute to each higher education institution its regulation. Given university autonomy, each higher education institution has its regulation on the acquisition of a doctor's degree and doctoral supervision (Ribau & Alves, 2017; Ribau 2018, 2019, 2020, 2020a).

The present paper presents two visions of the supervision process, regarding PhD students and others given by supervisors. This research aims to present the two faces of the same process.

METHODOLOGY

In the present research, doctoral supervision is understood as systematic research training, which implies the monitor and evaluation of the doctoral research project development, as well

as the guidance of the student, during the doctoral journey. In this context, this concept is broader than the concept of orientation.

The research aims were to capture the supervisor and doctorate reflections regarding the quality of the PhD.

A survey to collect data regarding doctoral supervision, namely their procedures during the PhD research monitorization, the PhD curriculum of their host institution, the team supervisors/joint supervision, was constructed, with open and ended questions.

To collect data regarding PhD students and capture difficulties faced daily the feelings, and emotions experienced along with their doctoral journey another questionnaire, with open and ended questions was constructed. It allows us to reflect on the role of each player (institution, supervisor, doctorate) and what support is provided to PhD students.

The two surveys were delivered, via institutional e-mail at NOVA School of science and technology (this school belongs to Universidade Nova de Lisboa, which is a public higher education institution, with high levels of research inputs) to the supervisors. The surveys were open for three months in 2019. Forty-four PhD supervisors answered the survey, but only 24 responded to the open question. Eighty-eight doctorates responded, which corresponds to 16.5% of all PhD students enrolled in NOVA School of Science and Technology PhD, but only forty-four answer the open questions. In this paper, the results of open questions are presented and discussed. The other questions (close questions) were presented elsewhere (Ribau, 2020b, 2021).

RESULTS AND DISCUSSION

The supervisor point of view

During Doctoral Research Monitorization and guidance. During the survey, some open questions were presented. Not all the supervisors, that answered the survey responded to the open question. Only twenty of them responded to the open questions, but they presented a clear view of what their rule as supervisors is.

Doctoral Research Monitorization and guidance

Eighteen supervisors of the 24 respondents reported having periodic meetings (frequently/ weekly) to discuss the data with students. Three supervisors ask students for "status updates" reports, write summary reports, or write papers and, two follow the students work by speaking with students frequently. Only five supervisors refer constrains bureaucracy (for three), funds (one), adequate space/equipment for research. One also refers to the inability of PhD students to meet deadlines.

Doctoral curriculum

In 2018 the Portuguese law stated in Article 31 (point 3) "the cycle of studies leading to the doctorate must essentially aim to guided learning of high-level research and development practice, and may, exceptionally and when duly justified in the context of the accreditation process, integrate the realization of curricular units aimed at research training." In this context, open questions regarding the curriculum units/disciplines that usually PhD students must enrol in the first year were asked.

Seven supervisors of 24 consider the curriculum units irrelevant, one of them says *"Absolutely irrelevant and counterproductive. UCs are simply a manifestation of the failure of master's programs."* Others emphasize that *"Not relevant. The learning of the theme must be directed towards R&D activities as it happened before the implementation of the curricular structure of doctoral plan."* Or as other stats *"No. Only if they are UC soft skills. It makes no sense to miss a lesson in classes that are only partially related to the thesis topic. The supervisor should define with the student the background he/she needs for the development of the thesis work. Both should find the best way to make it available to the student."* And other refer to *"Irrelevant, these students have different needs and since they are well oriented, they can acquire the knowledge of base they need in other ways, without going to classes"*.

On the other hand, two supervisors consider that *"In view of the diversity of student backgrounds that I direct / orient, I feel the need for further training in some areas. However, even if there were no UCs, it would be up to the Advisor to find a way for the student to acquire these skills, usually through tutorial classes. So, I do not consider the currently existing formal UCs to be essential. I already think that the orientation should correspond to some teaching service since it requires a lot of time from the advisor."* And the other states *"It depends on the doctorates; in the case of the programs, I participate it is irrelevant."* So, it seems that the irrelevance of the curriculum units is related to the fact that they aren't adequate to the students and supervisors need.

The rest of respondent supervisors consider that curriculum units are important. It is important to highlight some statements as they show some problems faced by supervisors and PhD students. The diversity of students' backgrounds may be a problem if there are no curriculum units. As a supervisor refer *"A student entering a doctoral program does not have strong specific training. You may only have a three-year degree, complemented by a two-year master's degree. Therefore, complementary training is required, related to the area in which the research will focus. The curricular units of the doctoral program will complement this initial training."* Others also indicate this problem *"I consider it a sine qua non-condition, particularly when we are dealing with Doctoral Programs that are not preceded by 1st and 2nd cycles. Additionally, I think that a year with curricular units, with guided readings and their discussion, allows the doctoral student to start research in a position of advantage. I think that only in extremely practical doctorates the need for curricular units may be less strong, although desirable."* or has other say *"A student entering a doctoral program does not have strong specific training. You may only have a three-year degree, complemented by a two-year master's degree. Therefore, complementary training is required, related to the area in which the research will focus. The curricular units of the doctoral program will complement this initial training."* So, for these supervisors it is important to have mandatory units because, as one supervisor says *"Additional curricular units are important to guarantee basic scientific training in the area, and to learn basic notions of scientific communication, ethics and entrepreneurship. The disadvantage is the time it takes vs the laboratory time needed to develop the thesis."* Other corroborate this idea saying *"I consider it important that there is a certain number of credits for the realization of curricular units because sometimes doctoral students come from different areas and need some bases to adapt to their new reality. In any case, I believe that 30 ECTS is sufficient and that doctoral student who does the thesis in their previous training should be able to be exempt from all or a large part of these credits. I also consider that the limitation of the curricular units to have to be of 3rd Cycle does not make any sense, considering my justification for considering the doctoral course important."*

The supervisor feels the necessity of students' frequent curriculum units because their background is insufficient to start doing research. They must deepen professional ethics and differentiated research tools, scientific writing and oral communication, statistical treatment, develop research methods and soft skills / transferable skills, Research Ethics, Create and develop Thesis projects. The units must be adequate to all doctorates (transferable Skills, and soft skills), and not specific. There should be flexibility in the type of mandatory units that students must do – they should respond to their needs.

Supervisor's team in supervision. Regarding the supervisor's teamwork in supervision, a question regarding it was presented with the aim of having the supervisor's view "The orientation of a doctoral project is often carried out in conjunction with other academics or researchers (advisor or co-supervisor). Refer to the advantages and disadvantages of this practice for the development and implementation of a doctoral project."

All twenty-four supervisors refer to advantages and almost all refer to disadvantages. In Table 1, the principal ideas are presented.

Table 1. Advantages and disadvantages of the orientation of a doctoral project carried out in conjunction with other academics or researchers (advisor or co-supervisor) for the development and implementation of a doctoral project

Advantages	Disadvantage
<ul style="list-style-type: none"> • Group feeling - belong to a group • Minimization of psychological anxiety problems • Diversity of areas. Transdisciplinary • Complementary knowledge /look for colleagues with the knowledge that is complementary to the project • Multidisciplinarity/ interdisciplinarity • Increase the interconnection between people and knowledge • Different perspectives / complementary perspectives on the challenges / Different approaches taken by the partners • "Networking" (the fundamental concept for any successful investigation) • To share guidance whenever projects address more than one area of research /distributed and lighter work for each of them • The existence of more than one advisor promotes the discussion of ideas and facilitates the support to be given to students • Enrichment of concept transmission and better monitoring of the student /there are more ideas for discussion. • Sharing knowledge and tasks • Different points of view and, even better, different aspects of the theory/methodology / research / data / software 	<ul style="list-style-type: none"> • disagreement about the path that the project should take when faced with crossroads. • greater likelihood of disagreements. • the disadvantage occurs when the advisors' perspectives are opposite and one of them negatively exploits these differences • being able to reconcile the availability of several advisors and that all participate with the same degree of time in the thesis. • both must have the same guiding principles • lost in a monitoring capacity • dilution of responsibilities • risk of "excessive" information and demand. • Sometimes the work is unbalanced (it is more about some) and conflicts arise.

Some supervisors have a neutral view regarding co-supervision, one stat *"It is my opinion that there are no advantages and disadvantages per se, that is, co-orientation should be used when it is necessary to gather a set of expertise from different areas."* others say *"It all depends on the area in which the doctoral work is focused. If it is a border area, which each of the co-advisors only partially controls, as long as there is good communication between them, a co-orientation can be beneficial."*

Many supervisors stress the advantages of multidisciplinary, transdisciplinary or interdisciplinarity. As one supervisor says *"Multidisciplinary helps in creative construction. It is very important because more and more there is a crossing of knowledge in a thesis and the doctoral student must have specialists in the different areas in which his doctorate is taking place"*, others emphasise the interconnection of different fields *"The advantages are greater knowledge sharing and broadening the doctoral student's horizons based on different inputs"*, or *"It allows bringing together specialists from different areas in a single project."* Others point out the students support *"It is good because it allows the student to have the support of people with different knowledge."* or learn to communicate *"It allows a multidisciplinary work and the adaptation of the doctoral student to different forms of communication"*.

Others underline the importance/necessity for some doctoral research of the supervisor team *"The conservation area is very interdisciplinary, and it is impossible to gather all the knowledge necessary for the efficient development of a doctoral thesis in a single supervisor. I think the advantages outweigh the disadvantages. It opens up possibilities for a greater multidisciplinary and more comprehensive discussion, which seem to benefit the thesis."*

As for disadvantages, the supervisors' mention is disagreements related to the research pathway, reconciling the availability of several advisors, unbalanced work, loss in monitoring capacity. As one writes in the survey *"The advantages and disadvantages are more linked to the relationship between the supervisor and co-supervisor than to the structure of the orientation. If the supervisor and co-supervisor have a relationship that generates synergies, it can only be positive; if they have a relationship with conflicts, it will only create additional and unnecessary problems for the doctoral student. Disadvantages: the difficulty of coordinating time availability. Advantage: sharing different ideas"*.

How to improve the PhD completions? some suggestions

Finally, where ask to supervisor proposal to improve PhD completion and reduce attrition. Some supervisors responded that there were no necessities of change or didn't answer. But four areas were referred by the respondents, curriculum, funding, supervisor qualification, and research monitorization and thesis assessment, Table 2.

Considering the Curriculum design some changes are proposed although antagonist, but they all have some premiss, the school part should be changed and as one supervisor refer *"curricular units should be more generic, allowing an adaptation of content to each of the students, depending on the scientific area in which their research is focused"* and as other says *"Curriculum with UCs more suited to the research topic."* Another topic referred to by supervisors is the Supervisor qualification to do supervision. One stat *"Only active researchers with quality scientific production should be supervisors"* reflects the opinion of others. Others

emphasise the training to be supervisor “Mandatory attendance of a scientific orientation course as a condition to guide doctoral students.” Which is referred for more supervisors. Funding and resources for research are also mentioned by some. Changes or improvement in monitoring the research development is pointed out by many of the supervisors’ respondents, which reflect the necessity of looking to it and improving.

Table 2. Supervisors proposed suggestions of changes on doctorates or on supervision, that benefit the completion of doctoral projects

Areas	Supervisors Proposal
Regarding curriculum	<ul style="list-style-type: none"> • Elimination of the school part - in any case, elimination of "qualification exams". /Abolition of Course Units/End the obligation to attend UCs. • Maintain the curricular part. Facilitate participation in Seminars / Conferences, some only "internal" for "training" and for debate / receiving various comments. • The curricular units should be more generic, allowing an adaptation of content to each of the students, depending on the scientific area in which their research is focused. • Curriculum with UCs more suited to the research topic. • Doctoral programs should have only general UCs such as "Research Ethics"; "Thesis Project". Specific UCs for each plan, in practice so far, have not worked well. • I suggest that a school cycle is mandatory and that this is left to the discretion of supervisors and doctoral students. • More time dedicated to thesis work
Supervisor qualification	<ul style="list-style-type: none"> • Only active researchers with quality scientific production should be supervisors • Mandatory attendance of a scientific orientation course as a condition to guide doctoral students. • Assignment of teaching service for 3-4 years for each PhD orientation. • I believe that the work of supervisors should be valued. The PhD course units, due to the requirement of their preparation and their tailormade character, should have an additional in accounting for teaching time. • Doctoral guidance should count as a teaching service.
Funding	<ul style="list-style-type: none"> • Selection method for funding • There should be a greater connection with companies or institutions outside the University. • In the case of funded doctoral programs, coordinators must be held accountable, distributing resources and facilities equally among students. • Reduction of bureaucratic acts, especially when registering, which is particularly difficult for foreigners
Monitoring the research development	<ul style="list-style-type: none"> • Not accept PhD students without a research project (written by them) already defined in the application process. • A doctoral student at the end of the 1st year should have a review article to show the capacity for bibliographic research and synthesis of ideas and to understand what has already been done in the area and what remains to be done. • If the advisor so requests the external evaluation by the monitoring commission/committee, it should be done again 1.5-1 year before the supposed delivery of the thesis, so that the doctoral student can have a broader perception of his performance and benefit from these inputs.

One supervisor reflects and highlights some ideas presented in other proposals *"The first suggestion of change that comes to mind is to end the obligation (internal rule) of a publication as the 1st author. This creates a requirement that can limit the development of the doctoral project and the quality of work is not measured by the number of publications or the impact factor of the journals where the work is published. England (at Imperial College) for example there is no such rule. But I also argue that the defence of the work must be done behind closed doors with two examiners, without the presence of the supervisor (again as is done in England). The examiners (one appointed by the supervisor and the other by the doctoral program), yes, should assess the quality of the document and require changes that could be additional experiences if necessary. The timetable must be flexible, the time with UCs should not exceed 3 months in total, without serialization (pass or fail assessment). As for monitoring if the thesis commissions worked it would be ideal. In my case, I have had difficulties in scheduling these meetings due to problems in matching the agenda of the various members. Unfortunately, it is a problem nowadays, too much time spent or in things that do not matter or should not be the responsibility of teachers/researchers."* This implies rethinking research project monitorization and guidance, but also thesis assessment and approval.

Rethinking doctoral education. The doctoral students voice

As happened with supervisors, not all doctorates responded to these open questions in the survey- only 44 of 88 PhD students that responded to the survey responded to the open questions. Nevertheless, the responses show that almost all used instruments to monitor their research and do good use of it and that deadlines and time management are the principal constraints that they face during their doctoral journey.

Instruments and tasks used by doctorates to monitor their doctoral research

When asked to PhD students what instruments they used, during the PhD, to monitor and evaluate their research development, the majority used computer software (excel files/worksheets, word files with resumes, presentations with results) and Laboratory or notebooks, but they use also calendar with the work plan and deadlines or agenda with the tasks to do it, Table 3.

It is important to note, that some students that refer used Laboratory notebooks or notebooks also indicated that they used computer software to complement it.

To perceive the use of the instruments, refer previously, they had to indicate/describe how they use them, Table 4

Table 3. Answers of PhD students to the question: What instruments you do use to manage, monitor, and evaluate the development of your research?

Instruments used to manage, monitor, and evaluate the development of your research	Number of students that indicate (in 44)
Agenda/ list of tasks/checklist	3
Calendar with work plan (organize deadlines and weekly activities)	11
Computer applications/programmes/software (excel files, word files, presentation, graph pad organized on the computer, Mendeleev ¹)	25
Activity management software (Evernote, MS Project software for research management, database in File maker)	14
Laboratory Notebooks	22
Notebook, Record books, Registration notebook; Notes	24
Portfolio	4
Meeting notebook	1
Monthly reports/write reports	2

¹ Seven students refer specifically software to manage bibliography - Mendeley manger

Table 4. Describe what you do (activities / tasks) to manage, monitor, and evaluate the development of your research and what constraints you face.

What activities you do to manage, monitor, and evaluate the development of your research	What constraints you face in the research
<ul style="list-style-type: none"> • During the working day I write down in a notebook the activities that are being done and the articles that have been read, at the end of the day before leaving I try to plan the main task for the next day • I work in a laboratory where part of the data is acquired using various software while another part is recorded in personal registration books. • Record meeting results in Evernote, planning, and scheduling tasks in Google Calendar • I make notes of the course of my research. • I use notebooks and software to manage bibliography and bibliographic references read. • I have a lab notebook where I record everything, I use Mendeley to organize my references and I try to plan everything in my agenda, keeping a list of tasks • Document Collection and Analysis, Photo Software • I perform laboratory tasks which I must plan to comply with my doctoral plan and the requirements of the project for which I work. I plan all my work in advance, and I must keep a record of all my work and the results obtained. • I write in notebooks / files the concepts, theoretical results, summaries of books or articles related to the subjects of study, organized by theme. I write a diary when I do programming, to keep track of experiences, algorithms, results, ideas. • I use a laboratory notebook to monitor my activities in the laboratory, reports that I complete for the successive tasks that I perform. To monitor my bibliographic research, I use the Mendeley manager and created a database in Filmmaker to organize the information collected from reading the bibliography. To manage tasks beyond the personal agenda, I keep a calendar of big tasks or long-term goals in Excel. 	<ul style="list-style-type: none"> • The tasks increase. They accumulate and sometimes it is difficult to complete them in time • The most common constraint is sometimes to manage and organize such a large volume of disparate information • Meeting deadlines. • Lack of time. • Difficult to analyze and organize the huge quantity of information. • Time and Motivation to be able to properly dedicate the writing of the thesis and articles • Fail to make the experiments reproducible. • Since I am not an FCT scholarship holder, but a NOVA FCT scholarship holder, the main constraints are related to time management and reconciling doctoral research with the work requested by the advisor under other projects. • The main constraint is sometimes the lack of time to organize information before generating new data. When this management is not done on time, it becomes more difficult to organize later. • One of the constraints I have is the fact that I do not have simulation/modelling programs to get an idea of the expected results, after carrying out the practical experiments, for the purposes of comparison and criticism.

- Experimental tests with massive laboratory control, bibliographic research with assistant organizing software (Mendeley), treatment of the data taken from the tests, writing of the Thesis
- Objectives planning. Planning.
- calendar / work plan shared with advisors
- Meetings with advisors, schedule of activities and checklists.
- I use notebooks and software (MS OneNote) to record results, procedures adopted, and notes taken from books or articles
- Produce glass samples and historical paintings, physical-chemical analysis of the samples.
- individual and group meetings;
- Excel with delivery schedule and activities
- Monitoring/ Guidance/ accompaniment from the advisor
- There is planning, and at this stage it is focused on reading and reviewing the bibliography.
- Organize deadlines and weekly activities
- Notebooks for results of the developed models, outlook agenda for organizing tasks/ meetings
- I have a calendar with deadlines that I must meet and, a notebook where I register my ideas, which I can use when writing articles.
- I use Google drive and always pay attention to the proposed calendar
- I use basic tools like annotations in text editor software or calendars using spreadsheets, eventually, I also use the MS Project software for research management.

Milestones and barriers in doctoral Journey

To deepen knowledge regarding doctoral supervision, doctorates were asked to share some critical moments (positive first and negative at last) in their journey. Many refer that they were in the first year so they didn't have yet passed/live critical moments. 10 PhD students responded that they didn't live yet critical incidents with positive effect in the doctoral research journey, 18 PhD students responded that didn't live yet critical incidents with negative effect in the doctoral research journey.

Critical incidents with positive effect in the doctoral research journey. PhD Students had to describe a critical incident (a situation that occurred between you and your advisor) with a positive impact on the development and/or completion of their PhD, which they have experienced during their doctoral career. They had to state what happened, what was the result

of the situation, what they felt in the situation and, what motivated them to act that way in the situation.

Some students point out that the described situations allow them to feel more confident on their own. *"My advisor and the group were discrediting the results I had achieved. They even talked about changing the topic of the thesis (since it had already changed once, two and a half years after the beginning of the PhD). I completely lost my motivation and thought about quitting the PhD, I was very confident in my work. So, after Christmas break, I decided that I would try to explain my results again. I changed the way of presenting the results; I made an almost childlike presentation to the advisor/group explaining step by step the interpretation of the results. Today we are writing a publication for Nature with these results."* Or *"At the first international conference to which I went to make an oral presentation, my advisor had given me feedback on my PowerPoint document, having been reluctant about some points of it but having given me some freedom to make the changes that I understood they were necessary. I agreed to make some changes that I thought could really improve my document, but I kept other points unchanged because I believed that what I had done was a better representation of my work and the style I was looking for on the day of the presentation. After my presentation, my advisor congratulated me on my performance and emphasized that he considered my presentation to be the best of the session in which he was inserted. This episode made me feel for the first time that my work was being properly valued by my supervisor. I think that since then he has more confidence in the outputs of my work and being aware of that makes me feel more fulfilled."* Other report situations of stress and anxiety *"I had to deliver the thesis and I waited for the feedback, and they only delivered the feedback close to the date they proposed for delivery. I was so anxious that I had an anxiety attack. it had a very strong impact on me and my work. I asked them to extend the delivery date if it wouldn't be too much pressure for me and I didn't deserve it because I kept my dates and schedule. Finally, I see this final incident as positive because it made me feel calmer in the finals."* Or the support gives by supervisors in the research *"The lack of funding for the nucleus where I was inserted for the development of experimental models led to the alteration of the factory where they would be produced, having directed me for weeks to the new factory that the advisor "guided" and which allowed the work to continue, even with investment personal of both."* Or dissatisfaction with supervisor/supervision *"The absence of constructive criticism led me to discuss with other researchers outside the project what allowed me to create techniques that were not initially considered.";* *"Dissatisfaction with FCSH and interest in transferring me to FCT. Advisor supported the idea based on the fears I presented for it, in view of specific needs for the execution of my research project. A positive result with the support offered."* The career support was also addressed *"I asked very directly if there was a possibility to stay in the group after the PhD, and if I were his daughter what would he advise me. He was very honest in his response, about his opinion of the state of science in the country and real opportunities, and that gave me extra motivation to look for an internship abroad and to look for alternatives in the country where I am still finishing my thesis."*

But almost all students simply described positive supervisors' attitudes that have a positive impact on their PhD journey, Table 5.

Critical incidents with negative effect in the doctoral research journey

PhD Students also described a critical incident (*"situation that occurred between you and your advisor"*) they have experienced during the doctoral journey, with a negative impact on the

development and/or completion of their PhD. They had to state what happened, what was the result of the situation, what they felt in the situation and, what motivated them to act that way in the situation.

Some critical incidents were reported. Almost all correspond to the lack of supervisor skills regarding students' support and guidance and supervision knowledge. This reflection is a very elucidation of this: *"I have no particular episode to report. There is, however, something that happens quite frequently, which is the fact that my advisor in each meeting asks me to direct my work in one direction, and in the next meeting, he wants the meaning to be the opposite. In other words, there is a great inconsistency in what my advisor asks me to do, which ends up not allowing the work to flow and advance if the guidance were more directed and grounded. What I choose to do is to establish priorities and do the tasks that seem to me to make the most sense in the scope of the work that has been developed so far, even if those tasks are not the ones most recently requested by my advisor "*. another student state *"Discussion on the writing of the project for the evaluation of the doctoral plan. Moment of stress occurs when the advisor did not know how to manage his level of demand. The discussion was based on spelling errors instead of focusing on content discussions. Instead of positive and constructive stimuli, the advisor focused on criticizing and humiliating the student."* Another report *"At the end of the first PhD year, I asked to change the subject because that line of research would have no future. They made me continue for another year and a half with something that will not be used in any way for the final document."* The lack of support was also described *"Advisor had to leave an appointment earlier in the laboratory where I was learning to use new equipment. Due to being left alone (and still a little lost) and without support, equipment damage was almost caused. In time I realized that something was not right, and I contacted the technician."* Some situations with a negative impact on their PhD journey are in Table 5.

Table 5 Positive situations with positive and negative impact on the PhD journey.

Situations with positive impact	Situations with a negative impact
<ul style="list-style-type: none"> • “Moments of anguish during the PhD, the advisor knew how to give support, and this strengthened the relationship.” • “Show attention, concern and, guidance in works and subjects related to the PhD.” • “Comply with the review date and delivery of the Doctoral Project Proposal” • “Suggested simplification of some of the activities planned during the follow-up meetings.” • “Explain in a few words the purpose of the PhD and what is its innovation.” • Supervisor ... “Show me the way forward” • “The high degree of empathy between the parties and the interest in research made it possible for orientation to be a process that made an essentially educational relationship, of joint work and mutual enrichment.” • “Student motivation in the first months” • “My advisor has shown himself several times to be proud of my development” • “Advisor's decision making in relation to part of my PhD. His initiative and vision drove the project towards a new and more innovative path. Although I was initially reticent, this change left me with more confidence and enthusiasm in my PhD project.” • “Assistance in making a scientific decision while I was abroad. I felt supported.” • “Group meetings / Results discussion meetings / Manuscript planning meetings. Delegation of tasks such as equipment management, suppliers. Opportunity to teach practical classes. All of these reasons lead to personal / professional development.” • “When the would-be Advisor shows interest and gives feedback on the Work delivered and when inviting them to participate in extra-class 	<ul style="list-style-type: none"> • “Absence of constructive criticism and support in understanding and solving problems, which resulted in a lack of productivity in several situations.” • · “None of them are very happy and satisfied with the advisor and co-supervisor I have” • · “I suffered an accident during serious laboratory activities that consequently took away my motivation to continue the work, despite not having given up and intending to complete the work.” • · “Little presence. PhD project is in line with another research project and therefore, the student ends up not having free thought about his research. Lack of motivation.” • “The lack of funding from the nucleus in which it was inserted delayed the development of experimental work, having resorted to new resources and adaptation to the available resources to cause the least impact on the work plan, which nonetheless skidded several months.” • · “Hurry to perform certain tasks without the proper infrastructure (non-functional GC-MS equipment).” • “Very short deadlines, many things at the same time.” • · “To be angry with me.” • “The lack of support by the Portuguese institution, which should be much more present during the PhD of a student abroad. Lack of organization, communication, and interest in the student.” • · “Some meetings where I feel that my work has been unfairly criticized.” • · “Possible delays in feedback to manuscripts. Excessive teaching service by supervisors prevents presence in the laboratory.” • “Stop me from teaching classes to undergraduate students, as my doctorate is not within my advisor's department” • · “I have always been very independent during my PhD. In one of the last meetings, my advisor made a comment about how

<p>activities, it is important, and I realize that I am joining the Research group.”</p> <ul style="list-style-type: none"> • “Openness and openness.” • “Constant encouragement” • “Openness to use my professional work for doctoral thesis content” • “Co-author proposal on patent submission. Satisfied and motivated with experimental results.” • “Change of theme, creativity and critical spirit needed to fulfill the new work plan, some setbacks that were not planned have to be well thought out and tested to overcome the problems”. 	<p>easy my doctorate had been, and everything had always gone well ... It reveals that he has no idea of the difficulties I went through, especially in the first year.”</p> <ul style="list-style-type: none"> • · “There have been no critical incidents with a negative impact to date.” • · “Some lack of technical knowledge that led to experimental delays. Frustration and stress.” • · “Impossibility to comply with the work plan initially proposed, slows compliance with the new plan due to the lack of knowledge of supervisors and students about new aspects to consider.”
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Changes in the PhD curriculum and supervision from the doctorate lens-the doctorate voice

“Suggest changes that, in your opinion, could improve doctoral degrees/doctoral courses (serialization, evaluation, monitoring, timetable, curriculum, guidance, whether there are course units, implementation of meetings/congresses between doctoral students, etc.) in FCT UNL.”

Regarding curriculum

The PhD curriculum is not similar in all PhDs in The NOVA School of science and technology. Some doctoral curriculum implies the enrolment in school subjects related to the PhD areas; some are optional others are obligatory. Others PhD don't have any school subjects but, students can enrol in the “NOVA Doctoral school “subjects. Some opinions regarding the curriculum are transcribed in the next part.

One student refers that “*The requirement for students to take courses at the Nova Doctoral School was of immense help to me. Supervisors should undergo training courses (regularly) for better guidance*”. Other stats, “*Existence of functional curricular units. Greater interest in accompanying doctoral students by their supervisors. Encouragement by advisors to make their advisors participate in congresses and conferences*”. Some says “*There are fewer parallel activities (classes, writing articles, participation in congresses and events, etc.) concerning research work. The communication part should come after the writing of the thesis is finished*”, one proposes “*The absence of curricular units and the substitution for more comprehensive disciplines.*”

Regarding the quality of the curriculum, one PhD student refers to “*Better curricular units, with more application possibilities there are no course units, except NOVA doctoral school*”. Other stats “*I have nothing to say about the doctoral supervision that was great. I think that I was very disappointed by the organization of the doctoral chemistry program, and I do not understand how the academic division can accept this situation and find no solution. There isn't even a PhD chair in this program, we must follow the chair of other doctoral programs, and I think this is very embarrassing knowing the price we paid for the doctorate. Another thing, I also think the time*

between the delivery of the thesis and the super-long presentation (almost 3 months), and we were without news during all this time (note other faculties and much faster)".

Bureaucracy level/students support

The guidance regarding the bureaucracy is also an aspect that is referred to with a negative impact in the PhD. As one PhD student states "It would be helpful to have someone to help with bureaucracy, especially for foreign students. Also, in my opinion, the first 6 months might be dedicated just to studying the field, with help of summer schools or courses. Also, more attention should be given to safety in the laboratory, and everyone should be informed about the emergency plan and what to do in difficult situations (a safety course before entering the lab would be good)." Others refer to "Much more organization in a doctoral program, balanced attention to all students, presence and periodic meetings, professionalism." Lack of training in the research activities is also related to PhD students' lack of support "More training on the route !!!"

Research development constraints

Some PhD constraints are related to other activities that PhD students must do during the research project. One student proposes *"Minimize requests for extra doctoral work"*, other states *"Evaluation and monitoring of the work developed by doctoral students within each department. Often doctoral students are 'forced' to teach classes without being given the option of not accepting. Teaching should be an option for doctoral students and not an imposition of teachers/supervisors. Doctoral students end up being harmed because instead of focusing on their work, they are using the time spent on their research to perform a task that they often do not want."* But planning extra activities and providing time to them in the PhD project, in the students' opinion, will help students to carry out the PhD research activities. One student's statement *"Well thought out and timely planning of activities that must be carried out due to the possibility of small constraints arising"* other refer *"Higher frequency of some curricular units of the Doctoral School. Limit the number of tasks that PhD students are asked to do, and that is not related to their projects"*. Other constraints are the lack of experience of doing the PhD supervision process, as one student refers to *"Monitoring of supervisors' forms of supervision and support in their training as advisors"*. Time to support students is indicated as other constraint *"Supervisors should have more time for research. They are full of school management jobs."* As well as difficulties to manage time in general and reconcile family and the PhD *"time management seminars/workshops (work plan / extra tasks and work/family relationships)"*.

Research monitorization

The PhD monitorization activities, to allow effective supervision and PhD guidance, were also scrutinized by PhD students. They suggest *"Monitoring tasks in the development of the thesis."*, *"Closer monitoring by the advisor"* but, also *"Greater accountability and participation of supervisors in their students' doctorates"* and *"Follow-up and counselling programs for doctoral students (with motivational support and planning and time management tips, etc., customized for each case)"*. One student wrote *"The advisor's task is not just to correct articles. And if it is, unless you (supervisor) do it on time, and don't delay the student's life."* This comment reflects some disappointment regarding their supervision.

Congress /meeting between PhD students

Students need to know each other. They must identify their partners in the journey to create communities of practice and increase students' socialization and enculturation in the academy.

Regarding this point, there is a consensus, of the necessity of meetings with their PhD peers. One student stat *“Undoubtedly, the implementation of meetings/congresses between doctoral students, having even been mentioned in several courses promoted by the Doctoral School of the University, the importance of transversal themes and that may hinder the development of innovative ideas that can contribute to the good name of the University.”* Other propose *“Co-orientation, communication writing and scientific writing workshops. In general terms, expansion of student participation spaces aiming to reduce the autocracy that still dominates relations within graduate programs”*. They also emphasize the communities of experts where they can see other thinks and may enrich their work and Knowledge: *“I think it is important to acquire knowledge about more than the area of the project, but I think there is no need for classes. I think that national and international congresses and workshops are more important where you can see other techniques but applied to the project”*. Other focus the dynamic of their research group *“One aspect that was implemented in my research group and that I think is very beneficial for my PhD was the implementation of exclusive monthly meetings between PhD students. In these meetings, each student exposes problems he is facing in his investigation and the other students suggest possible solutions. The most beneficial in these meetings is the fact that the student's research areas are very diverse, which brings to the discussion different ideas that would never arise among students in the same area. I think that implementing this kind of meeting in other research groups could be interesting, or even organize congresses in which students briefly expose their PhD theme and the biggest challenges they face now to encourage the discussion of ideas that can help in the resolution of those challenges. For my thesis topic, the curricular units that I had to attend were not relevant, so I ended up having the first year of a doctorate that was not very fruitful. I think it would therefore be more beneficial if the frequency of these units was optional. If the student already has a well-structured thesis plan in mind, then he/she would have the opportunity to invest the usual 4 years of a doctorate in his / her thesis, instead of attending unnecessary but mandatory curricular units in the first year.”* Other propose *“Greater attendance of face-to-face sessions, debate and discussions of articles and book chapters among researchers”* and another argument *“Fewer number of curricular units or greater adequacy to the planning of the PhD project. Discussions between doctoral students like PubhD.”*. An appeal also shows the necessity of creating a community of practice in this school *“yes, I very much ask that with your research you can pass on the message so that the advisors are aware of the conditions of their advisors. Most of the time, the advisors have a lot of work and even, so they guide people but without the care to know that they don't have scholarships, they must work, and they must finish the browning in the correct time. It cannot delay the defence. (..) I say to supervisors “if you don't have time, don't be an advisor. simple!” Furthermore, I think it is very important that supervisors include more students in research groups and in the academic field, which is not done in most cases.”*

Fundings

Regarding fundings and scholarship /grants students also have an important point of view. The need for more financial support, research financial support is felt by many students who didn't have scholarships or equipment/ apparatus to perform and develop the research. One Doctorate refers to *“More funds to allow access to conferences/equipment abroad.”* Others suggest *“Better integration between faculties when the PhD is interdisciplinary”* and others refer to *“Perhaps there will be better integration of doctoral students in research centres. It would be interesting to hold meetings between doctoral students to discuss the work that is being developed. It would also be important to have some clarification sessions/workshops on seeking*

funding and opportunities after the PhD." It is important to highlight that some students must do research on projects that are not their PhD to have fundings. This is confirmed by a student that refers "*It should not be necessary to carry out research (not related to the PhD), in order to have funding.*". The lack of information and the excess of bureaucracy is referred by other students who suggest "*Improved access to financing information at FCT (Fundação para a ciência e Tecnologia.*". In the opposite side are the students that are enrolled in the PhD and scholarship but, see the PhD scholarship as a resource of surviving "*The choice of candidates to scholarship (...), many people apply for a doctorate not because they like the scientific career but because there are no professional opportunities*". This last opinion also appears in research published in 2019 (Ribau, 2019), where some PhD students at this school also stated that they were doing a PhD only because they were unemployed and could have a scholarship.

Supervisors

The quality and the opportunity to choose their PhD advisor/supervisor were also analysed. Some are very critics regarding their supervisors. One stat is clear regarding it "*I believe that a simple website with the name of all teachers that can be advisors in the program, with a description of their way of acting as an advisor (for example: if you(supervisor) are more controlling, less controlling, more or less demanding with deadlines, publications and feedback's, etc.) and areas in which it operates, would assist in the search for the most suitable advisor for the student and the project to be developed. Also list how many students the supervisor already guides, whether there is a limit for students or not and if the supervisor has already reached this limit. I believe that information of this type would be of great general help to PhD students. I emphasize that information given by a PhD student regarding their PhD guidance by their advisor, and their way of conducting his orientations would be very interesting since it would add information that is not always disseminated, which we only learn about after meeting the advisor. An obligation to write a minimum number of articles (in my case I develop a PhD in the company. I also work for the company, so my schedule is conditioned, in this case, the work done in the scope of the PhD should benefit more the company).*"

CONCLUSION

Although there are few participants (PhD supervisors and students) in the studies (less than 20% of both populations of NOVA Science and technology school) it is important to know the opinion of the respondents.

The need to create a community of practice of PhD supervisors, that could support the supervision/advisor process emerge. It is not only the need for knowledge regarding the supervision process, that should not be based only on vicaries experiences, but should be based on solid knowledge of how to do supervision. Almost all PhD supervisors don't have academic formation regarding teaching or supervising. In Portugal there is no tradition in Higher Education, to give formation on teaching, to higher education teachers or researchers. They only need to have a PhD. But the degree doesn't imply competence in teaching and supervising. And, the statements of the PhD students, of this research work shows that. Doing supervision is teaching at a higher level, because it is necessary not only to dominate the research field (have deep knowledge of the researched area), to be up-date, to know how to lead a project but also to teach how to do research. The exchange of information and life experience regarding supervision will help the supervisors in their function but have made it possible to withstand the most difficult situations arising from the supervisory process. Supervisors would have

foundations and scaffolding that would allow them to have security in the decisions they have to make throughout the process.

Regarding doctorates, the first conclusion is the importance of giving a place to PhD spoke. It is necessary to create a community of practice with PhD students. This community of practice will bring support and will allow the sharing of experiences, motivate students in the development of their project and will be good support for students during the development of the research project (which always has high moments of euphoria and low depression).

In Portugal, doctoral supervision still is a private place. Not all the actors involved in it like to talk about it. Still difficult to obtain data, and to characterize the real supervision process. Nevertheless, we can continue to try to have access to data. And this is a limitation of this study. Even so, it is relevant to monitor the supervision process, analyse data, reflect and re(think) about it.

The solution that emerges in this work, the creation of communities of practices, isn't easy to implement, as it depends on supervisors or PhD Students, that overwhelmed by work, but on the other hand, doesn't need money to function. Therefore, this work is the trigger to start the creation and implementation of both communities of practice.

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