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# Supporting Ph.D. students' skills development: A three-stage doctoral program

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**Introduction:** Sustainable development is increasingly recognized as a crucial component of education at all levels, including specialized academic work. As a result, the importance of Ph.D. training in producing highly skilled academics and professionals who can contribute to sustainable development has been acknowledged, leading to increased investments in doctoral training across Europe. However, the diversity in Ph.D. training across countries and universities suggests a lack of studies based on best practices for developing effective doctoral training programs.

**Methods:** This study aimed to contribute to this discussion by combining the perspectives of 31 Ph.D. supervisors and directors from Portugal and England regarding the best practices for Ph.D. training. Participants from different disciplines were interviewed using semi-structured face-to-face interviews, and the data were analyzed using inductive thematic analysis.

**Results:** The study found that, despite coming from different countries, the participants' perceptions regarding the challenges and strategies for improving doctoral education were similar. Based on these findings, the study proposes a three-stage program for structuring doctoral training, consisting of initial intensive training, assessment of individual needs, and tailored training.

**Discussion:** The proposed program has the potential to be valuable in the development or restructuring of Ph.D. programs to address the primary needs of Ph.D. students, optimize institutional resources, and promote on-time completion by facilitating the timely development of necessary competencies for Ph.D. research. Furthermore, this approach could enhance the quality of Ph.D. education, broaden the spectrum and quality of graduates' competencies, and contribute to achieving sustainable development goals.

## KEYWORDS

Ph.D. training, higher education, Ph.D. competencies, sustainable development, doctoral programs

## 1. Introduction

The doctor of philosophy (Ph.D.) is the most prestigious academic degree a student can aspire to achieve as it is being recognized and valued across the globe. Ph.D. graduates are often presented as institutions' brightest students, being highly valued in academia and also from a social perspective (Bernstein et al., 2014).

Over the last 20–30 years, the number of students enrolling in Ph.D. has escalated, in part supported by the increased investments in doctoral education, as governments and other stakeholders started to acknowledge the contribution of high-level research to the economy and development (Park, 2007). These investments also led to changes in Ph.D. training to meet stakeholders' expectations about the political, economic, and social impacts of Ph.D. graduates (Gardner, 2009; Spaulding and Rockinson-Szapkiw, 2012; Bernstein et al., 2014; Elmgren et al., 2016). Over the last decades, the purpose of Ph.D. has been shifting from a “result” of an original contribution to science into a “process” of developing highly skilled professionals (Bernstein et al., 2014; Durette et al., 2016). This shifting is clearly stated in the Bologna process principles, recommending that although research should remain the central core of doctoral training, the latter should include training on transferable skills, with universities being responsible to guarantee that their doctoral programs are designed to address new challenges and include professional development opportunities (European University Association, 2005).

Ph.D. programs are recognized as a key to maintaining a workforce of highly skilled academics and professionals, who possess advanced knowledge and are strongly engaged in research and knowledge transfer capable of ensuring the development and financial health of nations, as well as responding to current and future challenges and threats (McAlpine and Norton, 2006; European University Association, 2007; Group of Eight, 2013).

Consequently, doctoral education is seen as crucial for addressing the sustainable development goals (SDGs) as it contributes to the development of these highly skilled academics and workers capable of impacting the different areas of society (Hasgall, 2019). As expressed in the 2019 Global Sustainable Development Report, “Science lies at the heart of sustainable development. It establishes the factual basis, anticipates future consequences, and contributes to finding pathways to sustainability transformations” (Independent Group of Scientists Appointed by the Secretary-General, 2019, p. 111). Research can contribute to addressing SDGs in many ways such as from promoting social discussions, creating and developing new knowledge or technology, or informing different stakeholders to improving policies (Hasgall, 2019).

Therefore, increasing the quality of doctoral education seems to address SDG 4 (education) by contributing to the development of employability skills (target 4.4) and the acquisition of knowledge and skills required to foster sustainable development (target 4.7), while, as mentioned earlier, assuring highly skilled professionals required to actively engage and address all the SDGs.

The positive impact of Ph.D. graduates on society development led to an increase in investments in doctoral education. However, delays in time to degree and high attrition rates in doctoral education represent considerable losses in terms of time, money, and several other resources, as well as highly qualified professionals (Gardner, 2009; Groenvynck et al., 2013; Jaksztat et al., 2021; van Rooij et al., 2021).

Several elements have been associated with Ph.D. progression and completion, which can be grouped into institutional, supervision, and student variables. Some examples of institutional variables are how the information is available for students, the

structure of doctoral programs, the quantity and quality of available training, the promotion of socialization and students interaction, and the availability of economic support (de Valero, 2001; Gardner, 2009; Wao and Onwuegbuzie, 2011; Geven et al., 2018). In terms of supervision, some of the variables are related to the student–supervisor relationship, the quality of the supervisory process, the expectations, and perceptions regarding each one's role, or how supervisors promote students' autonomy (de Valero, 2001; Figueiredo et al., 2012; Litalien and Guay, 2015; Sverdlik et al., 2018; Huet and Casanova, 2021). Finally, the students' variables are related to their expectations and beliefs, responsibilities outside academia, type of economic support, or the students' competencies including internal skills and resources as well as their psychological variables (Liechty et al., 2009; Wao and Onwuegbuzie, 2011; Durette et al., 2016; Castelló et al., 2017; Devos et al., 2017).

This study focused on the structure of doctoral programs, including available training, for fostering the development of students' competencies. For many years, Ph.D. development was tightly connected to supervision, relying on the supervisory team to ensure training, knowledge development, guidance, and some pastoral support (Abiddin, 2005; Elliot et al., 2020). However, with the evolution of Ph.D. training and increased concerns about graduates' skills, universities started to adopt more structured programs (Bastalich, 2017; Bogle, 2018). As an example, in the UK, the 1+3 Economic and Social Research Council model created in the 1990s, consisting of 1 year of master course followed by 3 years of Ph.D. research, represented an initial approach to the idea of including formal structured training in doctoral programs (Bogle, 2018).

The Bologna process and the recommendations for universities to create appropriate structures, such as courses or summer schools for developing doctoral students' competencies (European University Association, 2005), shaped the structure of Ph.D.'s programs across Europe. Furthermore, with the massification of doctoral education, Ph.D. programs are required to respond to some of the difficulties presented by students, especially during their initial times.

Undertaking a Ph.D. program can be a transformative experience for students, as it often requires them to work independently for the first time. In line with Paulo Freire's Pedagogy of Freedom (Freire, 1998), students are encouraged to take ownership of their research projects and work collaboratively with their supervisors to develop critical thinking skills and autonomy. However, many students struggle to adapt to less structured learning environments of Ph.D. programs, lack research competencies and theoretical knowledge, and have misconceptions about the level of commitment and challenges involved. These issues can lead to a lack of awareness about the expectations and requirements of a Ph.D. program (Geraniou, 2010; Garcia-Perez and Ayres, 2012; Castelló et al., 2017).

Over time Ph.D. changed to adapt to these challenges. Most training in European Universities is composed of an interconnection of different components comprising a previously pre-determined curriculum, additional training, development resources, and tacit learning. However, looking at Ph.D. programs from different European universities highlights that programs'

structure may differ according to the country, university, or even departments within the same university.

Despite the challenges, institutions have a shared goal of developing the competencies of Ph.D. students to produce highly skilled professionals who can make significant contributions to sustainable development, both within and outside academia. Therefore, it is essential to discuss and develop global approaches that can improve doctoral training. However, research aimed at identifying the best practices for Ph.D. training and providing guidelines for these programs is scarce.

This study examined the perceptions of supervisors and directors of Ph.D. programs in two different countries on current practices and suggestions for developing Ph.D. students' competencies. One of the countries included in the study is England, which has a long tradition of Ph.D. training. The development of programs to enhance the skills of postgraduate students began in 2003, and universities now offer varying levels of structured training to support their students (Bogle, 2018). As for Portugal, it was only after the 1974 revolution, and the changes to the political context, that substantial reforms were implemented leading the country's higher education, and consequently the Ph.D. degrees, to grow and become closer to the organization models of Western Europe (Teixeira and Videira, 2018). The adoption of structured doctoral programs aroused to answer the principles of the Bologna process, and currently, almost all doctoral programs in Portuguese universities combine a taught element, composed of mandatory curricular units, followed by the research component. Considering the differences between the backgrounds and current context, this study targeted England and Portugal, aiming to learn from different perspectives and practices in each country.

Based on these perceptions, the study intended to learn from the best practices in each country and suggestions for optimizing Ph.D. training programs. The results from this study are expected to inform the development or restructuring of doctoral programs, aiming to optimize students' training.

## 2. Materials and methods

This study used a qualitative approach with semi-structured face-to-face interviews to gather information regarding the strategies employed to enhance the competencies of Ph.D. students throughout their doctoral training. Data were analyzed using thematic analysis (Braun and Clarke, 2006; Braun et al., 2019).

### 2.1. Participants

The sample was composed of 31 Ph.D. supervisors, including directors of Ph.D. programs, from different disciplines, from one University in Portugal and another from England. This heterogeneity aimed to obtain different perspectives, including experiences in each role, and to increase the richness of data.

Table 1 describes the participants' code, gender, and role (supervisor only or supervisor directing Ph.D. programs) for each country.

### 2.2. Procedure

For conducting the interviews, two schedules were developed based on the literature and validated by two experts in terms of clarity, topic cover, and acceptability. The first section of each schedule served as introductory questions targeting supervision experiences (for supervisors with no leadership positions) and the organization of doctoral programs (for supervisors responsible for directing Ph.D. programs). The second section was the same for all participants and targeted the students' required skills for a Ph.D. and suggestions for developing those skills.

For recruitment, both universities' web pages were screened for identifying potential participants, resulting in two lists (one for each country). Supervisors were invited by an email addressed personally, aiming to increase the response rate. The email included an attached informed consent letter and briefly described the study, its objectives, and the expected duration of interviews. A single follow-up email was sent after 1 week to supervisors who have not replied. After formal acceptance, the respective interview was scheduled. A total of 53 supervisors were invited (England = 25 and Portugal = 28). There were no replies from 13 supervisors (England = 5 and Portugal = 8), four declined the invitation (England = 3 and Portugal = 1), and 36 agreed to participate. From the latter, it was not possible to schedule the interviews with five supervisors (England = 3 and Portugal = 2), resulting in 31 interviews (England = 15 and Portugal = 16).

Each interview started after collecting the signed informed consent. Each interview lasted approximately 30 min and was audio recorded. Transcriptions were made using clean verbatim and sent to the respective interviewee for feedback on accuracy.

Data were analyzed with NVivo 12 Pro software, using a deductive thematic analysis (Braun et al., 2019) aiming to explore the participants' suggestions for the organization of doctoral programs.

Familiarization with data started during transcription, and each interview was read two times before generating the first codes. Then, given the semantic level of the analysis, the first codes were created based on the explicit words of participants. During the third phase, codes were grouped based on their similarities, and then data within each group were analyzed, aiming for potential themes. During the revision phase, the candidate themes were further analyzed and refined, and similar candidate themes were merged. Over the last stage, themes were named and described accordingly to the participants' narratives. For increasing reliability and minimizing bias, the results at each phase were compared, analyzed, and discussed within research meetings.

## 3. Results

Despite the heterogeneity of participants, data revealed similar perceptions regarding the needs of Ph.D. students and how to organize their training.

In terms of the difficulties students face during their doctoral journey, and which may be overcome or minimized by doctoral training, supervisors highlighted misconceptions about doing a Ph.D., unawareness of the impact a Ph.D. may have on their lives,

TABLE 1 Description of participants.

Portugal			England		
Supervisor code	Role	Gender	Supervisor code	Role	Gender
1	Supervisor	M	2	Supervisor	M
5	Supervisor	M	3	Director	F
7	Supervisor	M	4	Director	M
9	Director	M	6	Supervisor	F
10	Supervisor	M	8	Supervisor	F
12	Supervisor	F	11	Supervisor	F
13	Director	F	14	Director	M
15	Director	M	16	Supervisor	M
20	Director	M	17	Supervisor	F
21	Supervisor	F	18	Supervisor	F
22	Supervisor	F	19	Director	F
23	Supervisor	M	25	Supervisor	F
24	Director	M	27	Director	M
26	Director	M	28	Supervisor	M
29	Supervisor	M	30	Supervisor	F
31	Supervisor	F			

and insufficient theoretical knowledge or skills required to start their research.

Narratives suggested a Ph.D. training based on three components.

### 3.1. Main difficulties of enrolling students

During interviews, supervisors emphasized that it is expected that students arrived at a Ph.D. possessing a minimum level of theoretical knowledge and research skills. As mentioned by supervisor 25 “So the basic skills that we assume students may have (...) we may assume that all of those students have got that skills from their undergraduate.”

However, nowadays students enrolling in a Ph.D. degree come from a wide spectrum of backgrounds and present different levels of skills, illustrated as “we never know the level of knowledge of our Ph.D. candidates” (supervisor 20).

In addition, “some students sometimes drift into doing Ph.D., maybe just as another qualification without really thinking what it involves” (supervisor 04), and “a Ph.D. is not an activity in which we enroll and easily complete within days.. it requires some specific and complex competencies... hence, I believe these aspects should be clear from the beginning” (supervisor 31).

### 3.2. Main differences between the two universities

Doctoral programs at the Portuguese and English Universities selected for this study differed in terms of their structure and organization.

In the English university, doctoral training resulted from the combination of training provided at the doctoral school and the faculty level,

“we[sic] have a Graduate Research School and it delivers generic training for all students or postgraduate students at masters research and Ph.D. research level [...] of skills-based training around the core things that one would expect a research student to be engaged in. [...] Then at the faculty level, which is the disciplinary-specific level, the training programs that are given for students [...] they tend to be skills-based, then they also do give methodology and theoretical training, according to the discipline” (supervisor 27).

Although the Graduate Research School’s training is similar to all students, at the faculty level, the organization of doctoral training differs accordingly to the different disciplines,

At the university level, graduate research school provides some generic training, [sic]At the faculty level, the faculty has its support and training programs: one for [discipline anonymized], one for [discipline anonymized] because they tend to require a different kind of more practical skills, and one for the rest of the faculty (supervisor 03) [sic].

The generic training of the Graduate Research School is mandatory, while their remaining offers of training are optional. At the faculty level, training being mandatory differs accordingly to the discipline,

The director of research in each of those two schools devises a program of study for Ph.D. students within those schools. Typically, every two weeks there is a session, which the students are required to attend. [...] They are not required, but they are strongly advised to go to the sessions. Specifically, in [discipline anonymized], we require all of our Ph.D. students to do 60 credits of taught postgraduate training [...] They have to pass that to meet their progression transfer (supervisor 04).

At the Portuguese university, doctoral training is organized at the faculty level. Each course has its own taught doctoral program consisting of mandatory curricular units over the first year, “In our doctoral program we have 5 curricular units, at the first year, and another curricular unit which is preparing the thesis project” (supervisor 26), “Our doctoral program is organized in one year, which is a curricular course” (supervisor 24).

Nevertheless, in some programs, students are allowed to choose to enroll in curricular units from other programs to complete their training, “the curricular component of our doctoral program has the so-called free option, that allows students to develop competencies in a specific topic [...] which can be in a curricular unit that has nothing to do with our field” (supervisor 15), “so we have 5 curricular units in our doctoral program, but students may replace them with other curricular units from other doctoral programs” (participant 26).

Apart from the taught course, students’ development relies mostly upon the supervisor and the offers available across the university. Supervisor 20 stated that “obviously[sic], after they have their supervisor and University often offers internal training,” and participant 15 stated that “then there is all sort of training around the university’s doctoral programs that students can take.”

### 3.3. Ph.D. training suggestions

#### 3.3.1. Initial training

To address the challenges faced by students, one effective approach suggested by supervisors was to provide initial training to ensure that students meet the minimum standards of knowledge and skills required for their doctoral studies. This stage can be presented as “general training so the students have those competencies [knowledge and skills]. Basically to homogenize all students, so they have more or less the same level” (supervisor 20). This idea of homogenization was also mentioned by supervisor 26 as building the foundations for the thesis, “look for homogenizing the students’ knowledge so afterward everyone may develop a thesis with quality.”

At the same time, this initial training would also contribute to assisting students to “find out what Ph.D. actually is. To try to make it explicit before a student starts, so they’ve got a really good understanding of what’s going to be required of them” (supervisor 04) while providing useful information about institution’s regulations, resources, and support. Supervisor 27 shared an example of how information about training opportunities can be communicated to students, stating that “our Faculty Director will emphasize the graduate training program that’s available. And sometimes we have the staff from the Doctoral School, who’ll emphasize what’s on offer regarding their training

programs”. This approach ensures that students are informed about the various training options that are available to them and can take advantage of these opportunities to enhance their skills and knowledge.

Also, supervisor 04 provided what may be described as a short description of this initial training:

I think that all subjects should have a taught component in their Ph.D.s, which covers not just recapping core methodologies but also ensuring that students are engaging with current developments in methodology, they’re keeping up-to-date with what’s going on within their discipline in terms of methodological developments, that their critical faculties are being challenged, and developed through an appropriate training program. That’s still missing here and missing in most universities.

The suggested approach is based on a structured course. Considering the purpose of being delivered to all students, narratives also suggest this initial training to be compulsory. Examples from English supervisors reveal the importance of adopting this approach to assuring students’ engagement: “Specifically, in [anonymized], we require all of our Ph.D. students to do 60 credits of taught postgraduate training. [...] The faculty-level training that we provide is not compulsory so fewer students go” (supervisor 04). Supervisor 14 provided a good example of how difficult it is to have students engaged when no assessment is involved “we try to say that this is compulsory, but in practice, it is really difficult to enforce that compulsory training concept to students, because we don’t have an official marking mechanism where they have to pass an exam.”

This approach to adopting a formal curriculum is widely implemented in most Portuguese Universities, covering from disciplinary-specific competencies to broader soft skills: “Our doctoral program is organized in one year, which is a curricular[sic] course, in which students learn a set of competencies, and from those, some are specific competencies related to the field” (supervisor 24).

#### 3.3.2. Assessment of needs

Supervisors’ narratives highlighted the importance of assessing students’ competencies and development needs to increase the awareness of both supervisor and student about the latter training needs and look for suitable development opportunities.

This assessment serves a dual purpose: first, it helps students to become “aware of the sorts of things that they need to develop over the three years” (supervisor 32). Second, it provides an opportunity for students to reflect on the specific requirements of their research project and plan their development training accordingly. Supervisor 08 describes this assessment as

a training-need analysis as people start. I think that’s really important in terms of what do[sic] they know. If they’re telling you they’re going to do surveys and use very complicated statistics, the question is okay, do you actually understand enough about statistics? Do you understand enough about the software you could use? Or if you’re going to do a systematic review, do you understand how to do systematic reviews, and

what are the benchmarks for good quality in this? And if you don't know, how we are going to address that, then going off on training, or e-learning or attending conferences, or whatever, but I think the starting off with, you know, how much knowledge skills competencies do you have for doing this? What we need to address through that program. I think that is really important.

### 3.3.3. Tailored training

As implicit in the earlier quotation from supervisor 32, assessment of needs and tailored training are closely related. After identifying training needs, students and their supervisors create an individualized development plan considering the student's knowledge and skills and the identified training needs: "I am going to need these tools [skills]. Where am I going to get them? I'll get them from that workshop, or from that classes" (supervisor 21). This stage requires collaborative planning between students and their supervisors to develop a roadmap for skill development. This involves working together to identify areas in which the student needs to improve and creating a plan for how to address these needs. One example was provided by supervisor 11: "make plans together, on the way they develop their skills (...) to develop a plan on what to do next."

Developing this tailored training implies that training opportunities are available and properly advertised. As mentioned by supervisor 05 "training offers and workshops are important. As long as things are available, people can make their choices, and the supervisor may have the role of drawing attention to these aspects." Supervisor 17 highlighted the importance of effective advertising when it comes to promoting training opportunities to students. This is particularly important for supervisors who need to be able to provide guidance to their students in selecting suitable training options: "we're progressing in the fact that there's now a website, at least, where we all have access to, so we as supervisors, we have a little bit more information, or easier access to information, of what is given to our students. Before it was kind of, you had to ask your students what was available."

Supervisor 09 summarized this concept of tailored training as

Curricular units that[sic] are freely available for students to enroll in if they need some sort of competencies, either soft or hard skills. These units would be available across the university for all disciplines and degrees. Basically, it would be several training modules, some sort of training a la carte[sic], in which students could choose the ones they need.

## 4. Discussion

The findings of this study are based on the perceptions and best practices of supervisors from two different universities, each with its own distinct doctoral training context. By examining these diverse perspectives, this study provides valuable insights into the challenges and opportunities associated with doctoral training and skill development.

One conclusion was that supervisors from both countries shared concerns about students being prepared to enroll in a

Ph.D. in terms of their expectations and competencies. These concerns reflect some of the difficulties that most students face related to transitioning to the less structured Ph.D. learning context, insufficient background knowledge or research skills, misconceptions about the Ph.D. and research, and unawareness about what will be required of them (Geraniou, 2010; Garcia-Perez and Ayres, 2012; Castelló et al., 2017).

Considering that a Ph.D. is expected to last from 3 to 4 years full time, students' training requires focused structured training that supports students to develop the required competencies on time, aiming for reducing attrition and increasing on-time completion. The results from this study suggest a structured training composed of three stages.

The first stage is composed of initial training aimed to level students and assure they all possess a minimum set of competencies before starting their research. The supervisors emphasized the significance of providing students with initial training, which, although in different ways, is implemented in both universities. The results also suggested this initial training to be mandatory to assuring students' engagement.

These results are consistent with the current practices in Europe and the literature. Most European Universities have included a more or less structured initial training for their doctoral programs or started to recognize the impact of structured doctoral training to reduce attrition and increase on-time completion (Kehm et al., 2018; Shin et al., 2019). According to existing literature, structured initial training can have a positive impact on students by helping to level their knowledge and skills, increasing their understanding of what will be expected of them during their studies (including required competencies and available resources for developing them), developing essential core competencies, easing the transition to the Ph.D. program, and fostering interaction with fellow students and academic staff (Geraniou, 2010; Parker, 2012; Pitchforth et al., 2012).

As students possess different sorts of competencies and each Ph.D. project requires specific skills for completing their tasks, it is unlikely for the initial training to cover all the required development for all students. Therefore, after this stage, students are expected to continue their development assisted by their supervisors. The results of this study suggest that optimizing student development can be achieved by assessing their training needs and designing tailored training programs accordingly.

To evaluate students' competencies against those required for their discipline and research tasks, a needs assessment is necessary. Students may conduct this assessment independently, but it is highly recommended that it be done in collaboration with their supervisory team during the early stages of their studies. This approach enhances both the student's and supervisor's awareness of their strengths and weaknesses, allows them to identify training needs, seek out appropriate training opportunities, and design tailored training suitable for each student's specific needs. The literature underscores the importance of helping students become aware of the competencies they will need during their Ph.D. program, which is considered a factor that contributes to increased completion rates (Parker, 2012; Pitchforth et al., 2012).

Based on the results of the needs assessment, the third stage involves providing tailored training. A Ph.D. can be often a poor or even an unstructured journey leading students to divert through diverse routes (Elliot, 2021). As a consequence, they may miss

important skills necessary for specific tasks at various stages of their research. Research suggests that providing students with the necessary skills to meet the demands of their research journey can lead to reduced delays, increase the likelihood of on-time completions, and prevent them from abandoning their studies due to a lack of required competencies (Castelló et al., 2017).

Designing tailored training, including identifying training opportunities and creating a suitable timeline, would contribute to providing a structured guidance map that would assist students to organize their training and optimize their progression. At the same time, it could assist in monitoring the development of each student, allowing to highlight delays in development that could hinder the thesis progression and take suitable actions.

As proposed by some supervisors, some modules for either initial training or tailored training could be developed at the faculty level, taking advantage of their specific knowledge, and turned available in the university's training portfolio. Implementing this strategy would not only optimize institutional resources but also promote interaction between faculties and their Ph.D. students, facilitating interdisciplinary and multidisciplinary cooperation required to tackle present and future challenges and find solutions for sustainable development (Hasgall, 2019; Chaleta et al., 2021).

## 5. Conclusion

Ph.D. education has been identified as a key element for achieving the SDGs, as it assures the development of highly qualified professionals capable of impacting different areas of society and addressing current and future challenges. Therefore, improving the quality of Ph.D. training, while directly linked with SDG 4—education, can be described as crucial for maintaining the workforce equipped with the necessary skills to address all the SDGs.

This study provides interesting data on the perspectives of supervisors from two different countries regarding the organization of Ph.D. students' training.

The findings led to the development of a proposal for organizing doctoral training and supporting the development of Ph.D. students' skills, which consists of three stages. The proposed model shares similarities with the UK's new route Ph.D. (also known as integrated Ph.D.), which includes an initial intensive program of structured training followed by research for the Ph.D. thesis. However, the proposed approach in this study places additional emphasis on the assessment of each student's specific training needs and the creation of an individualized training plan.

Students arrive at Ph.D. with different levels of knowledge and often possess misconceptions about a Ph.D. and what will be required from them. The first stage, or initial training, would serve to level students' knowledge and provide research skills and knowledge to enable students to be prepared to start developing their Ph.D. projects and initiate their thesis. Additionally, this stage would also help to dispel any misconceptions about the Ph.D. and increase awareness among students about what will be required of them and what resources are available to support their success.

After completing the initial training, the second stage proposes that students, with the assistance of their supervisors, assess their

competencies in terms of knowledge and skills. This assessment of needs aims to identify areas that require further development to meet the demands of the Ph.D. project and to assist in designing tailored training programs.

The third stage embraces tailored training, where an individual training plan is designed, including training opportunities and a timeline to guide the progress. This plan is adjusted to each student regarding the students' competencies against the requirements of their thesis.

As mentioned in the introduction, several factors play a role in Ph.D. progression and completion. This three-stage approach can contribute to addressing some of the challenges related to Ph.D. training.

It can be used to assist in optimizing time and resources for institutions, supervisors, and students, providing the latter with a structured approach that would guide their skill development throughout their journey. At the same time, by contributing to assuring the identification and development of essential competencies, hence assuring they became readily available, this approach can theoretically contribute to reducing attrition and increasing on-time completion.

This study also highlights the need for universities to increase their portfolio of options for tailored training. It suggests promoting inter-faculty training options, available to all students. Each department, taking advantage of its know-how and optimizing resources, would deliver different modules related to its expertise area. This approach would likely contribute to increasing the overall quality of doctoral training, as well as promoting the interaction across disciplinary domains, which ultimately contributes to enhancing competencies of networking and interdisciplinary discussion and cooperation required to impact society and contribute to addressing the SDGs.

Nevertheless, certain limitations should be taken into account when looking into the findings and considered for future research. Only Ph.D. supervisors were interviewed. Although supervisors responsible for doctoral programs were interviewed, including students that have completed their Ph.D. may have allowed us to obtain perceptions from different actors in the process and potentially obtain additional suggestions. Furthermore, the interviews were conducted with supervisors from only two universities, which, although providing perspectives from two different countries, may limit the generalizability of the findings. For future research, it is recommended to investigate whether similar results are obtained from other universities.

## Data availability statement

The datasets presented in this article are not readily available because of privacy and ethical restrictions. Requests to access the datasets should be directed to [paulo.chalo@ua.pt](mailto:paulo.chalo@ua.pt).

## Ethics statement

The studies involving human participants were reviewed and approved by the Center for Higher Education Research and Practice

(CHERP) Research Ethics Committee of Kingston University London under the application CREC88. The patients/participants provided their written informed consent to participate in this study.

## Author contributions

PC and IH: introduction, literature review, and methodology. PC: data collection and writing. PC, IH, DN, and AP: data analysis, discussion of results and conclusion, and reviewing and editing. All authors contributed to each section of the manuscript and approved the submitted version.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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