






# Developing and Implementing hands-on training on Open Science and Open Innovation for Early Career Researchers

## D2.1 – The DIOSI Model for Doctoral Learning A holistic approach

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## List of acronyms and abbreviations

<b>DC</b>	Doctoral Candidate
<b>ECR</b>	Early Career Researcher
<b>DH</b>	Doctorate Holder





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## Executive summary

Doctoral learning in Europe (and the world) is a topic subject to a wide variety of complex systems linked to national, regional and institutional regulations, practices and habits. The many systems and visions for doctoral learning can obscure the common understanding of what a PhD means. Due to the multiple competing factors and pressures on the PhD process, evolutions in doctoral learning have sometimes been difficult to adopt and implement. With the advent of the creation of European Universities, now is the time to take stock, and to meaningfully update doctoral learning as we know it.

This report aims to envision a joint model for doctoral learning at the DIOSI institutional partners, by building on existing policy and academic literature, and a SWOT-analysis of partners' doctoral education systems and their future-facing vision for the process. From this consultation with experts at each institution, a joint vision and model is created which will be further adapted for the ensuing implementation roadmaps for each institution. With this report, the aim is not to impose but rather to *envision a joint model of doctoral learning at the DIOSI partners*.

In this policy paper, a **holistic approach to doctoral learning** in terms of research, self-development and training formats is argued for. Based on finding from the literature and expert interviews, four main arguments are made:

- 1) Pressures on the doctoral process (be it by funding, time restrictions, formal obligations etc.) are thereby pressures on the quality of doctorates and the experience of the doctoral candidate. Therefore, the DIOSI model emphasises the learning outcomes to be acquired and synthesises these components into a comprehensible and manageable guided process. The DIOSI model emphasizes creativity and critical thinking as essential to building innovation in doctorates, and promotes open science practices as part of the new normal.
- 2) At the same time, the development of the doctoral candidate (DC) is placed centrally, following Mowbray & Halse's (2010) conceptualisation of doctoral learning within Aristoteles' Virtue theory. The benefit is that this allows to 'shift the lens from the instrumental production of the skilled PhD graduate to the progressive building of virtuous individuals who contribute to society through their productive actions' (Mowbray & Halse 2010).
- 3) A vision where the doctoral candidate stands at the centre of the doctoral universe emerges, where they are comprehensively supported by the supervisor and the institution. Supervisors take several roles in the doctoral process: that of director, mentor, coach and supporter (Link Edu-Res project –





[toolbox](#)). Moreover, career guidance is essential to alleviate the employability-related stress of DCs. Therefore, the formation of supervisory teams is proposed, that include a mentor with specific remit for career guidance and formal training opportunities.

- 4) Acknowledging diverging models and perspectives on formal training within doctorates, it is recommended for institutions to use a mix containing both informal learning and formal training. For those institutions that have no formal training installed and/or could use inspiration, a training programme for the DC is proposed. This recommendation is inspired by the benefits that this can bring:
  - a. Courses are an efficient and financially viable way to disseminate knowledge, crucial in guiding doctoral candidates (e.g., by providing an overview of all existing methods, or existing communication methods to valorise their PhD) and limiting the time to completion of the degree (time-to-degree)
  - b. Training courses allow for exchange with peers outside the research group/domain and the cross-fertilisation of knowledgebases.
  - c. Courses enable the development of a learning cohort and builds community.

In conclusion, this paper proposes a joint vision and framework for doctoral learning at the DIOSI partner institutions, providing a common language and understanding for the partners. Furthermore, this new framework propels doctoral learning into a future where universities are fully engaged in society, and where society can also engage at the level of doctoral learning. The next steps are to develop implementation roadmaps that consider the individual context of each institution (foreseen in the DIOSI-project) and to run (small) pilots to test the DIOSI-model in practice.



# DIOSI Model for Doctoral Learning<sup>1</sup>

## 1. Introduction: Coming to terms with doctoral learning in a changing higher education environment?

A doctorate is about an original contribution to knowledge, to which there is general agreement (Lee, 2013). Ackerlind & McAlpine noted, among supervisors, an evolution from the more product-oriented primary focus (on the final product, the contribution of knowledge in the doctorate) to a more process- or person-oriented one during the doctoral process (Ackerlind & McAlpine, 2017). *'The creation of knowledge arises through a process of enquiry, and enquiry-led learning is now a recognised pedagogic process from undergraduate through to doctoral studies'* (Healey & Jenkins, 2009; Kahn & O'Rourke, 2004; Lee, 2012; Tosey, 2008) in Lee & Murray 2013, p. 558-559). Furthermore, it is about preparing skilled and innovative (and ethical) knowledge workers (Ackerlind & McAlpine, 2017, p.1687 ; Lee, 2013, p.119). Although both foci are and remain central elements of the purpose of the PhD, supervisors have been found to show a clear focus on the process of developing the student/person in their descriptions of the primary purpose of a doctorate (Ackerlind & McAlpine, 2017). Apart from that, several views are held by supervisors and by doctoral candidates on the purpose(s) of the doctorate, which includes among others, a focus on developing a researcher. At the European level, a trend has been noted towards regarding supervision as a pedagogy (Lucas Zinner, Chair PRIDE Organisation, Eurodoc Conference 2021).

In the past decades tensions have emerged over the alignment of academic research, staff capacities, the doctorate requirement and funding resources. One main tension relates to the career options for doctorate holders, the short term (instable) project-based funding and resulting pressure on early career researchers. *'The root of the problem ... A failure to adjust the entrance workforce to the slowing expansion of the research system in more recent years has led to an overproduction of aspiring scientists with limited opportunities for permanent careers in academia. While a failure of adjustment may be expected for sudden changes and variations in research expenditures, the problem has been raised for over twenty years with very little noticeable improvement (see Alberts, 1999; Marincola & Solomon, 1998 for early works noticing the issue; in Aubert-Bonn, 2015, 250)'*. Two other explanations exist, according

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<sup>1</sup> Throughout this paper, the terms 'doctoral learning' is used for the model, and preferred over the terms doctoral education, doctoral studies or doctoral training. The terminology doctoral learning puts the doctoral candidate's experience at the centre, rather than focussing on the provision of training or education. Furthermore, it emphasises that a doctoral candidate is involved in a learning and developmental process that is in its essence different from a Bachelor or Master study/education experience. The terms doctoral studies or doctoral education place too much emphasis on structured education, whereas the term doctoral training can be interpreted as formal training in transferable skills but not encompassing the whole doctoral experience. In this report, the terms doctoral education and doctoral training are thus used encompassing both the research and the training aspect.







- What are the strengths, weaknesses, opportunities and threats of the doctoral educational systems at the DIOSI partner institutions from the points of view of the three main actors involved (supervisor, supervisee/doctoral candidate, institution)?
- What vision for doctoral learning do experts have?

There are also applied questions guiding this paper: what common vision can be derived to shape the future of doctoral learning? What are the essential components for a joint model for doctoral learning?

In the next section, the two main unifying elements are discussed: the European learning outcomes and the role of the supervisor. In section 3, the method used throughout this paper is explained. Then, the analysis from the SWOT and vision exercises are presented in section 4. Based on the analysis, a new model for doctoral learning is defined (section 5), that develops: a joint vision on doctoral learning, a strategic reframing of supervisory relationships, desired outcomes for a DIOSI PhD-holder, and an over-arching framework for the doctoral programme that includes several components (research, personal and career development, skills by formal and informal learning) and acknowledges diverging expert visions on the ideal learning format(s) for the doctorate.

## 2. Unifying elements in a broad variety of doctoral systems

### 1. Learning outcomes of the doctorate at European level

To create a model for doctoral learning, first it is necessary to consider the expectations regarding the knowledge and capacities of the recipient of a doctorate. This focus on learning outcomes is needed to derive a training model, and to be clear on the contemporary value of a doctorate.

The three learning outcomes corresponding to the level of the doctorate (level 8) in the [European Qualifications Framework for Lifelong Learning \(European Commission, 2008\)](#) are:

- *knowledge at the most advanced frontier of a field of work or study and at the interface between fields*





- *the most advanced and specialised skills and techniques, including synthesis and evaluation, required to solve critical problems in research and/or innovation and to extend and redefine existing knowledge or professional practice*
- *demonstrate substantial authority, innovation, autonomy, scholarly and professional integrity and sustained commitment to the development of new ideas or processes at the forefront of work or study contexts including research.*

The European Qualifications Framework level 8 is compatible with the PhD-level (or so-called third cycle) of the Framework for Qualifications of the European Higher Education Area developed in the Bologna-process:

*Qualifications that signify completion of the third cycle are awarded to students who:*

- *have demonstrated a systematic understanding of a field of study and mastery of the skills and methods of research associated with that field;*
- *have demonstrated the ability to conceive, design, implement and adapt a substantial process of research with scholarly integrity;*
- *have made a contribution through original research that extends the frontier of knowledge by developing a substantial body of work, some of which merits national or international refereed publication;*
- *are capable of critical analysis, evaluation and synthesis of new and complex ideas;*
- *can communicate with their peers, the larger scholarly community and with society in general about their areas of expertise;*
- *can be expected to be able to promote, within academic and professional contexts, technological, social or cultural advancement in a knowledge based society (Bologna working group, 2005)*

In terms of communication, the Framework for Qualifications of the EHEA mentions dissemination through refereed publication, but also that doctorate holders are capable of communicating with ‘society in general’ about their areas of expertise, and that the DH is able to promote advancement in a knowledge-based society – within professional contexts. There is also reference to making a ‘contribution’ – which draws in the innovation capacity of the PhD, but there is no mention of being capable to introduce and use methods of making research accessible through open science and open data. Competition among academics can hamper responsible and collaborative science, yet modern open science tools allow the acknowledgement of academic contribution and open collaboration in each part of the research process.

The European Qualifications Framework for Lifelong Learning, then again does make a mention of autonomy. There are no outcomes for developing self-management





capacity in doctorate holders, but it is recognised that becoming autonomous in research, decision making, and project management should also be included in the DIOSI model.

## 2. The role of the supervisor

The supervisory relationship is at the heart of doctoral education, it forms part of the accepted consensus, the academic culture and is embedded in the formal regulations.

This section is based on information gained from the paper ‘Analysing National and Institutional Doctoral Regulations’ (Schneider, Kortese, Sivonen & Tans, forthcoming) that was developed in the Link Edu-Res project – information on universities that are not in DIOSI was left out, while information for UCY and NCU was added. In this report, the following conclusions were reached with regard to supervision:

*‘The role of the supervisor may be considered **the biggest similarity** between the universities. In all cases, the supervisor is responsible for guiding the research and teaching, assessing the research and making corrections, overall management of the progress, dedicating time to the candidate and their research, and ensuring interaction with other academics/bodies within the university, faculty, department, school, or institute.*

*In principle, all universities establish that a candidate should have at least one supervisor whereby a second supervisor (or co-supervisor) is possible. At UNIRI regulations make mention of a (single) mentor who guides and monitors the student. However, at most universities (NCU, UAntwerp, UEF, UBremen, UM, UC3M, UEssex, UCY, and UNIRI) multiple supervisors are either mandatory or allowed upon approval. Furthermore, most universities distinguish between a principal supervisor and secondary supervisors/co-supervisors. At UNIRI, UEF, UBremen and UM the supervisor (or at least one of the (co-)supervisors) may be external to the university. By contrast, at UAntwerp, UEF, and UCY, the (principal) supervisor must be affiliated to the university or to the doctoral/graduate school. In some cases, a co-supervisor may originate from either another doctoral school (e.g., UAntwerp, UEssex) ... At UCY, a single PhD supervisor from the institution guides the doctoral candidate. The appointment of two PhD Supervisors for a doctoral candidate from the same Department is permitted, provided that one of the Research advisers is appointed as the main supervisor.*

*The level of qualification and position of the supervisor varies per university and sometimes even per discipline. The main trend nevertheless is that professors act as supervisors. Additional members of staff also qualifying for a supervisory role are senior members of academic staff (UAntwerp, UM), holders of a doctorate (UAntwerp, UM),*





*academics expert in the field of the doctorate (UNIRI, UEssex), postdoc (UBremen), scientist with Habilitation (UBremen, NCU).*

*A maximum number of supervisors is maintained at UAntwerp (max. 4 supervisors) and UM (3 supervisors), and NCU (2 supervisors).*

*For URTV, no provisions in relation to supervision appear to be made. Nevertheless, the Collegio dei Docenti (doctoral board) consisting of professors and researchers plays a core role in supervising research and teaching activities of doctoral candidates by approving candidates' progress to subsequent years and admitting them to the final doctoral examination.*

*Indeed, several consortium members have an independent body monitoring annual progress of doctoral candidates. UAntwerp, URTV, UC3M, UEssex, UCY and NCU provide supervision oversight through committees that are either fully or partially composed of academics not directly involved in the supervision of the candidate. These committees have a role in monitoring the research progress (often on an annual basis) and approving the thesis for defence.*

***This paragraph is based on Schneider et al, forthcoming; with information for UCY and NCU added by author.***

### 3. Method and data collection

This paper is based on desk-research (literature analysis of academic and policy sources) and on semi-structured interviews with experts on doctoral training from all of the DIOSI-partners. The interviews were specifically designed to bridge the gap between an analysis of the stated rules, regulations and formalities of doctoral regulations and any adjustments in the lived practice.

The ten institutional partners interviewed have joined hands in building a European University alliance: the Young Universities for the Future of Europe. The interviews include one business partner InnoEXC GMBH – to also include the private-sector/business perspective.

- the University of Antwerp (BE),
- the University of Bremen (DE),
- the University Carlos III of Madrid (ES),
- the University of Cyprus (CY),
- the University of Eastern Finland (FI),
- the University of Essex (UK),
- the University of Maastricht (NL),





- the Nicolaus Copernicus University of Toruń (PL),
- the University of Rijeka (HR),
- Tor Vergata University of Rome (IT)
- InnoEXC GMBH (CH)

During the interviews we asked experts from the partner institutions to conduct a SWOT-exercise on their current doctoral education systems. They were then asked for their visions of an ideal doctorate and doctoral journey. From analysis of these interviews, clustering common topics and ideas, it was possible to distil a joint vision and model for doctoral education.

Each partner was asked to nominate one expert for the interview<sup>2</sup>. Due to the large variation in institutional settings, this meant that sometimes our respondent was an academic, and sometimes an expert in a managerial role. Acknowledging the multiple perspectives gained in this process, the respondents were heads/deans of discipline-specific and also of umbrella doctoral schools or programmes, policy advisers and academics. Due to this broad variety of respondents and institutional configurations, the discussion of the results will centre on topics where there was some commonality.

The data from these interviews is extremely valuable, reporting on the de facto situation of doctoral education at the partner institutions, as well as achieving expert insight and commentary on specific systems. The interview data provided the background and context to the expressed visions from the experts. The interviews usefully record the cases where experts were advocating for very different models, whilst desiring the same outcomes. Sub data was also illuminated by a 'nil-response' to questions where an emerging practice or process was revealed. What for some partners was considered an advantage, could be construed as a disadvantage for others – either because their visions on doctoral learning differed, or because they were within a particular institutional or regulatory landscape. Each system has and leads to its own rationale.

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<sup>2</sup> This does not imply that the experts' visions therefore represent the vision of their whole institution.





## 4. Analysis: Pressures in doctoral learning

### 1. The quality of the doctorate

Even with aspects of formalization and procedural frameworks, the doctorate remains an individualized experience. All partners mentioned flexibility as necessary to support the individual doctoral projects and researchers.

Doctoral learning is not always compatible with immovable bureaucratic oversight or rules and regulations that create obstacles and impose prohibitions. This may mean that doctoral systems that become too rigid may push towards more informal interactions. Work-related strictures and lack of incentives may cause supervisors to accept DCs only informally, for example if there is no recognition of the work put in supervision, if they prefer/need to avoid the responsibilities that come with employment/formal supervision, ... (Interview 3, 5).

With informal supervisions institutions do not have a full overview of the number of persons conducting research and the progress of their trajectories. Hence no complete monitoring of the numbers or success of the doctoral candidates is attainable. Therefore, at the same time, flexibility also has its downsides:

*‘So high flexibility comes with non-transparency and no control mechanism at all.’ (Interview 5)*

Several experts mentioned that the strictures on time-to-complete can negatively affect the quality of the doctoral process, and of the doctorate:

*‘Most of the doctoral students are experiencing problems in completing their PhD requirements on time as outlined in the rules of the university.’ (Interview 9)*

Other issues mentioned were linked to the quality of the produced PhD, the composition of the final jury, and also to (severe) breaches of integrity (Interviews 5, 8, 10).

### 2. Producing skilled PhD graduates

All interviewees mentioned the topic of careers after the PhD. The public debate on the poor working conditions and career destinations for researchers is seen as a threat to the system, with some concerns over the unsustainability of a high turnover of incoming and outgoing PhDs without corresponding clear direction into the labour market (Interview 5). Universities risk losing their appeal and reputation, in terms of





being an attractive destination and employer. Additionally, the PhD can struggle to be valued in other sectors outside academia, which can reduce the employability options for doctorate holders.

### 3. The supervisory relationship is key

The relationship between a supervisor and doctoral candidate will always be of a unique kind. It is about an intense collaboration, meeting at the nexus between developmental process, professional experience and intellectual development. The traditional master-apprentice relationship has its strengths but also its weaknesses, specifically when tensions arise in the supervisory relationship that are obscured due to the lack of oversight.

*‘People work for 4 years and there is no Ph.D. at the end, because of some quarrel. This is not rational.’ (Interview 1)*

*‘One threat is the toxic supervision. Many supervisors just want you to stay at the bench night and day and not do anything else. This leadership style sets the example and also the benchmark sometimes, so that the doctoral candidate sometimes not understand that this is not good for them. Sometimes they understand when they finish that they wasted some opportunities.’ (Interview 6)*

*‘... we don’t have anything formal, or anything to actually see if the supervisor is a good supervisor or not. The only thing is that the ... PhD candidate, during the process could ask to change supervisor. That is a clue that something is not going well’. (Interview 10)*

*‘There are no regular meetings of the supervisors with the doctoral students.’ (Interview 9)*

Regardless of formal requirements, three experts mentioned having knowledge of (in their own and/or other institutions) supervision taking place outside of formal enrolment of the doctoral project or candidate (*interviews 3, 4, 5*) which connects to the above discussion of flexibility in the process.

The number of doctoral candidates varied. Some supervisors have one/a few supervisees, whereas in systems where there is pressure to ‘produce’ PhD’s, there were supervisors with up to fifteen doctoral candidates. Certain institutions impose a maximum number of supervisees per supervisor, as a measure of quality assurance, which was a practice largely supported by the experts in the interviews. However, at the same time, external pressures related to the financing of institutions and the





running of large projects may push certain supervisors to taking on as many DCs as possible.

*‘And only when the PhD is defended, then the university says: ‘great now we get the money from the [...] government and you get the bonus’. ... The pressure on young professors [...] to get PhD’s defended is very high. Why is this so important? Because the university gets money. This is the neoliberal business model.’ (Interview 7)*

Interestingly, at the University Carlos III of Madrid, a **tutor** is appointed next to a supervisor. The tutor watches over the training component during the doctorate. Although in practice the role of tutor is generally taken up by the supervisor. At NCU, mentoring also takes place, however, there are significant overlaps with supervision. At UNIRI, the word mentor is used for supervisor. At UEssex, the expert noted that informal bonds arise between doctoral candidates and members of the professional research staff, or external mentors variously connected to the University. This paper raises the question of the potential benefits of formalising these relationships.

#### 4. The value of formal training in a PhD

The core is the doctoral research project. In order to be able to conduct this research thoroughly, ambitiously, or in a timely manner, several partners see a formal training component as reinforcement of knowledge production. For some this meant adhering to a US-style system, having mandatory courses, while for other partners this was deemed unnecessary. Instead, they would prefer an optional and flexible course offer, with the freedom to take research skills courses, or even, transferable skills courses.

Including a formal training component is beneficial for the doctoral candidate to achieve the necessary research and transferrable skills in a timeframe beneficial to their project.

- The time to complete a PhD /during which a PhD is regularly limited to three or four years. Spending more time on a doctorate, given limited funding periods and employment in academia, not a desirable outcome. Therefore, formal training – which can be tailored to individual needs, can have favourable effects.
- Formal training allows DCs to gain skills, but also to meet with peers from other faculties, institutions, countries. It favours community building and interdisciplinarity of DCs by having them step out of their research group or lab.







- Mandatory formal training can be seen as a tool to safeguard the doctoral candidate, inculcating them into correct ethical and risk mitigating processes, and establishing space for personal development and investment in wellbeing.

A formal training component, and providing structure in general also may present a risk to the intellectual, professional and personal development of the doctoral candidate if the training structure provided becomes too patronizing. One of the essential parts of a doctorate is the candidate becoming independent in a world full of information, and able to navigate uncertainties. Therefore, it is essential that the training offer still centres independent thought and encourages the development of the highest level of self-management. This paper recommends a tailored approach to each doctorate and doctoral candidate, as to allow them to develop not only intellectually, but also personally.

## 5. The DIOSI Model for doctoral learning: a holistic approach

### 1. The DIOSI vision for doctoral learning

The doctoral candidate stands at the centre of the (doctoral) universe as an active steward in charge of their research and career. Ownership and autonomy are key to achieve personal and professional development, and throughout the learning process.

In this process, the DIOSI DC is supported by both the supervisor, the supervisory committee and the institution. During the doctorate, the candidate engages in a Ph.D. research project, with a clear goal in mind – but flexible to adapt to the research findings and evolutions in the work. The doctoral candidate is encouraged and empowered to engage in cooperative work at different stages of the research and doctoral process, aware of the support that open science tools and practices provide and with the guidance of a non-academic mentor<sup>3</sup> (cf. 5.2 below). The doctoral candidate is open to inspiration from and cooperation with communities, citizens, and/or stakeholders during the process.

The doctoral candidate progresses to the point of being the only one to solve problems and issues arising during the project; they become the holder of unique expertise on the specific subject, stretching the barriers of new knowledge. During that

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<sup>3</sup> With mentor we mean a person in a non-academic role that can provide guidance to the doctoral candidate on career perspectives.





process, the doctoral candidate goes through a transformative process from information-gatherer, to knowledge creator and owner. This goes hand in hand with a development in the capabilities and capacities of the doctoral candidate, at the level of personal development and even in identity formation.

The process should be mirrored in the professional portfolio and career development of the doctoral candidate. The institutions should devote constructive and practical support with the supervisors as the guide. The doctoral candidate becomes a highly developed intellectual that brings enrichment to a variety of professional contexts.

## 2. The supervisory team

The relationship between supervisor and supervisee is key to the success of the PhD, and of the wellbeing of all persons involved. As a supervisor, professors take on many roles going from director of a thesis, to a mentor and coach and even supporter role (Link Edu-Res [toolbox](#)). Should all those, and even more roles besides, be fulfilled by one and the same person? Or can the load be divided?

Certain universities (as mentioned in section 2.2) have already broadened the supervision setup to include a team or committee of supervisors – which may be a solution to problems in the supervisory relationship noted in the master-apprentice model, and also may be a solution to disparities and inequities in incentivisation (e.g., rewards for number of supervised doctorates).

In the DIOSI model for doctoral learning, a new basic component to the supervisory team is added, the non-academic mentor. There are several reasons to include this person: career goals, training goals, a stronger relationship with society, to impact and public engagement, and potentially even between the doctoral candidate and the institution. This mixed supervisory committee has the potential to propel the DIOSI partners to align their doctoral education systems while maintaining best practice from valuable traditions. There is thus a tripartite of supervision in which three parties are present: a traditional supervisor (academic, professor with a PhD), the doctoral candidate and a non-academic mentor. The institution's role remains to support the doctoral candidate and supervisor throughout the trajectory.

It is as simple as it is ground-breaking: it connects the heart of doctoral education to the outside world where additional expertise and knowledge is brought in to serve the doctoral candidate, the research process and the doctoral outcomes.





Adding a non-academic mentor to the supervisory meetings and committees in all doctorates, regardless of disciplines, potentially mitigates against weaknesses/threats that the experts identified in the SWOT-analysis:

- Recognizing that supervision requires investment and takes effort this initiative will lower burdens on supervisors/professors, as they no longer have sole responsibility for guiding doctoral candidates on aspects such as career advice, employability strategies, and doctoral training.
- To provide a clear framework for doctoral candidates that includes research but also transferable skills and career guidance and support as an integrated part of the PhD – and that therefore also lowers the (mental) burden for them by making expectations linked, comprehensible and navigable.
- To create an additional contact and support point for the DC, as mediation and pastoral support in case the supervisory relationship is over-burdened or goes awry.
- To improve wellbeing and mental health of DCs as they have more contact and support points, and by alleviating career-related stress.
- Allows for institutional monitoring on the number and progress of DCs.
- Allows for the cultural and institutional embedding of Open Science practices.
- Allows for a more inclusive and diverse approach, as it can help doctoral candidates find ‘mentors’ and role models that they identify with.
- Allows for doctoral candidates to become even more imaginative and ambitious, in terms of research, career development, and outside world opportunities.
- Allows for professors and institutions to maintain relationships with alumni for longer periods of time and remain in contact, regardless of the professional outcomes of the alumni.
- Allows more of a balance between academic autonomy; while at the same time opening up academic practices to modern developments of Open Science, inclusivity/diversity etc.

The supervisory committee would be composed as follows:

- The academic supervisor/supervisory committee as per usual in the institution
- The addition or inclusion of the non-academic mentor with the necessary credentials to guide a DC’s development: (preferably) a PhD holder working in





another sector or in a non-research position, or a person with equivalent experience/expertise. This person

- Needs to hold a PhD or equivalent research experience, scholarship or professional practice, which is preferably relevant to the doctoral candidate's project
- Will primarily guide with specific attention to the formal training and professional development components and to non-academic career related questions which might encompass wellbeing.
- Provides an additional link to the institution – even if employed elsewhere. The person would have to be acknowledged by the institution as part of the guidance team during the whole PhD-duration.

Ideally, such mentors would get a training at the beginning of the PhD trajectory on the expectations for their role, the functioning of the institution (i.e., the doctoral regulations, the relevant institutional contacts) and on providing career guidance to the DC.

Further questions relating to implementation remain to be discussed in the Consortium, adapted to specific institutional frameworks, and tested in pilots where several configurations with non-academic mentors are put in place.

### 3. The learning process: Learning outcomes or acquired intellectual virtues?

As mentioned above, there are two documents that show a consensus on the learning outcomes from doctoral learning, the European Qualifications Framework for Lifelong Learning from 2008 and the Framework for Qualifications of the European Higher Education Area from 2005. The European Qualifications Framework for Lifelong Learning (European Commission, 2008) mentions three main outcomes that could in a way be rephrased into three large categories: knowledge, skills/technique and the requisite behaviours of autonomy, integrity, and other agreed competencies for the doctoral holder.

- *knowledge at the most advanced frontier of a field of work or study and at the interface between fields*





- *the most advanced and specialised skills and techniques, including synthesis and evaluation, required to solve critical problems in research and/or innovation and to extend and redefine existing knowledge or professional practice*
- *demonstrate substantial authority, innovation, autonomy, scholarly and professional integrity and sustained commitment to the development of new ideas or processes at the forefront of work or study contexts including research (European Commission, 2008)*

Our expert interviews have shown that due to the pressures on doctoral education, doctoral candidates, and on supervisors and research staff, there is also pressure on the learning outcomes, the quality of the doctorate and the doctoral process.

One solution that could marry the benefits of the competence framing, with the focus on the acquisition of skills, whilst remaining relevant to the needs of society and also centring on the development of capacities comes from the 2010 publication *Emerging Directions in Doctoral Education* by Susan Mowbray and Christine Halse.

In their words:

*we propose that theorising the PhD as the acquisition of intellectual virtues moves beyond the limited economic agendas of the skills push. It shifts the lens from the instrumental production of the skilled PhD graduate to the progressive building of virtuous individuals who contribute to society through their productive actions. The rationale for such a theory is clear. We cannot know in advance what work opportunities will be available in the future, what skills future employers may require or how national and global developments will affect future labour markets. For these reasons, it is sensible to attend to the logic of the skills push but to avoid its excesses by rejecting its epistemological claims over the PhD. A theory of the PhD as the acquisition of intellectual virtues accomplishes this goal because it offers a theoretically rigorous language and method for capturing how students' experience the PhD while also holding open the need to accommodate an unknown future.* (Mowbray & Halse, 2010).

The benefits of using Aristotelian virtue theory in learning contexts have been recognized and appreciated by scholars (see for example Hoyne, Alessandrini & Feldman, and has for example also been used in the development of courses on research ethics and integrity for (doctoral and other) researchers (see for example VIR2TUE project).

*... as Aristotle argued in Nicomachean Ethics Book VI and Nussbaum (1986, 1990) reminded us, it is through the development and application of the intellectual virtues that individuals flourish in their daily life and work and contribute to the wider human good (Mowbray & Halse, 2010).*



A long conceptual discussion falls out of reach of this paper, yet the DIOSI model builds upon the conceptualisation created by Mowbray & Halse, where the virtues conceptually coalesce into three domains (see fig. 1). These three main virtues that doctoral graduates acquire; and which came from empirical interviews, align with the three learning outcomes defined in the European Qualifications Framework for Lifelong Learning. Another benefit is that this broad conceptualization leaves room to fit with other more detailed competence profiles as updated according to changing labour market needs, such as the researcher competence profile currently under development by the European Commission (or previously developed profiles such as the VITAE Researcher Development Framework, Adoc Talent Management's tree of competences, the Eurodoc skills framework, ...).

Whereas not all may adhere to this theory or conceptualization, this paper invites every single doctoral candidate, supervisor and expert to enter a dialogue on the value of doctoral learning, the learning outcomes, competencies and virtues debate.

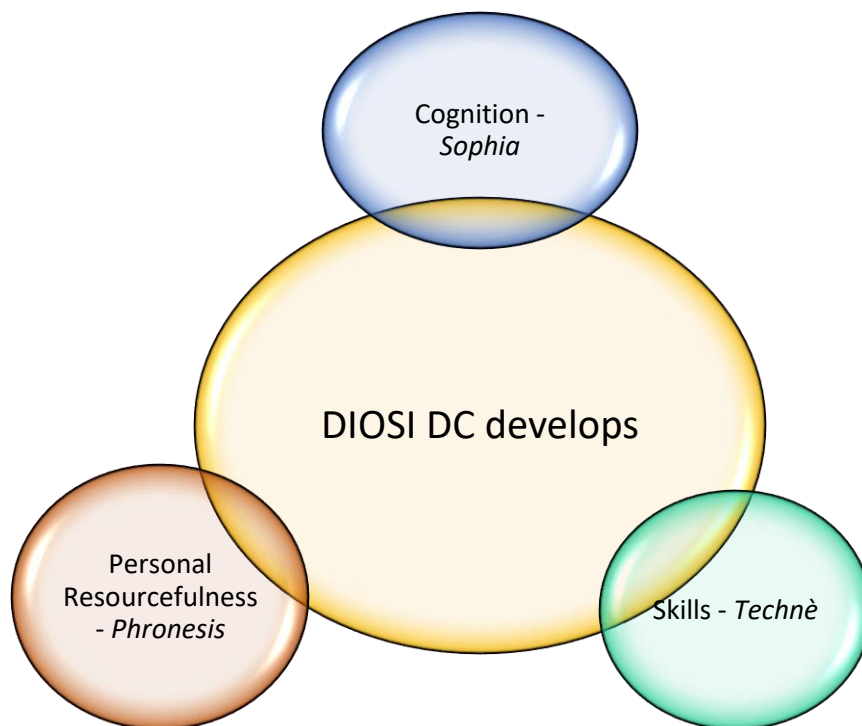


Fig. 1: Virtues that DIOSI DCs acquire (based on Mowbray & Halse, 2010)



## Developing cognition: the acquisition of *sophia*

The capacity to perceive and know is central to the doctoral learning process, it is about developing knowledge and understanding, and engaging in critical thinking. Doctoral candidates learn how to generate and apply new knowledge, theories and concepts. (Mowbray & Halse, 2010) It coincides with the first learning outcome:

- *knowledge at the most advanced frontier of a field of work or study and at the interface between fields (European Commission, 2008)*

Someone acquiring a DIOSI PhD holder is not a yes-sayer, but a critically, reflective and responsible person – that can deconstruct false arguments and fake news and can afterwards build a new model from their own creativity/originality to provide solutions. They are one of those rare persons that cannot only face uncertainty, but adapts their views to include new reality/data/observations, and update their strategy accordingly. They know how to use the ‘research approach’ to all kinds of problems, by analysing the issue and providing creative solutions to release deadlock. This is the base of innovation.

The DIOSI doctoral candidate is aware about their values and beliefs, the YUFE-values and how these are translated into the day-to-day of research life (unconscious bias, research integrity).

## Developing research and other skills: The acquisition of *technè*

Doctoral candidates learn to master techniques related to their field and topic, they employ the basics learnt during their BA/MA studies and put them into practice. By conducting their research in an open collaborative way, they become experts in methods, a certain laboratory or computer equipment, technology for using data or managing projects, open and collaborative tools for engaging with peers and societal actors. This broadly coincides with the second learning outcome:

- *the most advanced and specialised skills and techniques, including synthesis and evaluation, required to solve critical problems in research and/or innovation and to extend and redefine existing knowledge or professional practice. (European Commission, 2008)*





## Personal Resourcefulness: the acquisition of *phronesis*

A PhD holder can define and reach professional goals and self-manage. They have reflected on career paths and have acquired the ‘language of competences’. The PhD holder knows how to comprehend and partition an activity undertaken into the different skills that have been acquired/sharpened throughout that activity. The PhD has defined a career goal and identified a path (or paths) to reach this goal. A PhD is the steward of her/his own career. PhD holders know how to express themselves and reaches different types of audiences by clever communication. The PhD holder is a steward of the university, able to spread enthusiasm about research, their project and results. The PhD is able to form/participate in the research group, national and international networks, with academic and other contacts. The PhD holder is a recognized expert in the domain within and outside the academic world. *‘Personal resourcefulness can be understood as the acquisition of skills that enable students to become more assertive, confident, resilient, persistent and resolute in determining how to progress their PhD while balancing their other commitments’.* (Mowbray & Halse, 2010)

The wording in the European Qualifications Framework for lifelong learning is also looking in this direction in the third learning outcome:

- *demonstrate substantial authority, innovation, autonomy, scholarly and professional integrity and sustained commitment to the development of new ideas or processes at the forefront of work or study contexts including research* (European Commission, 2008)

### 4. The DIOSI PhD process: a mix of types of learning

The level of the doctorate is the highest possible level to achieve. One can take several pathways to reach that ultimate level of intellectual development, by formal and informal training. The doctorate is the level at which the learning process is a catalyst for the creation of new knowledge – and there is no single method towards approaching and reaching that goal. Learning can be done on the job or via courses, both have their benefits, the preferred option depends on the case, skill, doctoral candidate, opportunities, and level of specialisation.

Therefore, a strict formal training framework resembling a Masters educational setting remains complicated to develop in Europe. This would hamper the creativity needed for the development of knowledge. Yet, no formal training at all, is not seen as







propitious (cf. section 4.4). During courses, doctoral candidates meet one another, and learning cohorts can be formed. In addition, they can obtain an overview of possibilities for their project and career, and identify suitable strategies. This can all serve to shorten the time-to-degree.

It is fruitful to talk about the doctorate encompassing training - as it is in big part a learning by doing exercise and experience, rather than sitting in a classroom and taking in knowledge. There is guidance by a supervisor in the process, but ultimately, it is up to the candidates themselves to stick through and find a way through the maze. Structure to the learning process can be offered, however, the process remains unpredictable, as predicting the exact outcomes of a doctorate is hard in advance.

The PhD, regularly started right after a Master's degree (or BA\*), takes place at a specific time in the developmental process of a person. Coming right out of MA-studies, but forming as a professional individual and taking their first steps in terms of career and work experience, there are inherent tensions pulling at the doctoral candidate.

The following components within the DIOSI doctoral trajectory are proposed, which would (ideally) be enabled by a personal allowance for courses and access to training courses run by the DIOSI partners:

1. Research Plan and individualised development plan, which includes a thorough self-reflection (allows for identifying specific needs and tailoring the learning process to the doctoral candidate)

Ideally this includes research plan, training plan and personal development plan. The next step would be to address the question of how this plan would look like at each institution in the implementation roadmaps.

2. Topics of learning/training

The following topics seem necessary to all DCs (given the concerns mentioned by the interviewees with regard to these topics):

- Research ethics & integrity, unconscious bias in research and the work context
- Open Science & Innovation
- Research skills
- Broader skill development (related to career goals)





The topic of entrepreneurship is recommended for those that would benefit from training on it.

3. Mix of informal and formal training formats

- Joint formal training to foster community and/or cohort-development
- Formal training (to choice) as a financially viable and effective way for learning
- Informal training

4. PhD thesis with a side-note reflection on acquired competences during the learning process

Table 1: By way of inspiration for partners that do not have any formal training: a minimal DIOSI doctoral trajectory with the following mandatory but highly flexible programme is suggested - that is to be adapted to the current institution's and discipline's needs:

Year 1	Individualised research and development plan, discussed with both supervisor(s) and mentor jointly  Mandatory courses <i>Research ethics &amp; integrity and Unconscious bias in research and the work context</i> <i>The basics of OS (DIOSI course)</i>
Years ...	1 or 2 courses related to cognition and skills topic, methods, ... 1 or 2 courses related to broader development (transferable skills)  (Recommendation is to take at least 1 course for each, second course can be replaced by a 'learning obtained': a reflection note on the learning process including an 'AHA-moment' where one felt one had developed/acquired a new skill.)
Final year	Submission of thesis including a side-note reflection on acquired competences/virtues during the learning process





## 6. Conclusion

In this academically inspired, policy solution-oriented paper, **the case has been made for a holistic DIOSI model of doctoral learning** based on four main arguments.

First, pressures on the doctoral process (be it by funding, time restrictions, formal obligations etc.) are thereby pressures on the quality of doctorates and the experience of the doctoral candidate. Therefore, the DIOSI model emphasises the learning outcomes to be acquired and synthesises these components into a comprehensible and manageable guided process. The DIOSI model emphasizes creativity and critical thinking as essential to building innovation in doctorates, and promotes open science practices as part of the new normal.

Second, the development of the DC is placed centrally, following Mowbray & Halse's (2010) conceptualisation of doctoral learning within Aristoteles' Virtue theory. The benefit is that this allows to 'shift the lens from the instrumental production of the skilled PhD graduate to the progressive building of virtuous individuals who contribute to society through their productive actions' (Mowbray & Halse 2010).

Third, a vision where the doctoral candidate stands at the centre of the doctoral universe emerges, where they are comprehensively supported by the supervisor and the institution. Supervisors take several roles in the doctoral process: that of director, mentor, coach and supporter (Link Edu-Res project – [toolbox](#)). Moreover, career guidance is essential to alleviate the employability-related stress of DCs. This model proposes that this should not be another burden on the shoulders of professors. Providing career mentoring on non-academic career destinations falls beyond the scope of the academic supervisors' mission. Therefore, the formation of supervisory teams is proposed, that include a mentor with specific remit for career guidance and formal training opportunities.

Last, acknowledging diverging models and perspectives on formal training within doctorates, it is recommended for institutions to use a mix containing both informal learning and formal training. For those institutions that have no formal training installed and/or could use inspiration, a training programme for the DC is proposed. This recommendation is inspired by the benefits that this can bring:

- a. Courses are an efficient and financially viable way to disseminate knowledge, crucial in guiding doctoral candidates (e.g., by providing an overview of all existing methods, or existing communication methods to valorise their PhD) and limiting the time to completion of the degree (time-to-degree)





- b. Training courses allow for exchange with peers outside the research group/domain and the cross-fertilisation of knowledgebases.
- c. Courses enable the development of a learning cohort and builds community.

As a next step, the DIOSI-partners will develop implementation roadmaps, to identify the routes to implementation for all partners involved. Ideally, the partners can in future as a first step towards actual implementation develop a pilot (or several pilots with slightly different configurations) to test the model.





## 7. List of figures

Fig. 1: Virtues that DIOSI DCs acquire (based on Mowbray & Halse, 2010)

## 8. List of tables

Table 1: By way of inspiration for partners that do not have any formal training: a minimal DIOSI doctoral trajectory with the following mandatory but highly flexible programme is suggested - that is to be adapted to the current institution's and discipline's needs

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