

Report of the outputs from: EPSRC Workshop on the Review of Doctoral Education with representative groups

Summary

These workshops were designed to seek input from the wide variety of representative groups in the engineering and physical sciences community, into EPSRC's review of its support for doctoral education. The workshops covered the following topics

- 1) The culture of doctoral education: what experiences are required to ensure that doctoral students are prepared for all future careers and how EPSRC can enable a diverse and inclusive student population.
- 2) How EPSRC can ensure our doctoral education investments allow the research landscape to respond to priorities and emerging areas of research.

The review is being carried out in order to check that the doctoral education EPSRC supports enables the student to acquire the skills and knowledge needed for their careers, now and in the future.

The workshops were attended by members of organisations that represent communities within the engineering and physical sciences landscape, in order to provide EPSRC with an expert view on the culture of doctoral education in engineering and physical sciences fields.

This report provides a summary of the discussions that were had at the workshops.

Introduction

The review is considering what outcomes in terms of knowledge, experience and skills should be supported through EPSRC doctoral training investments. The changing nature of research means that EPSRC wants to check that the experiences provided by the doctoral education it supports, enables the recipient to acquire the skills for the career they choose now and in the future. EPSRC also wants to ensure that the landscape is adaptable to changes in future skills needs.

The review is covering the following five areas:

- The value of doctoral education: to the individual and their career, to the research landscape and to employers
- Skills and Experiences: What skills and experiences should be provided by a doctorate
- Student Population: how to enable a more diverse student population, including increased mobility between academia and industry
- How the doctorate is provided: including different qualifications, ways of providing the doctoral experience and how support is provided.
- Ways of identifying, developing and responding to strategic priorities: how can the landscape respond to changing directions and needs.

The workshop is one of the methods that EPSRC is using to gather evidence to help us develop recommendations for what outcomes in terms of knowledge, experience and skills should be supported through EPSRC doctoral training investments regardless of investment mechanism or topic area. Other methods include, a community survey, data analysis, literature survey and strategic conversations. The recommendations will be developed in consultation with members of EPSRC's Strategic Advisory Network and Council.

Two workshops were held on the 09 March 2021. A total of 15 attendees came to the workshops and the delegate list can be found in Annex 1.

Opening Address

The meeting began with EPSRC welcoming all participants. Shyeni Paul, Senior portfolio manager, EDI & People then gave an opening address and provided an overview of:

- UKRI's Talent Strategy
- EPSRC's Vision and Priority Framework, including the focus on Realising excellence in people
- The purpose of the review of EPSRC's doctoral support
- The scope and proposed timeline for the Review

This was followed by a question and answer session. The slides can be found in Annex 2.

What Skills and Experiences should be provided by a well-rounded doctoral education?

EPSRC has collected significant evidence from previous engagement activities on what experiences should be available during a well-rounded doctoral education and therefore wanted to take a more in depth look into two aspects of the provision of experiences

During this session the attendees discussed two questions:

1. What Technical Transferable skills are required to do a modern doctorate/ for a future career and what are the ways these skills can be provided to a wider section of the student population
2. What experiences should be available to doctoral students and what are the barriers for participation that need to be addressed.

The technical transferrable skills that were identified were:

- Problem design/Specification – including the ability to construct an abstraction of a problem that's traceable
- Experimental design
- How to formulate and test a research hypothesis
- Proposal development
- Reproducible research - this has different requirements in different research disciplines but is important across all of them
- How to build and share research techniques

- Computational modelling skills – how to build new models for problems that might be encountered.
- Robust coherent data reporting skills – data science skills
- Statistical methods
- Critical appraisal skills
- Sustainable research practices – how to consider and adapt for the environmental impacts of the research and outcomes
- Research ethics and responsible research
- Interacting across discipline boundaries – how to communicate across disciplines and having an awareness of how the research areas is perceived by both technical and non-technical audiences and how this needs to be considered when communicating
- Self-assessment of development needs – both technical and transferable to ensure the student can progress with the project and into a career

There was then a discussion on how these skills can be developed by the students over the course of the doctorate. The key points raised were:

- Generally, the skills mentioned above are not taught at the undergrad level or there are no current plans to teach them on a widespread scale. Therefore, the students need to develop them in order to progress their doctorate as well as for use in their future careers.
- Funding is not readily available for training. The current investment mechanisms lead to a big discrepancy in the amount of training available to CDT and DTP students. There are also discrepancies in how much of the DTP is spent on training between different universities. However, there are significant benefits of having multiple investment mechanisms.
- The funding for training needs to be available to a wide range of individuals and organisations to ensure the training is being provided by the most qualified people.
- The training provision should be flexible. There isn't a need for EPSRC to be overly prescriptive, but more guidance/clarity could be given on EPSRC's expectations.
- Training requirements should be driven by the student but with assistance to help them identify their needs and learning styles
- If there are more training requirements there needs to be more time. However, the time can't be extended indefinitely, as this puts people off and disadvantages some, but there does need to be a consideration of the amount of time required for development activities. There could also be a method for applying for additional time if required.
- Mentoring is a valuable way of applying skills and continuing to develop. It would also be beneficial to teach students how to mentor/coach to support peer to peer learning.
- Courses are good when tailored to the audience and designed well.
- Placements provide real benefits but need to be flexible.
- Working on interdisciplinary projects is a valuable way to learn a wide range of skills. This requires the creation of opportunities to participate in these projects.
- There may be a growing need for doctoral students to buy in skills when they can't develop them over the course of the doctorate. While this can be beneficial to the project, it needs to be managed carefully so the student can still show ownership of the original contribution.
- There needs to be a clearer set of outcomes regarding what professional skills a student should develop over the course of the doctorate

During the discussion around what experiences should be available to doctoral students and what are the barriers for participation, the attendees were asked to sort the experiences and barriers into four sections using the following proforma. This helps ensure that any action taken to address the barriers is proportional and can be applied in the relevant areas.

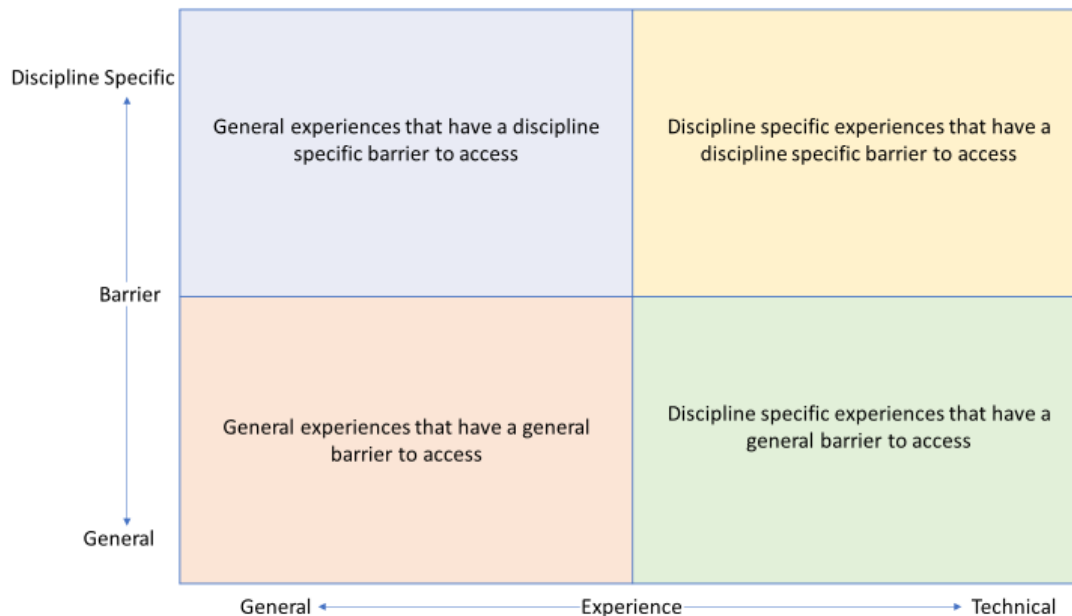


Figure 1: Proforma used to identify the experiences and associated barriers

The experiences discussed were:

- 1) General experiences that have a general barrier to access
 - A wide range of experiences are affected if the student has caring responsibilities, from needing more absences which prevents completion in a timely manner to accessing conferences, placements, training etc. EPSRC does allow the additional cost of participating in activities that are over and above the standard doctoral project working pattern, to be charged to the training grant (e.g. cost of additional care while the student is at a conference etc.) but this flexibility is not well known and requires universities to retain funds to utilise it.
 - Participation in experiences can be greatly affected by the supervisor's perception of participating in the experience and their ability to facilitate the experience. Sometimes, supervisors can prioritise their own level of research rather than provide student training. EPSRC should promote supervisor training to ensure the student receives the necessary support and learns effectively. EPSRC could also make their expectation on what experiences should be available clearer and promote the benefits of participation. Culture change is needed by supervisors.
 - The need for some students to more strictly maintain set work hours due to other commitments may prevent them from participating in extra curricular activities, especially informal networking activities.
 - International activities, conference and placements can be affected by the student's ability to get a visa.

- International activities, conferences and placements can be affected by whether the country is safe for people with some protected characteristics especially those related to gender and sexuality.
- Outside perception of the doctorate experience and value may lead to some students trying to complete it as quickly as possible and prevent them from participating in activities that are perceived as additional.
- There are different levels of training available on different schemes and another disparity again with non-UKRI funded students. This can create an awkwardness within the university environment, but the general consensus was that universities should 'level up' and not 'level down'.
- Lack of inclusivity in the research group can prevent a student from wanting to participate in group activities.
- If a student requires time away due to mental health and well-being, this can cause issues relating to the availability of training/equipment access etc.

2) General experiences that have a discipline specific barrier to access

- Perception that placements are a distraction from the thesis writing by supervisors and students.
- Reduced access to teaching experience due to money-saving initiatives in universities. Teaching experience can be very different across disciplines
- In research areas that are new or emerging or there has been a recent step change in knowledge required to complete a doctorate, then students may not understand what training they require or have access to suitable training
- The perception that a doctorate is only a preparation for an academic career can lead to additional experiences being ignored
- Within specific areas of a discipline there can be different perceived training needs
- Access to specialist training outside of their own institution
- Access to specialist equipment can cause issues if there is limited availability or access as at specific times may cause additional issues
- Placements can have a variety of barrier from: knowledge of the placements, access issues due to location of placement, funding issues
- Access to research technology professionals
- A split site experience can cause issues with logistics and living arrangements
- Community networking opportunities are harder at small institutions/research groups

3) Discipline specific experiences that have a general barrier to access

- Having/gaining digital skills – to enable students to benefit from digital technologies in their own research and to 'speak the language' of digital experts
- Difficulties in data-sharing and confidentiality agreements when working with industrial partners can put the university off involving them in projects
- Importance of sustainable practices. Increasingly researchers are considering the environmental impact of their research both in terms of how the research is carried out and, in the applications,
- Opportunities for interdisciplinary interactions are dependant on connectivity of supervisory team and this will vary by discipline
- Lack of role models can exacerbate impostor syndrome within underrepresented groups meaning some students are reluctant to put themselves forward for enrichment experiences such as committees etc.

- Awareness of and access to placement/internship opportunities can vary by discipline
- 4) Discipline specific experiences that have a discipline specific barrier to access
- International opportunities are more available in some disciplines than others. Participating in them benefits the student by establishing collaborators and allowing the access to equipment
 - Access to enterprise skills and business awareness for staff and students
 - The effect of CDTs on other students in small research areas. When most students in a research area are already connected, it can distort the access to training, networking issues etc.
 - Mature students can lack of confidence in their abilities in relation to the discipline's technical knowledge
 - Whether the student has had directly relevant UG/PGT training ; in multidisciplinary areas or areas without a clear link to UG curricular, then the students' knowledge levels can be very different and therefore they require very different training, not all of which may be easily accessible.
 - Some research topics require large teams to make rapid progress and remain competitive but then it can be difficult for individuals to identify their specific contribution
 - Ensuring access to specific research facilities and where not possible providing remote access options
 - Opportunities for interactions with other experts (outside of supervisor team) can be difficult especially in smaller research groups
 - Opportunities for interactions with industry – central brokerage of interactions might help

Summary of outputs

There is a need to ensure that training opportunities and other experiences are available to students regardless of the funding mechanism that supports them. Training should be provided by the most relevant person and therefore there needs to be ways of supporting and funding those on non-academic career tracks to provide training.

The barriers to accessing experiences are varied but often relate to the need for equal availability to access opportunities regardless of the study location, research group size and funding mechanism. There is also a need for clear advertisement of what a doctorate entails, what opportunities should be available and the benefits of a doctorate to the individual.

Identifying and Responding to Strategic Priorities

EPSRC wants to support the long-term needs of the research landscape but also ensure that our doctoral investments don't hinder its ability to respond to changes and emerging areas of interest. EPSRC asked the attendees to provide a perspective on what how EPSRC should be identifying and responding to strategic priorities in relation to doctoral education investments.

The following points were raised in the discussion:

- The choice of research areas should predominately driven by the researchers. However, EPSRC could be doing more horizon scanning and to provide information to help universities and individual researchers scope future directions
- Both the discovery and application of emerging ideas need to be supported.
- The flexibility of the DTP does allow it to support emerging areas when used in this manner by universities
- There does need to be a framework whereby funding can be provided in a short timeframe to allow a response to an emerging area
- As well as funding for studentships in emerging areas, there needs to be funding for the people who train the students in the new techniques/research. This is especially true if the area is growing rapidly and the number of experts are not able to provide all the training required for the number of students. There also needs to be a recognition that training is provided by others than the academic supervisor and additional funding may be required to support these individuals.
- The EngD qualification was designed to enable greater industry engagement in doctoral education but appears to have been forgotten in wider discussions about doctoral education.

Next Steps for the Review

The outputs of these workshop are being reviewed by a group of members from EPSRC's Council Strategic Advisory Network (SAN). They will be combined with the outputs of other engagement activities that are happening as part of the review of EPSRC's doctoral education support. The advisory group will be using the combined evidence to develop a series of recommendations for what outcomes in terms of knowledge, experience and skills should be supported through EPSRC doctoral training investments. EPSRC will then use those recommendations to develop its future approach to doctoral investments, in the context of direction in UKRI and the national funding landscape.

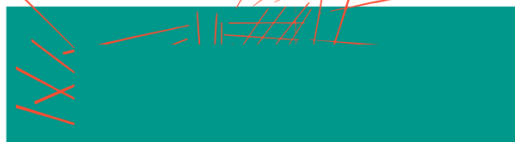
Annex 1: Delegate List

- British Computer Society
- Council of Professors and Heads of Computing
- Edinburgh Mathematical Society
- Institute of Chemical Engineers
- Institute of Civil Engineers
- Institute of Mathematics and its Applications
- London Mathematical Society
- Operational Research Society
- Royal Society
- Royal Society of Chemistry
- Society of Research Software Engineering
- Software Sustainability Institute
- UK Computing research committee
- Institute of Physics
- Royal Society of Statistics

Annex 2: Slides from opening address

EPSRC Doctoral Support Review

Shyeni Paul, EPSRC, EDI & People
21/10/2020



Our vision and mission



Our vision is for an outstanding research and innovation system in the UK that gives everyone the opportunity to contribute and to benefit, enriching lives locally, nationally and internationally.



Our mission is to convene, catalyse and invest in close collaboration with others to build a thriving inclusive research and innovation system that connects discovery to prosperity and public good.



Delivering our vision and mission

- The research and innovation system is complex and multidimensional and must be considered holistically. This is reflected in the interconnected nature of our four mission statements. They are not separable, and all contribute to multiple outcomes.
- In this corporate plan we set out our objectives for the current year grouped under our four mission statements, matching them to the statement to which they are most relevant, while recognising that these statements are deeply interconnected.



We will **convene and catalyse**, by listening to and connecting diverse communities to create new combinations, working in partnership with others. And we will help to make things happen, catalysing new activities through our work and investment.



We will **incentivise** the development of a research and innovation system that realises our vision through all the choices we make, how we behave, and in our policies and activities.



We will **invest** in people, ideas and infrastructure, through a portfolio of investments that ensure public benefit from the system as a whole, informed by engagement and evidence. We will fund well – efficiently and effectively.



We will **conduct** high-quality research and innovation and provide critical national capabilities through our centres, units, and institutes.



UKRI talent in numbers

- In the financial year 2020/21 UKRI has an investment budget of more than **£9,000m**.
- UKRI invests about £600m** annually in talent programmes, including approximately **£400m in doctoral training**
- £260m is invested per year in England through the **Research Degree Programme (RDP)** Supervision funding, and about **20% of QR** (approx. £210m) is used for attracting and retaining talent, training and doctoral students
- Fund **1,500 research fellows**
- Support over **27,000 active students**, approximately 7000 starts in the last year.
- We also support more than **24,000 researchers** on research and innovation grants



EPSRC Vision: Corporate Plan 2020/21



▪ Delivering economic impact and social prosperity;

To decrease the timescales between discovery research and impact through our Productive, Connected, Healthy and Resilient Nation priorities.

▪ Realising the potential of engineering and physical sciences research;

To support and draw together people, expertise and facilities from across institutional boundaries to maximise the potential of the UK research base, promoting excellence across all our investments.

▪ Enabling the UK engineering and physical sciences landscape to deliver

To invest in the core foundations of the research base to ensure the UK remains globally competitive and maintains its world-leading position for research and innovation including investing in research facilities and accessing talent through equality, diversity and inclusion.

How do we achieve our vision?

- community engagement and partnership
- work effectively with our community, partners, advisory groups, learned and professional societies and government to position our portfolio of funding
- be effective in articulating our future portfolio needs and directions
- may need to respond at pace



The Priority Framework

Objective 2: Realising the potential of engineering and physical sciences research

To unlock the potential of EPS research by stimulating and challenging the research community to open up new areas of science; supporting talented people; and strengthening engagement with users and business



Promoting Excellence in Research



Realising Excellence in People supporting researchers to work across university and business sectors



Connecting the Research Landscape to Accelerate Impact continue and extend IAA activities



Enhancing Business Engagement



Engineering and Physical Sciences Research Council

Realising Excellence in People

To be productive and competitive, the UK needs a diverse workforce with the right skills.

- **People** with world-leading research ideas;
- **People** with the analytical, critical thinking, and other skills that employers need to lead and deliver innovation;
- **People** to help achieve the economic and societal impact that research has the potential to have.



Engineering and Physical Sciences Research Council

Reasons for doctoral training

- EPSRC is a major funder of doctoral students, funding 25 to 30% of all EPS doctoral studentships in the UK
- Well-established and recognised approach to developing and training highly skilled researchers and innovators
- Research outputs are recognised and important
- Future of the R&D workforce which will encourage the growth of the UK's capacity and capability in emerging research challenges.



Realising Excellence in People
Supporting researchers to work across university and business sectors

EPSRC Doctoral Education review

Ensuring that the doctoral education we support :

- enables the recipient to acquire the skills and knowledge needed for the careers that doctoral students take-up
- ensure that our investments are helping the research and innovation system adapt to changes in future skills needs



Realising Excellence in People
Supporting researchers to work across university and business sectors

EPSRC Doctoral Education Review

- Phase 1 2020 -2021 :

What

Developing principles for EPSRC's doctoral education support

Mechanism and budget agnostic

- Phase 2 2021:

How

Develop recommendations for EPSRC's future approach to doctoral investments

EPSRC Doctoral Education Review

The value of doctoral education: to the individual and their career, to the research landscape and to employers

Skills and experiences: What skills and experiences should be provided by doctorate

Student population: how to enable a more diverse student population, including increased mobility between academia and industry

How the doctorate is provided: including different qualifications, ways of providing the doctoral experience and how support is provided.

Ways of identifying, developing and responding to strategic priorities: how can the landscape respond to changing directions and needs.



EPSRC Doctoral Education Review

Phase 1:

- Working with all stakeholders
- Workshops
- Strategic Conversations
- Student Focus groups
- Call for evidence
- Recommendations developed by EPSRC SAN and Council members



EPSRC Doctoral Education Review

Phase 2:

- Comparing the recommendations to the current investment mechanisms
- Developing the future of EPSRC Doctoral Education investments, within the context of UKRI developments



Centres for Doctoral Training



Doctoral Training Partnerships



Industrial CASE



Engineering and Physical Sciences Research Council

Next Steps for the Review

Engagement activities are continuing

EPSRC will be developing the recommendations with the Strategic Advisory Network and Council. These will be published (~Late Spring 2021)

Phase 2 of the review will then commence, looking at implementing the recommendations



Engineering and Physical Sciences Research Council