Entrepreneurship education for doctoral candidates at the University of Antwerp, Belgium

Abstract: The University of Antwerp (UAntwerp) has entrepreneurship as an explicit educational priority. It is a member of the Young Universities for the Future of Europe European University Alliance (YUFE). The University sees an urgent need to reform doctoral education to deliver more entrepreneurial graduates equipped with open science competences and to open new career opportunities for doctoral candidates. UAntwerp coordinated a European project entitled "Developing and Implementing hands-on training on Open Science and Open Innovation for Early Career Researchers" (DIOSI). In this project, together with partner universities, UAntwerp developed a concept for educating early-career researchers about entrepreneurship as well as sessions in which teachers can learn how to teach entrepreneurship. Key items of the concept are a non-academic mentor, training modules about the basics of innovation and entrepreneurship as well as a three-day train-the-trainer course. UAntwerp measures the short-term and long-term impact of the training modules on doctoral candidates. The DIOSI partner universities continue implementing the concept beyond the project funding. Several spin-off companies have emerged from doctoral research at UAntwerp, and the University expects that the number will continue to increase in the future.

1. Background | Profile of the University of Antwerp

The University of Antwerp (UAntwerp) is a young university that originates in three separate institutions that began to cooperate under the name University of Antwerp in 1973. In April 2022, the University had more than 21,000 students – among them 2,171 doctoral candidates – and more than 4,700 academic staff members. UAntwerp has nine faculties: Applied Engineering; Arts; Business and Economics; Design Sciences; Law; Medicine and Health Sciences; Pharmaceutical, Biomedical and Veterinary Sciences; Political and Social Sciences; and Science. UAntwerp is a member of the Young Universities for the Future of Europe European University Alliance (**YUFE**)[1], one in a group of European University Alliances selected and funded by the European Commission.

Entrepreneurship is an explicit educational priority at UAntwerp. The other four priorities are education-research combination, internationalisation, being competence-focused and activating students.[2] Major activities in which this priority becomes visible include an Advanced Master of Innovation and Entrepreneurship[3], the Antwerp Centre for Entrepreneurship Research[4] and a diligent Valorisation Office. In 2021 and 2022, UAntwerp coordinated a European project titled **"**Developing and Implementing hands-on training on Open Science and Open Innovation for Early Career Researchers**" (DIOSI)**. The project builds on a lifecycle concept of doctoral education. It encompasses three parts: the development of a new joint doctoral educational programme, training on open science, open innovation and entrepreneurship, and measuring the impact of the training with a framework for impact and

[1] See https://yufe.eu/.

[2] See https://www.uantwerpen.be/en/about-uantwerp/organisation/facts-figures-rankings/. The University's mission and vision includes valorisation of knowledge as one of four tasks; see https://www.uantwerpen.be/en/about-uantwerp/organisation/facts-figures-rankings/

[3] See https://www.uantwerpen.be/en/study/programmes/all-programmes/innovation-and-entrepreneurship/.

[4] See https://www.uantwerpen.be/en/research-groups/antwerpcer/.

through graduate tracking. Other YUFE universities[5] and a company, InnoEXC were partners in the project.

This case study focuses on how UAntwerp implemented the DIOSI training concept and describes their experiences.

2. Objectives | Rationale for entrepreneurship education for doctoral candidates

The three parts of the DIOSI concept – programme, teaching, and impact – follow a defined rationale.

First, the newly developed doctoral programme seeks further integrating skills training into PhD programmes, in particular transversal skills as equal to research skills.

Second, the DIOSI concept provides training on open innovation, entrepreneurship and open science for doctoral candidates and early career researchers from all the University's faculties. The aim is to tackle skills shortages and a perceived need for a culture shift towards open science.[6] The training also seeks to open new career opportunities to young researchers as well as increase the societal impact of research. During the project, over 300 doctoral candidates and early career researchers from the YUFE universities benefited from the training. UAntwerp as well as the other YEFU universities continue the training programme beyond the project funding.[7] The University is also developing an online handbook to aid the dissemination of the training. Moreover, the DIOSI project developed train-the-trainer sessions to build the trainers' capacity in innovation and entrepreneurship teaching and to improve existing offers. Via the DIOSI project, local educators participated in a train-the-trainer programme organised by an expert from the InnoEXC company. In this programme, educators learned how to initiate innovation and entrepreneurship courses in their own institutions or strengthen existing ones. Uantwerp continues organising such sessions for its internal trainers. Each newly educated trainer shall be able run innovation and entrepreneurship sessions.

Third, DIOSI developed an impact and graduate tracking framework to understand the impact of innovation and entrepreneurship training. Uantwerp is one of the YUFE members that pilot the framework and seek further developing and implementing it.

3. Entrepreneurial activities | Programme development

In the DIOSI model, the doctoral graduates shall acquire cognition, skills and personal resourcefulness. This is in line with the European Competence Framework for Lifelong Learning.[8] The DIOSI model emphasises creativity and critical thinking. Moreover, it adds a new basic component to the supervisory team, the **non-academic mentor**.[9] "Non-academic" means that

[5] Further YUFE university members include Maastricht University (the Netherlands), Nicolaus Copernicus University (Poland), Universidad Carlos III De Madrid (Spain), University of Bremen (Germany), University of Cyprus (Cyprus), University of Eastern Finland (Finland), University of Essex (United Kingdom), University of Rijeka (Croatia), Université Sorbonne Nouvelle (France).

[6] For example, a study on behalf of the European Commission found that none of the bioeconoy-relevant doctoral study programmes identified in ten surveyed countries offered comprehensive entrepreneurship training. See Deloitte/empirica/FGB (2022): Promoting education, training and skills across the bioeconomy. Final Report, p. 64 – 65.

[7] See https://www.uantwerpen.be/en/centres/antwerp-doctoral-school/doctoral-study-programme/training-offer/course-offer-ads/4200ads003/.

[8] See European Commission (2008): The European qualifications framework for lifelong learning (EQF). Luxembourg: Office for Official Publications of the European Communities.

[9] See DIOSI (2021), pp. 18 – 20.

they are not directly involved in the doctoral research of the candidate (i.e., they are not a supervisor, co-supervisor, member of an evaluation committee or doctoral jury). These mentors can be academics affiliated with the university or another university, but they can be external stakeholders as well, not affiliated with a university at all. These mentors will support the candidates' career and personal development goals, training goals, the relationship of the candidate with society and their public engagement. Potentially, the mentor can even strengthen the relationship between the doctoral candidate and the higher education institution. Uantwerp will implement non-academic mentors in 2024. The non-academic mentor needs to hold a PhD or equivalent research experience that should be relevant to the doctoral candidate's project. Possible benefits of a non-academic mentor include the following:

- Professors share responsibility for guiding candidates on training, career and employability
- Doctoral candidates receive more advice about transversal skills as an integrated part of their training – which links their expectations more strongly to the needs of society and future employers
- Non-academic mentors can facilitate open science practices through their business contacts. They can be role models and help doctoral candidates to become more imaginative and ambitious in terms of research, career and interaction with society. They can maintain relationships with alumni

4. Training offers

4.1. Training for doctoral candidates and early-career researchers

The DIOSI training includes formal and informal elements, and it assumes that doctoral training should include the following topics: Research ethics and integrity; unconscious bias in research and the work context; open science and innovation; research skills; broader skill development related to career goals; and entrepreneurship. The dedicated offer in entrepreneurship is a course on the "Basics of Innovation and Entrepreneurship" (see the box below). After DIOSI ended, Uantwerp took over this course into its regular curriculum in 2023. It is one of 47 courses on offer in the Uantwerp doctoral training programme.[10] The Antwerp Doctoral School has been offering the course twice a year, once per semester since autumn 2022. It is open voluntarily to doctoral candidates from all faculties and disciplines.

Basics of Innovation and Entrepreneurship
The teaching programme "Basics of Innovation and Entrepreneurship" includes four modules of 1.5 hours each. The maximum number of doctoral candidates is 18. Uantwerp led the development of the programme.
Module 1: Introduction on (Open) Innovation and Entrepreneurship
Module 1 makes doctoral candidates familiar with the fundamentals of innovation and entrepreneurship as well as with the European Commission's Entrepreneurship Competence Framework. Doctoral candidates explore how these concepts relate to their personal career ambitions. A CEO from a university spin-off acts as a guest speaker to make the concepts tangible.
Module 2: From research to value creation and innovation: technological and commercial readiness
Module 2: introduces learners to the concepts of the technological readiness level and the commercial readiness level which are frequently used in academic innovation and entrepreneurship. Doctoral candidates learn how to build a roadmap for collaborations, funding and investments related to their research based on the two concepts.
Module 3: The Business Model Canvas and how to apply it to your own research
Module 3 introduces learners to Osterwalder's Business Model Canvas. Doctoral candidates learn, translate and elaborate the canvas in a research context.

[10] See https://www.uantwerpen.be/en/centres/antwerp-doctoral-school/doctoral-study-programme/training-offer/course-offer-ads/4200ads001/.

Module 4: From research to valorisation: which route to take?
The last module trains doctoral candidates about different routes for the valorisation of their research such as licence agreements, service platforms or the start of an own spin-off company. The head of the valorisation office runs this module.
Source: DIOSI training for early career researchers (Phds), internal document, and https://www.uantwerpen.be/en/centres/antwerp-doctoral-school/doctoral-study-programme/training-offer/course-offer-ads/4200ads003/

4.2. Training for trainers

DIOSI identified trainers as the most important factor influencing the quality of training. In DIOSI's concept of entrepreneurship education, trainers shall not only transmit knowledge but support the learning process of every doctoral candidate and early-career researcher. Trainers shall be able to build knowledge (fundamentals of innovation and entrepreneurship), attitudes (valuing the impact of entrepreneurial training) and skills (being able to organise challenge-based training in innovation and entrepreneurship for early career researchers). Towards this purpose, DIOSI designed a three-day train-the-trainer course. After DIOSI ended, Uantwerp did not continue this course in this form. However, Uantwerp incorporated it into another existing course and organises related courses for its researchers.

DIOSI Open Innovation and Entrepreneurship three-day Train-the-Trainer Course

Day 1: Definition and general processes of innovation and entrepreneurship, basics of intellectual property management, teamwork on a case study. (8.30 a.m. – 4.30 p.m.)

Day 2: Basics of accounting, lean startup concept and business model canvas, case study on minimum viable product. (8.30 a.m. – 4.30 p.m.)

Day 3: Business strategy development through Michael Porter's five forces model as well as analysis of strengths, weaknesses, opportunities and threats (SWOT analysis). (8.30 a.m. – 12.30 p.m.)

Source: DIOSI Deliverable 3.1

5. Impact measurement and graduate tracking

The DIOSI Impact and Graduate Tracking Framework includes two different time perspectives (short and long) and three levels of tracking (training participants, graduates and impact on the university, stakeholders and wider society).

5.1. Short-term perspective

The main objective of the short-term perspective is to monitor the effectiveness of the specific programmes in open science, open innovation and entrepreneurship – effectiveness in terms of participants' course experience and perceived learning outcomes. In each training course, learners fill out a self-assessment questionnaire adapted to the course content before and after the training.

Key performance criteria of the DIOSI Impact and Graduate Tracking Framework – short-term perspective

Training course	"Open Innovation and Entrepreneurship training"		
Impact level	1: reaction	2: learning	3: behavior
Measurement time	After the training	Before and after the training	Before and after the training
Learning outcomes / Key performance indicators	Training satisfaction: - applicability of the content presented - preparation and expertise of the trainer - personal benefit of participating in the activities - satisfaction with the activities	Knowledge & Skills: - understanding of the general processes of innovation and entrepreneurship - knowledge of the basics of intellectual property management - brainstorming ideas and creativity - understanding the basics of accounting - understanding the lean start-up concept and the use of the business model canvas - understanding the minimum viable product (MVP) - knowledge of key aspects of business strategy such as Porter's 5 forces and SWOT analysis - knowledge of key sources of funding for innovation - familiarity with innovation funding options for early career researchers - knowledge of how to present an innovative idea and attract funding, collaborations or customers	Attitudes & Intentions: - attractiveness of the entrepreneurial career - entrepreneurial self-efficacy - entrepreneurial / intrapreneurial intention

Source: DIOSI Deliverable 5.2.

5.2. Long-term perspective

For the long-term perspective, DIOSI applies the Rugby Team Impact Framework (Rugby Team, 2008). This is an evaluation model specifically tailored to the training and development of researchers in higher education. It includes four levels of outputs and outcomes:

1) Reaction: participant's response to the activity.
2) Learning: change in attitude, e.g. improved knowledge, increased skills.
3) Behaviour: behaviour change, e.g. thoughtful, confident, self-aware.
4) Outcomes: external impact, e.g. better research, improved qualification rates.

6. Stakeholders | How stakeholders contribute to doctoral entrepreneurship education

UAntwerp runs the entrepreneurship course in close cooperation with experts from a large variety of enterprises and backgrounds and from the University's valorisation office. The universities in Flanders also cooperate jointly with the non-academic labour market, the cooperation is embedded in a working group in the Flemish Interuniversity Council (Vlaamse Interuniversitaire Raad - VLIR). They organise events and training courses relevant in the framework of the doctoral training programme in which companies are closely involved. The VLIR hosts an interuniversity working group that consists of staff members of the doctoral schools at the Flemish universities, who collaborate with industries to organise events, activities and courses with a focus on entrepreneurship and the non-academic labour market.[11]

[11] See for instance https://vlir.be/events/job-shadowing-for-phd-candidates-postdocs-2024/ and https://jobmarketforyoungresearchers.be/en/phd-postdoc.

7. Outputs, outcomes, impacts and lessons learned

Several spin-offs have emerged from research at UAntwerp. Some doctoral graduates from UAntwerp founded start-ups, commercialising technologies they developed during their studies. While the spin-offs stem from doctoral research, they are not all related to the DIOSI programme. Examples include:

- Iflux that provides groundwater monitoring solutions (https://iflux.be)
- Immunewatch that provides immune-therapeutic solutions (https://www.immunewatch.com)
- Icometrics that enables value-based care for people with neurological conditions (https://icometrix.com)
- Crowdscan that provides sensor technologies for managing crowds (https://www.crowdscan.be)
- Farmdesk that integrates software development, agricultural knowledge and data engineering (https://www.farmdesk.eu/en/)

However, UAntwerp expects the number of spin-offs from doctoral research to increase in the future due to the programme.

Pieter Spooren from UAntwerp summarises the University's ambitions and lessons learned about promoting entrepreneurship in doctoral research and teaching as follows:

> "We believe it is vital to teach our researchers that they can generate impact with their research not only through the traditional academic route of publications. We also want that they learn how to translate their research results into higher technology readiness levels and commercial readiness levels. In our approach, students, researchers, but even professors and staff should understand that impact goes beyond achieving a publication in a high-impact journal. While this is already a very ambitious outcome, creating innovative impact is another significant milestone. We encourage the development of a more entrepreneurial mindset. They should strive to bring their research results to society. To achieve this, they should work in multidisciplinary teams to explore the business case, understand the unmet needs, and determine how their research can optimally address these needs. They should have insights into the willingness to pay and the voice of the customer, understand the regulatory pathway to market, and have a broad overview of the competitive landscape, even beyond their own expertise or discipline. Furthermore, they should be open to partnerships, recognising that they cannot achieve success alone, but also need to consider their IP strategy, balancing openness with necessary confidentiality." (Pieter Spooren, UAntwerp Department of Research)

8. Sources

This case study was prepared by Dr. Stefan Lilischkis from empirica Gesellschaft für Kommunikations- und Technologieforschung mbH, Bonn, Germany, through collection and analysis of broad documentation about start-up-oriented professorships and interviews with key representatives from the University of Antwerp.

The status of information provided in this case study is June 2024.

9. Contacts at the University of Antwerp

Margaux Kersschot, Policy Advisor Young Universities for the Future of Europe, Doctoral & Postdoctoral Training

Karla Tersago, Head of Antwerp Doctoral School

Pieter Spooren, Department of Research Affairs

10. Links and references

DIOSI project: https://diosi.eu/

DIOSI (2021a): D2.1 – The DIOSI Model for Doctoral Learning. A holistic approach. Lead Author: Dr Margaux Kersschot (UAntwerp) (Download at https://diosi.eu/wp-content/uploads/2021/12/20211130-DIOSI-Model-Doctoral-Learning_D.21.pdf).

DIOSI (2021b): D3.1 - Training Programme Open Innovation & Entrepreneurship (OI&E). Lead authors: Marios Demetriades (University of Cyprus), Anastasia Constantinou (University of Cyprus), Elena Christodoulou (University of Cyprus), Marco Masia (INNOEXC GMBH) (Download at https://diosi.eu/wp-content/uploads/2023/02/DIOSI_WP3_Training_Programme_FV.pdf).

Rugby Team. (2008). The Rugby Team Impact Framework. London: The Careers Research and Advisory Centre (CRAC) Limited. (https://www2.le.ac.uk/departments/doctoralcollege/about/external/publications/impact-framework.pdf/view)

UAntwerp doctoral school: https://www.uantwerpen.be/en/centres/antwerp-doctoral-school/