OPENING DOORS

Opportunities and education in networked innovation for new graduates with PhDs using open online resources

Science with and for Society in Horizon 2020

H2020-SwafS-2020-1

Final course curriculum and online delivery format

Deliverable 2.2

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Introduction

OPENING DOORS is a project, funded by the European Commission, that sets out to develop an educational intervention that is: open, intersectoral, interdisciplinary, international, networked, state-of-the-art, scalable, sustainable, and fit-for-purpose. Its objective is to enrich the learning experience offered by higher education to early career researchers. The goal of this project is to shape more innovative, socially aware, entrepreneurial and employable post-doctoral research graduates, ready to meet the challenges of the future. This will be accomplished through a challenge-based, open, online educational course in open science and open innovation. Using a virtual learning environment, we aim to reach a larger, international cohort of postgraduate students for education in open science and open innovation using connectivism as the pedagogical approach. Connectivism reflects the networked innovation environments of the future. This education will not be discipline or sector specific.

Workpackage 2 of Opening Doors, Co-Design of Curriculum, was led by Maynooth University and involved all beneficiaries and partners. Building on the intelligence gathered in Work Package 1, a 2-day curriculum co-design workshop was undertaken which involved a) the project personnel; b) the project advisory board and c) a purposeful sample of stakeholders including academics, industry representatives, citizen organisations, policy makers, data science experts, human resources specialists, intellectual property experts, social entrepreneurship experts, recent PhD and Post-Doctoral graduates. The participants were invited to an interdisciplinary, intersectoral "open innovation" curriculum design day which took place online, via Zoom due to Covid-19 health restrictions. The consortium members then met in a further workshop to integrate the findings from the co-design workshop and to explore how best to develop the valued skills identified in WP1 and collaboratively developed a module proposal and draft curriculum. Aarhus university took this draft curriculum and used it to develop a draft technical specification for an online open platform that would allow the Opening Doors consortium to deliver a sustainable curriculum. The methodology utilised for the workshop, as well as the draft curriculum and draft technical specification are all detailed in Deliverable 2.1.

This first draft underwent further review by industry stakeholders in Ireland and the Czech Republic before being finalised by the Opening Doors consortium. This final version of both curriculum and technical specification is detailed in this deliverable. See Figure 1 below for an overview of the design process.

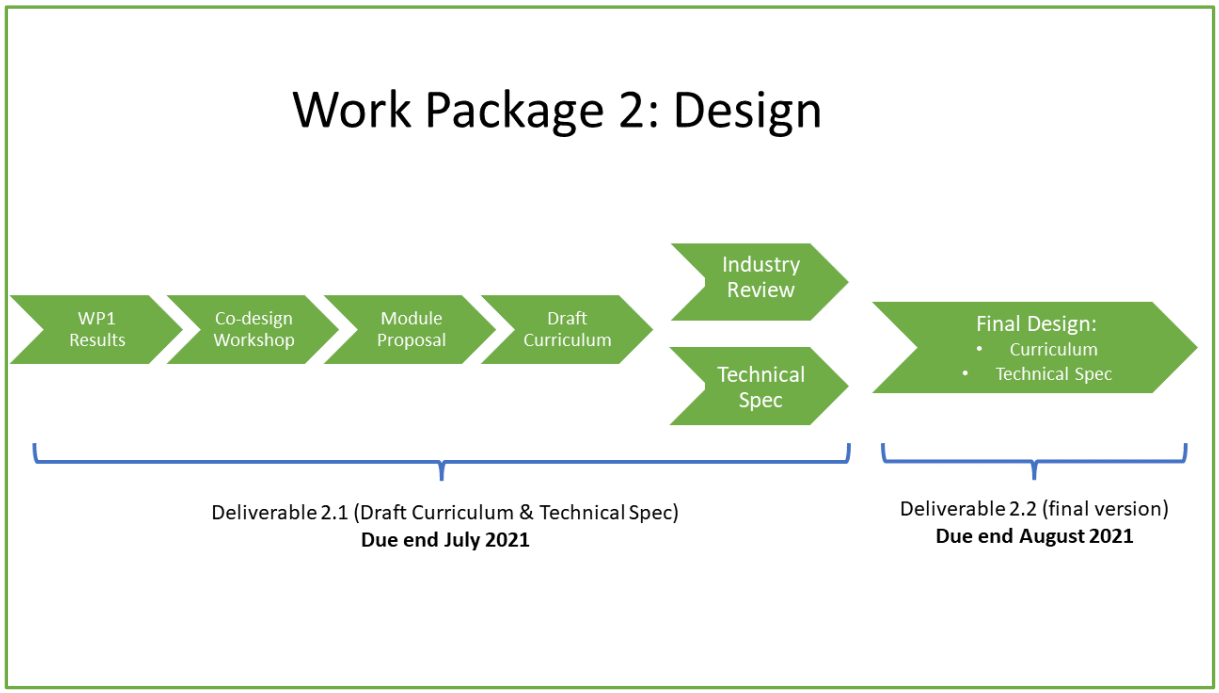

Figure 1: Flowchart for Curriculum Co-Design

1. Industry Check

1.1 The Industry Check Process

The finalised first draft of the course curriculum as detailed in Deliverable 2.1 has undergone industry review in both the Republic of Ireland and the Czech Republic. The purpose of this step was to verify with stakeholders who were not involved in the previous engagements to check that a) the curriculum meets the learning outcomes and b) the course is deemed fit-for-purpose and valuable from the perspective of individuals working in innovative and knowledge-driven areas. Feedback on the draft curriculum was invited via e-mail or as a mark-up on the supplied text, or via a Zoom meeting – whatever was deemed to be the most suitable. It was explained in the email that the feedback would be used towards finalising the curriculum that would ultimately be delivered as the online course in open science and open innovation.

In Ireland the draft curriculum was presented to members of the External Industry Advisory Committee at the SFI Insight Centre for Data Analytics (Ireland's largest research centre) for review. This research centre was established in 2013 by Science Foundation Ireland and has received funding of over €100 million. There are ~450 researchers working at this research centre, across 7 universities with over 80 industry partners. As part of its governance structure, the Insight Centre reports to an independent Industry Advisory Committee which is composed of representatives of Insight's industry partners involved in projects with Insight, and also leading industry experts in the field of data analytics. This advisory committee was one target group for the industry check. Additionally, an expert in online learning solutions - Dr Margaret Korosec, Head of Digital and Enterprise Learning Solutions at University of Derby Online Learning – assessed the curriculum in terms of its suitability for the online

learning industry. Dr. Korosec is a member of the Opening Doors Advisory Committee and was engaged in the project for her expertise and oversight in this capacity.

In Czech Republic, 6 non-academic employers were contacted who were identified previously as having experience in open science/innovation. The response rate was poor given the summer holiday season. Two detailed responses were obtained at the time of submission of this deliverable.

Revision of the curriculum was informed by the outcomes of this exercise.

1.2 Feedback received

Ireland

In Ireland, all those who were asked to provide feedback on the draft content, did so. The feedback from this industry check was mostly positive and validated the approach:

> *"This program certainly covers the main priorities for industry. Graduates from a PhD like this could go anywhere and will be set up with a unique advantage of an industry relevant skillset combined with their PhD!"*

In particular, respondents emphasised the value of the communication skills training included in the curriculum (such as the thesis in 3 competition):

> *"Nice focus on the core components required for industry. Presentation and communication is fundamental for the transition from PhD to Industry. Our PhD hires have been all rounders but most of the time what has set them apart in interviews is their ability to communicate complex topics effectively and sell their work as such".*

> *"Thesis in 3 is a great addition, can they explain the area they are in succinctly and more importantly can they almost sell it in terms of you get excited about their work and want to know more".*

The inclusion of intellectual property training in the curriculum also met with approval:

> *"We often find our PhD hires are working on IP heavy areas and we spend the first week with training in this area. Coming in with foundational expertise here is a unique advantage".*

One respondent advised the use of a planning template that raised a number of key questions about the online learning platform and pedagogies, and included a more detailed and structured weekly plan. We adopted this approach which led to the creation of a separate technical requirements section (section 3. of this document) along with a more refined curriculum including further information on: the content e.g. whether it is asynchronous or synchronous; how the learning outcomes mapped to each learning activity; details on formative assessments to guide the students on how they are progressing through the course; clarifications on how long students are expected to spend on learning activities. The finalised weekly curriculum is presented in section 2.

The Czech Republic

Feedback was largely positive with the curriculum seen as well designed and logically structured. The topic of system thinking was singled out for praise as this was seen as a highly necessary skill for the development of IT based modern society.

Concerns were, however, raised that the curriculum might be too broad in aiming to cover such a wide variety of soft skills. It should be noted that this respondent did agree that such skills were

> *"well identified and indeed necessary/important for open science and innovation, but it is not possible to learn them thoroughly within a scope of three weeks. The participants will only have opportunity to „try them out".*

A suggestion was to better distinguish between those goals that are core to the module and those that are supplementary. Goal 6 (Create a plan for professional development and the development of a professional network to open up traditional and non traditional career paths that align to your values, talents and interests) was perceived as omittable in relation to course´s purpose (though very useful for students from general perspective).[1]

In relation to Goal 2 (Design and implement collaborative projects with other researchers (from different sectors, disciplines and geographies), industry or community groups, understanding the importance of process as well as outcomes) one respondent's feedback concerned a lack of clarity as to what is meant by 'project' and encouraged a clearer articulation of this in relation to the course purpose. This was echoed by the second respondent who encouraged more detail as to project/research design thinking. Their view was that this area is often underestimated but is, in reality, very important and can be difficult to master. It includes skills such as comprehensive initial reviews of existing research/results so as not to repeat what was already done by someone else, to design research leading to commercially competitive and sustainable service/product etc.

Respondent feedback was particularly positive as to the content: „Introduction to Individual Task and brief explanation of each one: Carry out one of the following:

- Create a data management plan for your research.
- Pre-register a study.
- Design an engaged research interaction.

This respondent encouraged us to make this part of the course core and give it most attention.

Like the Irish respondents, the Czech Republic respondents also appreciated the emphasis on Intellectual property (IP), seeing it as a key topic for commercial subjects about which the PhD graduates often lack practical knowledge. They linked this to the project/research design thinking as it is necessary to be able to conceptualize the innovations within the IP framework. While this was seen as very important for science and technology disciplines, respondents acknowledged that is may be less important for humanities and social sciences.

Following on from the emphasis on communication skills in the Irish context, Czech respondents highlighted the need to develop interdisciplinary cooperation between scientists and

[1] This goal was included as a key element of the Opening Doors project proposal and forms part of the contract with the EU funders. It will therefore be maintained despite this feedback.

business. They believed that students should learn to interact not only with scientists from other disciplines, but also with business people who have very different points of view.

1.3 Response to feedback

Based on the feedback received during the industry check, as well as further development by the consortium partners based on the results of WP1 and the co-design workshop, the curriculum was revised and further developed. In particular:

- The template suggested by an Irish respondent was adopted and completed (section 2.4)
- More detail was added to all elements of the curriculum.
- Detailed project descriptions were solicited from industry which would be provided to students at course outset.
- Intellectual property, communication skills, interdisciplinary working, project skills, and the individual tasks were all designated as core to the module.
- The breadth of activities was maintained on the understanding that this was about allowing students to 'try out' multiple elements rather than developing in-depth expertise or experience in any one area. This exposure to multiple ways of thinking, planning and communicating was considered by the consortium to be core to the open science and open innovation mission of the module, given its interdisciplinary and intersectoral goals.

2. Final Curriculum

Following the detailed co-design methodology (described in D2.1) and the industry review process outlined above, the final curriculum is as follows:

2.1 Module Title

- Opening Your Research to Create Collaborative Futures

2.2 Learning Objectives

1. Build awareness of, and practice using open innovation frameworks and tools to facilitate co-creation and innovative thinking with stakeholders to increase the societal value of research.
2. Build awareness of, and practice using a selection of open science tools and approaches including ethical considerations such as research integrity and data management.
3. Design and implement collaborative projects with other researchers (from different sectors, disciplines and geographies), with other industry or community groups, understanding the importance of process as well as outcomes.
4. Communicate and open your research up to a variety of international stakeholders including researchers from other disciplines, community organisations, governments, businesses, and civil society.
5. Articulate and explain your knowledge, worldview, methodologies and research goals and be able to respectfully engage on these topics across sectoral and disciplinary boundaries.
6. Create a plan for professional development and the development of a professional network to support traditional and/or non-traditional career paths that align to your values, talents and interests.

2.3 Teaching and Learning Approach

This module will involve individual preparatory work in advance of the module delivery, such as: reading or watching introductory content; self-reflection/self-enquiry. Students will be expected to familiarize themselves with the introductory content in advance of the commencement of the module, in a flipped classroom approach. They will then attend live seminars where experienced academics and/or practitioners will further assist them in developing the key concepts and ideas in a discursive setting, through a variety of learning activities outlined in section 2.4. Students will then form groups and will implement and practice the key concepts while undertaking a real-life project in collaboration with a non-academic partner. The work aligns to a "challenge-based learning" (CBL) pedagogy.

CBL constitutes a pedagogical approach that reflects problem-based learning in terms of setting real life and open-ended educational challenges reflected upon experiential and project-related learning frameworks that "develop and nurture creativity" (Olivares and Cabrera, 2017 p. 3 cited in Pérez-Sánchez et al., 2020 p. 2). To accomplish that, technological tools and internal and external resources are present and exploited, including the instructor who is "coaching" and "co-designing" with the student (Baloian et al., 2006 p. 4). CBL has its roots in experiential learning, which carries the main objective that students evidence a deeper long-lasting learning process when they actively participate in open learning experiences compared to passively-structured ones (Proctor, 2010).

The CBL approach was popularized by the Apple (2008) research movement with the support of other innovative technology groups such as the New Media Consortium, The Society for Information Technology and Teacher Education, and the U.S. Department of Education Office of Educational Technology (Gibson et al., 2018). Employed across diverse educational learner groups, it tends to encapsulate learning as a somewhat business-related procedure consisted of interrelated stages/levels/phases: in thinking of open-ended "grand" multidisciplinary ideas/challenges, creating optional questions, exploring the challenges, resolving them in individual and (or) team level with the use of technology (i.e. "visual inspiration") and publishing the findings supported by other curricular and social tools and resources (Cobbett, 2013), while applying knowledge/awareness acquisition and attitudes and skills improvement at the same time (Nichols et al., 2016). It has been linked to greater learner participation based on students' own choice of learning paths (Enelund et al., 2013). Reflecting design thinking principles, CBL may be perceived as embedding a) inspiration/insight, the "problem or chance that motivates the search for a solution", b) ideation, the "procedure of generating, developing, and assessing ideas", and c) implementation/deployment, "the pathway that leads from the project level into people reality" (Brown and Wyatt, 2010 p.33). Gama et al. (2018) report that three significant facets of an inspiration/insight/idea may relate to innovation: end users find it desirable, industry /stakeholders perceive it as a viable and feasible product/service in terms of technology and commercialization. CBL is collaborative and hands-on, asking students to work with peers, teachers, and experts in their communities and around the world to ask good questions, develop deeper subject area knowledge, accept and solve challenges, take action, and share their experience (Nichols and Cator, 2008, p. 1). Research has shown that across all educational levels, 90% of tutors have indicated that CBL seemed to contribute to 21st century skills i.e. leadership, creativity, digital media literacy, problem solving, collaboration, critical thinking, flexibility, communication, adaptability, innovation and responsible research. 80% of them declared improvements in productivity, social skills, accountability, self-direction, information literacy and global awareness. This approach is thus an exciting opportunity to address the learning objectives and overall goal of the "Opening Doors" module.

In the “Opening Doors” online module, each multidisciplinary student group will be assigned a facilitator and a challenge owner, the latter who seeks assistance with an issue faced within their organisation. The project will require that each participant approaches it from their own discipline, as well as integrating other perspectives, thereby creating a bigger picture. Examples of potential ‘challenge’ projects might include a business/industry/or societal issue. Students are then asked to articulate that challenge from their disciplinary perspective, listen to how others articulate the challenge, and together develop a collaborative approach to the project. An assigned facilitator will ensure open communication, regular meetings and a culture where all can participate and contribute. Students will be supported in:

- Challenge mapping: describing and understanding the problem through a process that ensures the incorporation of multiple perspectives; multiple contexts and situations will be considered where this challenge has emerged and how it was/could be tackled.
- Ideation/Idea generation using open innovation methodologies learned as part of the course e.g. collaborative brainstorming/hackathon/crowdsourcing approaches to engage with the problem.
- Research and Reflection: Engaging in research actions to elicit/filter/integrate/use data and information from multiple sources that permit the identification of solutions mapped onto corresponding theories and real-world needs.
- Assessing/evaluating their development: Formative evaluation of their own skills and attitudes performed by the student, supported by the learning environment – e.g. the group, the online resources, the challenge owners and the facilitator.
- Communicating/Publishing solutions: dissemination of results in an appropriate and engaging way that describes viable, feasible solutions.

2.4 Final Schedule

Planning Model

Schedule:	This lists the parts of the week
Theme:	The primary theme for each part of the schedule is listed
Content:	What content will be used? Is it asynchronous or synchronous? It may be that the pre-work is asynchronous and others are facilitated synchronous sessions. The advantage of digital platforms is that it can be synchronous, independent as well as other combinations. Articulating this here will help ensure balance of activities.
Learning Outcomes:	Learning outcomes should be articulated against each section of the schedule and can be dispersed over the three weeks.
Formative assessment tasks	How will the learner know they are on track and progressing throughout the course? What activities help guide the student and enable peer or tutor feedback. This should not be a graded activity, but rather opportunities to engage and model.
Time to complete (Learner)	Approximate time to complete activities both inside and outside of class is clarified

Week 1						
Schedule	**Pre-work**	**Wednesday PM**	**Thursday AM**	**Thursday PM**	**Friday AM**	**Friday PM**
Theme	Open Innovation Team Working	Societal Innovation	Collaborative Working	Challenges	Challenges - Group	Challenges - Independent
Content	**Asynchronous session:** Open Science & Open Innovation Intro (~3 min video) Open workflows/collaborative technologies (~3-5 min video) Tuckman's Team Dynamics Open Innovation in Science (Beck et al., -2020)	**Synchronous session:** 2 x Lecture – Societal Change and Learning Organisatons; Quiz and Discussion of Collaborative Science Readiness; Self-Assessments on Open Science Knowledge and Capability, Interpersonal and Problem-Solving Ability, Intercultural Sensitivity	**Synchronous session:** Lecture on the affective, behavioural, cognitive states and processes of relating in teams; Group Discussion: Self/Group Cognitive biases; Lecture & Peer practice - Effective Listening Techniques; Win-Win Negotiation Skills	**Synchronous session:** Lecture & Discussion: Introduction to "Challenges" (i.e. a challenge contributed by an external partner to be researched and "solved" by the students) Workshop: Thesis in 3 Preparation **Asynchronous session:** Students submit preferences on which challenges they would like to work on via a Google Form Student via an online journal, reflect upon a personal 'Area for Growth' wrt collaborative science	**Synchronous session:** Students are assigned to one of 5 Challenge groups Each group meets their External Partner (meeting organised by facilitator) Facilitated: Each person presents Thesis in 3 to your group; Undertake 'speed dating' (i.e. explaining in 3 minutes how you view the Challenge from your disciplinary perspective); "Idea Tree" on the project; **Asynchronous session:** Working on Challenges – Hackathon methodology as an example of an open innovation approach; Collaborative Mind Mapping	**Asynchronous session:** Working on Challenges –(independently, in groups) **Synchronous session:** Guest speaker – Open Science

Learning outcomes	LO1, LO2, LO3	LO1, LO2, LO3	LO3, LO4, LO5	LO3, LO4, LO5, LO6	LO1, LO3, LO4, LO5	LO2, LO3, LO5
Formative assessment tasks		Contribution to discussion boards in small groups as well as whole groups; Quiz	Discussion group contributions; peer practice; Journal	Contribution to discussion boards; Self-assessment according to thesis in 3 checklist; Journal	Ice breaker contribution; Action plan for next steps;	Action plan for next steps; Personal reflection;
Time to complete (Learner)	30 minutes	Synchronous Session – 3 hrs: Lectures 45 mins Self-Assessments: 60 mins; Quiz & Discussion: 45 mins	Synchronous Session – 3 hrs: Lecture: 30 mins Group Discussion: 45 mins; Peer Practice: 75 minutes	Asynchronous work : 60 mins Synchronous session : 30 mins on Challenges 75 minutes on Thesis in 3	Meeting with Partner 45 mins Ice-breaker Activities 60 mins Asynchronous session: 60 mins	Asynchronous session: 100 mins Guest Speaker 60 mins

Week 2						
Schedule	**Pre-work**	**Wednesday PM**	**Thursday AM**	**Thursday PM**	**Friday AM**	**Friday PM**
Theme	Open Science	Open Science	Challenges – Interaction with External Partners (Open Innovation)	Challenges - Independent	Challenges – Interaction with External Partners (Open Innovation)	Career Planning
Content	**Asynchronous session:** Open Science Initiatives (~3 min video) Video explaining Individual "Open Science" Tasks to be chosen by students (~8 min video) Responsible Research & Innovation FAIR principles (~6 min video)	**Synchronous session:** Discussion session on Individual "Open Science" Tasks: Students carry out <u>one</u> of the following: ❑ *Create a data management plan for your research;* ❑ *Pre-register a study;* ❑ *Design an engaged research interaction;* ❑ *Secure a short-term internship;* Workshop: Public Engagement in Research: Citizen Science; Crowdsourcing, Participatory Research Approaches	**Asynchronous session:** Working on Challenges – (independently, in groups) **Synchronous session:** Facilitated preparation for interim meeting with partner	**Asynchronous session:** Working on Challenges – (independently, in groups)	**Synchronous session (independently organised):** Interim Meeting with External Partner **Synchronous session:** Facilitated reflection on interim meeting with partner	**Synchronous session:** Career Planning - Values/Talents/Interests/ Networks "The PhD Career Ladder Program" Guest Speaker - recent PhD graduate transitioned to non-academic role
Learning outcomes	LO1, LO2, LO4, LO6	LO1, LO2, LO4, LO6	LO3; LO4; LO5	LO3; LO5	LO3; LO4; LO5	LO6
Formative assessment tasks		Contribution to discussion boards in small groups as well as whole groups	Feedback from Facilitator on project plan and engagement plan	Peer Feedback; Action Plan for Next Steps	Feedback from External Partner; Group Reflection; Feedback from Facilitator	Personal Questionnaires; Ladder Framework and medium term action plan; Journal

Time to complete (Learner)	20 minutes	Synchronous Session – 3 hrs: Discussion of Open Science tasks: 60 minutes Workshop: 90 mins	Synchronous work: 60 mins Asynchronous work: 120 mins	Asynchronous work: to be decided by participants	Synchronous work (independently organised): 60 Mins Synchronous work: 60mins	Synchronous Work: Career planning -120 mins Guest Speaker - 60 mins

Week 3						
Schedule	**Pre-work**	**Wednesday PM**	**Thursday AM**	**Thursday PM**	**Friday AM**	**Friday PM**
Theme	Presenting	Open Science	Challenges - Independent	Challenges - Independent	Open Science/ Open Innovation	Open Science/Open Innovation
Content	**Asynchronous session:** Presentation Skills (~6 min video) Team Reflexivity (Written Guide)	**Synchronous session:** Guest Speaker : Intellectual Property Parallel Tutorials on Individual Open Science Tasks	**Asynchronous session:** Working on Challenges – (independently, in groups)	**Asynchronous session:** Working on Challenges – (independently, in groups)	**Synchronous session:** Group Project Presentations to External Partner and Expert Panel	**Synchronous session:** Facilitated group and written individual reflections Data Collections Close
Learning outcomes	LO3, LO4, LO5	LO1, LO2, LO4, LO6	LO3; LO5	LO3; LO5	LO3; LO4; LO5	LO1, LO2, LO3, LO4, LO5, LO6
Formative assessment tasks		Contribution to tutorial; Action Plan for Next Steps on Individual task	Peer Feedback; Action Plan for Next Steps	Peer Feedback; Action Plan for Next Steps Journal	Feedback from Panel; Personal reflection	Personal reflection; Self-Assessment Quiz
Time to complete (Learner)	20 minutes	Guest Speaker: 60 mins Tutorials: 90 mins	Asynchronous work: to be decided by participants	Asynchronous work: to be decided by participants	Presentation and Feedback to last 30 mins per group	Reflections: 60 mins Self-Assessments: 60 mins; Close: 30 mins

3. Final Technical Specification

This section details the technical setup for the open online course. The setup has been aligned with the course curriculum. The specific technologies and details for functionality are outlined below.

The technical setup for the open online course consists of the following subsections, briefly described next:

1. Enrolment and registration.
2. Main course site.
3. Video conference tool.
4. Course communication forum.
5. Storage of course content.
6. Collaboration tools.
7. Shared resources.
8. Tools for open science.

3.1. Enrolment and registration

Technology: Standalone website.

Functionality:

- Enrolment in course (name, e-mail, position, affiliation).
- Registration of users in course systems.
- Aggregation of mailing list with all users/participants.

3.2. Main course site

Technology: WordPress Blog.

Functionality:

- Webpage for description of course.
- Webpages for each module.

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- Webpage with links to course content, blog/forum, collaboration tools, webinars, etc.
- Embedding of videos, etc.
- Different user roles (students with posting rights).

3.3. Video conference tool

Technology: Zoom.

Functionality:

- Webinars for teaching, supervision, guidance and group work.
- Shared screen.
- Breakout rooms.

3.4. Course communication forum

Technology: Teams or blog or Google Currents.

Functionality:

- Messages from teachers and students.
- Comments by teachers and students.

3.5. Storage of course content

Technology: OneDrive or Google Drive and Panopto.

Functionality:

- Storage of files accessible to course participants.
- Storage of videos accessible to course participants.

3.6. Collaboration tools

Technology: Office 365 Teams or Google Drive and Padlet.

Functionality:

- Documents and presentations for collaborative group work.
- Tools for collaborative mind maps and brainstorming.
- Tools for (peer) feedback and comments.
- Students should be able to upload and create new documents.

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3.7. Shared resources

Technology: Zotero or Hypothes.is.

Functionality:

- Shared list of references
- Shared annotation platform

3.8. Tools for open science

Technology: Osf.io or Europen Open Science Cloud, Open research Europe

Open Science Repositories (Open Research Europe; Figshare)

4. Conclusion and Next Steps

This final curriculum and technical specification represents the culmination of a stakeholder engaged co-design process, further strengthened by an industry review process. We are confident that it captures the needs of all stakeholders, in particular those of early career researchers and employers. This design and specification will now form the baseline for Work Package 3 of the Opening Doors project which will:

- Develop an open, online learning platform through which the OPENING DOORS course can be delivered.
- Recruit PhD and Post-Doctoral Fellows to OPENING DOORS.
- Pilot test version 1 of OPENING DOORS open, online course.
- Deploy OPENING DOORS course to PhD and Post-Doctoral Fellows across Europe.
- Evaluate student learning and learning experience of the OPENING DOORS open, online course, and
- Track participants along their career development pathway.

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