

Teacher's Handbook

Open Science Moodle Course



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1. INTRODUCTION

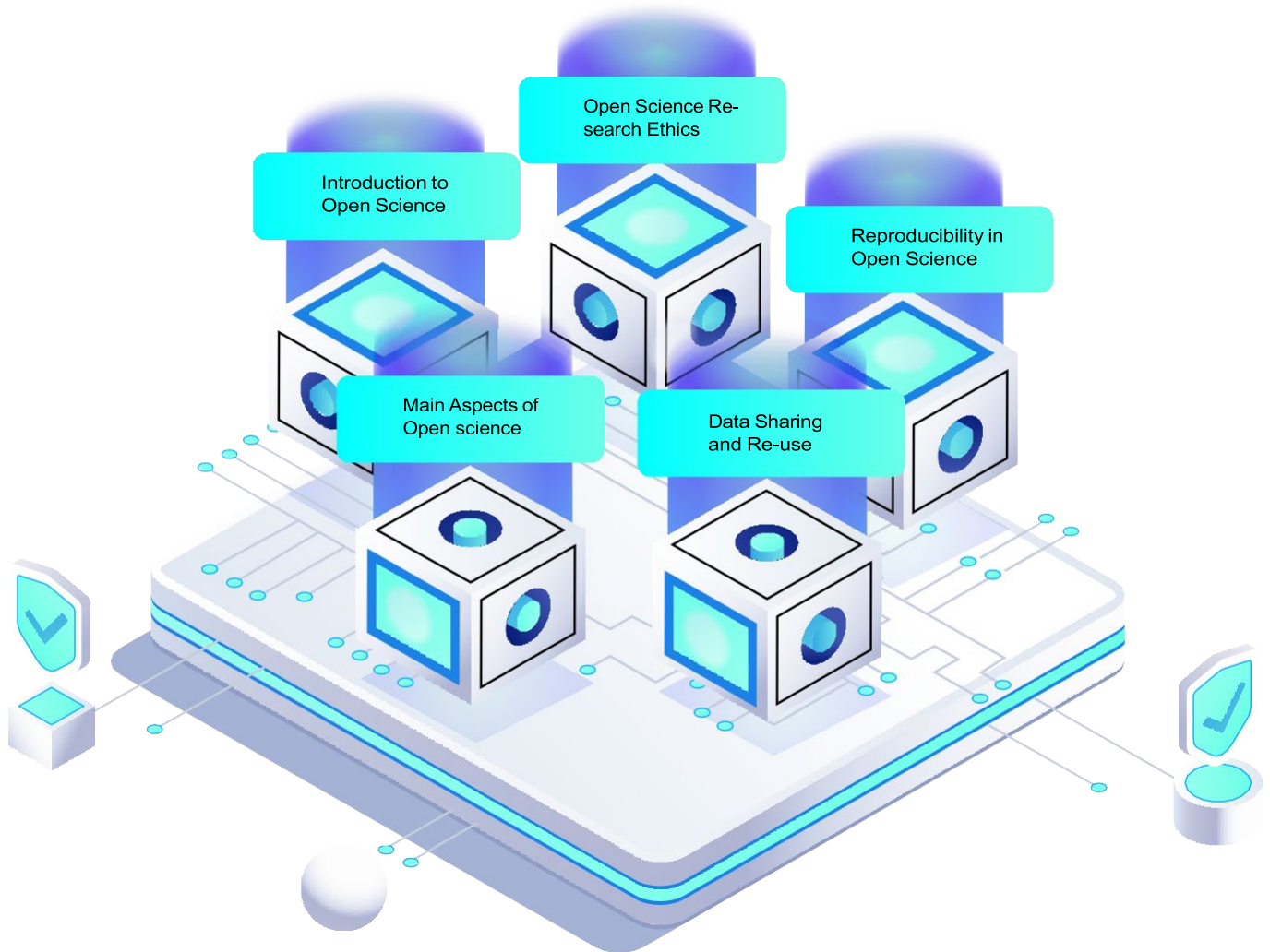
This course is constructed based on the OS learning material (Toivonen, 2023) established in INVEST4EXCELLENCE project to support the competence-based capacity building of the alliance in the area of open science. The INVEST4EXCELLENCE project, funded by the European Union's Horizon 2020 research and innovation programme (SwafS), aims to enhance regional sustainability through institutional transformation in research and innovation. The course content is derived from the alliance's joint strategy on research and innovation developed under the INVEST4EXCELLENCE project, which emphasizes the importance of open science in fostering collaboration, transparency, and innovation.

This course is designed to provide INVEST researchers, RDI personnel and Master's and PhD students with a comprehensive understanding of the principles, practices, and tools that make up the Open Science movement. Whether you are new to the concept or have some prior experience, this course will equip you with the knowledge of the fundamentals of open science and skills needed to actively participate in and contribute to Open Science.

The course is designed for both self-oriented and teacher-facilitated learning. Since each module stands alone, you can

choose which topics to explore first. The course is divided into five modules. While the contents of the modules are interconnected, each module works as an independent introduction to the topic. Thus, they do not need to be completed chronologically. This allows teachers as well as self-learners to tailor their teaching and learning according to their own needs and choose the most relevant topics.

The handbook outlines the course structure and objectives followed by detailed descriptions of the five core modules: Introduction to Open Science, Main Aspects of Open Access, Data Sharing and Re-use, Reproducibility in Open Science, and Open Science Ethics. Each module is structured to provide key concepts, practical examples, and self-assessment quizzes to reinforce learning. Additionally, the handbook includes instructions on how to access the course on the Moodle platform. Finally, the handbook provides additional materials and learning resources for more in-depth information on the topics.



1.1 Course Structure and Objectives

The course is divided into five modules that discuss the core dimensions of open science. These modules include:

1. Introduction to Open Science: This module provides an overview of the open science movement, its principles, and its significance in the modern research landscape.

2. Main Aspects of Open science: This module explores the various models of open access publishing, the benefits and challenges associated with it, and the tools and platforms available for researchers.

3. Data Sharing and Re-use: This module covers best practices for managing research data including data sharing, data preservation and the use of data repositories.

4. Reproducibility in Open Science: The module provides a comprehensive overview of the principles and benefits of reproducibility, emphasizing its significance in contemporary research and offering practical examples and tools to implement reproducible research practices.

5. Open Science Research Ethics: This module addresses the ethical and legal considerations in open science covering issues related to intellectual property, data privacy and research integrity.

1.2 Module Structure

By the end of this course, students will be able to:

- **Understand the principles and practices of Open Science**
- **Be able to implement Open Science practices in their research**
- **Gain knowledge and skills to engage in and contribute to Open Science**
- **Foster a mindset of openness, transparency, and collaboration in their research practices**

Each of the five modules follows a consistent structure. Each module in this course consists of a PowerPoint presentation and a multiple-choice quiz. PowerPoint presentation provides key concepts and insights on the topic in a clear and organized manner. In addition to the presentation, each module provides a self-scoring quiz at the end of each module to help learners gauge their understanding of the material. The quizzes reinforce the learning and help the students identify areas needing further review.



2. COURSE DESCRIPTION

This section includes the detailed description of the modules' content, learning objectives and learning outcomes (using the Bloom Taxonomy, Armstrong 2010), the types of core learning materials and activities and estimated workload.

21 UNIT 1: Introduction to Open Science

In this unit, participants will delve into the fundamental principles and benefits of Open Science, enabling them to implement Open Science practices in their research endeavours. The unit offers a comprehensive overview of Open Science, introducing key concepts and highlighting its significance in the contemporary research landscape. The unit begins by elucidating the concept of Open Science, emphasizing its core principles and aims. Participants will explore the ethos of transparency, collaboration, and accessibility that underpin Open Science, as well as its potential to revolutionize traditional research practices. Through this exploration, participants will gain a deep understanding of how Open Science can foster scientific progress and innovation. Next, the unit delves into the various benefits associated with embracing Open Science practices. Participants will discover how Open Science can enhance the quality and reproducibility of research, foster interdisciplinary collaboration, and promote the widespread dissemination of scientific

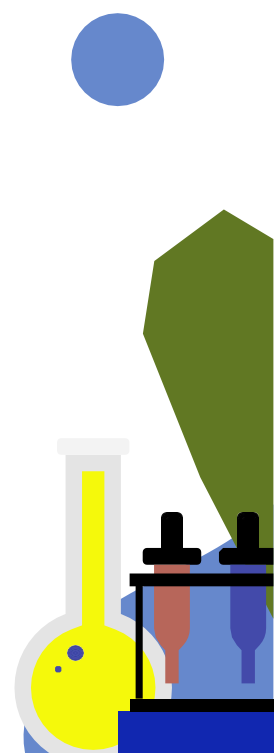
knowledge. The unit also explores the potential for Open Science to foster public engagement and trust in scientific research. Moreover, the unit provides concrete examples of Open Science practices in research. Participants will examine real-world case studies and success stories, illustrating how researchers have integrated Open Science principles into their work. These examples encompass a wide range of disciplines, demonstrating the applicability and impact of Open Science across diverse fields of study. By the end of this unit, participants will have a solid foundation in the principles and benefits of Open Science. They will be equipped with the knowledge and insights necessary to incorporate Open Science practices into their own research, fostering a culture of transparency, collaboration, and openness in their scientific pursuits.

Unit core material:

presentation and multiple-choice quiz

Workload (Estimated study time):

30 min



Learning objectives

- Understand the concept of Open Science
- Familiarize with key concepts and principles
- Recognize the benefits of Open Science
- Explore real-world examples of Open Science practices in research across different disciplines
- You will acquire the knowledge and skills necessary to incorporate Open Science practices into your own research endeavours
- Cultivate a mindset of openness and collaboration in your research practices

Learning outcomes

1. Knowledge level:

- Identify key concepts and principles that underpin Open Science

2. Comprehension level:

- Understand the concept of Open Science and explain its core principles and objectives
- Recognize and articulate the benefits associated with Open Science practices

3. Application level:

- Analyse and provide examples of Open Science practices in research,

4. Analysis level:

- Analyse and provide examples of Open Science practices in research across various disciplines

5. Synthesis level:

- Foster a mindset of openness, transparency, and collaboration in research practices.



22 UNIT 2: Main Aspects of Open Science

The module begins with an introduction to OA, highlighting its significance in scholarly communication and knowledge dissemination. Participants will gain a clear understanding of the principles and goals of Open Access and its role in promoting accessibility, visibility, and impact of research. Next, participants will delve into the types of OA models prevalent in the academic landscape. They will explore the distinctions between Green and Gold OA, understand the advantages and limitations of each model, and examine real-world examples to illustrate their practical implementation. The benefits of OA publishing will be explored in detail, emphasizing the advantages for researchers, institutions, and society at large. Participants will gain insights into increased visibility, enhanced collaboration, accelerated scientific progress, and the potential for societal impact through OA publishing. Understanding the key OA policies is crucial for researchers and institutions.

This module will provide an overview of the institutional, national, and international OA policies and mandates. Participants will learn about the policy landscape, compliance requirements, and the significance of aligning research practices with these policies. The different types of OA publishing, including Green and Gold OA, Creative Commons licenses, and Institutional Repositories, will be discussed. Learners will

understand the unique characteristics and considerations associated with each type, enabling them to make informed decisions regarding their publishing choices. Compliance with OA policies and mandates is essential for researchers. This module will equip participants with practical knowledge on how to comply with OA policies, including the steps involved in depositing manuscripts in repositories, ensuring appropriate licensing, and meeting the requirements of funding agencies and institutions. Finally, participants will learn strategies to identify reputable OA journals and platforms. They will explore criteria for assessing the credibility and quality of OA publications, ensuring that their research is published in trusted venues and avoiding predatory publishers.

By the end of Module 2, participants will have a comprehensive understanding of Open Access publishing, its models, benefits, policies, compliance requirements, and the process of identifying reputable journals and platforms. This knowledge will empower them to make informed decisions about their own research dissemination and contribute to the broader Open Science movement.

Unit core material:

presentation and multiple-choice quiz

Workload (Estimated study time):

30 min

Learning objectives

- Understand the concept and significance of Open Access (OA) publishing
- Differentiate between various OA models, including Green and Gold OA, and provide examples of their implementation,
- Identify and articulate the benefits of OA publishing for researchers and society,
- Gain an overview of OA policies at the institutional, national, and international levels,
- Classify different types of OA publishing, such as Green and Gold OA, Creative Commons licenses, and Institutional Repositories
- Demonstrate knowledge of how to comply with OA policies and mandates,
- Develop skills to evaluate and identify reputable OA journals and platforms

Learning outcomes

1. Knowledge level:

- Recall the concept of Open Access (OA) publishing
- Memorize the different types of OA models, including Green and Gold OA

2. Comprehension level:

- Comprehend the benefits and advantages of OA publishing
- Understand the implications and scope of OA policies at different levels
- Describe the characteristics and features of various types of OA publishing
- Understand the process of complying with OA policies and mandates
- Interpret and assess the credibility of OA journals and platforms



23 UNIT 3: Data Sharing and Re-use

Content

In this module, participants will delve into the fundamental principles and benefits of data sharing and reuse, enabling them to acquire the knowledge and skills needed to effectively share and reuse research data using Open Science practices. The section offers a comprehensive overview of platforms, search engines and ways to shape and share research data, introducing key concepts and highlighting their importance in today's research landscape.

The lesson begins by clarifying the concept of data sharing and reuse, emphasizing its basic principles and objectives. Participants will explore the ethics of transparency, collaboration and accessibility that underpin "FAIR" principles. Through this research, participants will gain an in-depth understanding the benefits of sharing data and basic information about the tools and resources for sharing research data. The module then looks at the various benefits associated with selecting data for reuse. Participants will discover some of the best practices for data reuse and citation. With this module, we aim to improve the efficiency and reproducibility of research, encourage interdisciplinary collaboration and promote the wide dissemination of scientific knowledge.

In this part, we distinguish the main databases, as well as the standards used to work in them.

In addition, the module provides concrete examples of databases and data repositories for finding datasets for reuse in research. Participants will receive hands-on guidance and have the opportunity to register with real scientific data repository sites. These examples will demonstrate to them the breadth of data collected and give them a basic understanding of how these repositories work. By the end of this module, participants will have established accounts in the various research databases and a solid foundation in their working principles. They will be equipped with the knowledge and practical examples needed to use and cite scientific information in their own research, fostering a culture of transparency, collaboration and openness in their scientific pursuits.

Unit core material:

presentation and multiple-choice quiz

Workload (Estimated study time):

45 min

Learning objectives

- **Understand the concept of data sharing and reuse:** You will gain a clear understanding of what data sharing and reuse involves, including its basic principles and objectives
- **Familiarize yourself with key concepts and principles:** You will become familiar with the basic concepts and principles that underlie data sharing and reuse
- **Recognizing the benefits of data sharing and reuse:** You will become familiar with the various practices and methods involved in adopting data citation and reuse
- **Identify examples of data sharing and reuse in research:** You will explore real-world examples by hands-on access to different data repositories and creating your own profiles there and understand how they are properly cited
- **Acquire the ability to put into practice the sharing and reuse of data:** You will acquire the necessary knowledge and skills to be able to find the necessary information from the right source without problems and to be able to reuse it in the right way
- **Cultivate a FAIR mindset:** You will apply FAIR principles to FAIR data – discoverable, accessible, interoperable and reusable

Learning outcomes

1. Knowledge level

- Identify key concepts and principles that underpin of data sharing and reuse

2. Comprehension level

- Understand the concept of data sharing and reuse and explain its core principles and objectives
- Recognize and articulate the benefits associated with the practices of citing and reusing scientific data

3. Application level

- Provide examples of data sharing and reuse practices in research papers

4. Analysis level

- Analyse and provide examples of data sharing and reuse practices in research papers, articles and books

5. Synthesis level

- Promote FAIR thinking: discoverable, accessible, interoperable and reusable content of the reused data

24 UNIT 4: Reproducibility in Open Science

In this unit, participants will delve into the fundamental principles and benefits of Reproducibility, enabling them to embrace and implement Reproducible research practices in their works. The unit offers a comprehensive overview of Reproducibility, introducing key concepts and highlighting its significance in the contemporary research landscape. The unit begins by introduction of the concept of Reproducibility, emphasizing its core principles and aims. Participants will explore the core definitions, but they will also delve into some more detailed distinctions of reproducibility across different fields.

Next, the unit delves into the various benefits associated with embracing Reproducible research practices. Participants will discover how reproducibility helps the researchers and the whole research community so that they are acquainted with its advantages. The unit also explores the barriers to conducting reproducible research so that participants are aware of the challenges they might encounter. What's more, the unit provides concrete examples of Reproducible research practices in different fields. Participants will examine real-world case studies, illustrat-

ing how researchers have integrated the Reproducible research principles into their work.

By the end of this unit, participants will have a solid foundation in the principles and benefits of Reproducibility. They will be equipped with the knowledge and insights necessary to incorporate Reproducible research practices into their own research, fostering a culture of rigor, trustworthiness, and transparency in scientific pursuits.

Unit core material:

presentation and multiple-choice quiz

Workload (Estimated study time):

3 hours

Learning objectives

- Understand the fundamental concepts of reproducibility: You will gain a clear understanding of what reproducibility entails, including its core principles and objectives.
- Familiarize with key concepts and principles: You will become familiar with the fundamental concepts and principles that underpin reproducibility.
- Explain the benefits of reproducibility: You will comprehend the various benefits associated with embracing reproducibility practices.
- Recognize the barriers to reproducible research: You will identify the different barriers associated with conducting reproducible research.
- Apply the FAIR principles for reproducible research: You will get acquainted with the FAIR principles as a guideline to enhance the reusability of your data.
- Use the tools for conducting reproducible research: You will be informed about the various tools which are used in reproducible research.
- Identify examples of reproducibility in research: You will explore real-world examples of reproducible research practices across different disciplines.
- Cultivate a mindset of openness and collaboration: You will develop a mindset that embraces the values of reproducibility - integrity, trust, respect, and collaboration

Learning outcomes

1. Knowledge level

- Define the key concepts and principles of reproducibility

2. Comprehension level

- Discuss the concept of Reproducibility and explain its core principles and objectives
- Explain the benefits associated with embracing the Reproducibility research practices
- Recognize the barriers to Reproducible research

3. Application level

- Apply the FAIR principles for Reproducible research Analysis level
- Use the tools for Reproducible research

4. Analysis level

- Analyse and provide examples of reproducible research practices in different fields

5. Synthesis level

- Develop an approach for Reproducibility in his/her research which shows integrity, inspires trust and respect, and encourages reuse

25 UNIT 5: Open Science Ethics

In this unit, participants will get acquainted with the basics of Research Ethics. The unit includes the following topics: 1) Introduction to research ethics, 2) Understanding the principles of research ethics 3) Best practices for conducting research ethically 4) Ethics in practice (Conflicts of interest, plagiarism, common ethical issues in research) 5) Future of research ethics in science.

Special attention will be paid on the concept of Research Integrity, The European Code of Conduct for Research Integrity, and the Good Research Practices. The European Charter & Code for Researchers will be explained with its general principles and requirements.

The research topic “Towards a Research Agenda for Promoting Responsible Research Practices (RRPs)” will be presented. A special question of consideration will be: What is responsible research in the context of open science? Responsible Open Science from ethics and integrity perspective will be scrutinized in the context of the topic of the future of research ethics in science. There will be a short discussion on the topic “Artificial Intelligence and Research Ethics”. Learners will be encouraged to follow the references’ links and read further the recommended materials. Learners will be asked to write an essay on a topic they choose.

Unit core material: presentation, video

Workload (Estimated study time):
45 min



Learning objectives

- Understanding the concepts of Research Ethics and Research Integrity,
- Familiarizing with the principles of Research Ethics,
- Recognizing the benefits of conducting research ethically,
- Identifying examples of Responsible Research Practices (RRPs),
- Gaining the ability to incorporate Responsible OS practices into own research endeavours,
- Cultivating a mindset with the general ethical principles in research.

Learning outcomes

1. Knowledge level

- Identify key concepts and principles in Research Ethics.

2. Comprehension level

- Understand the Research Ethics and explain its core principles
- Recognize and articulate the benefits associated with Good Research Practices

3. Application level

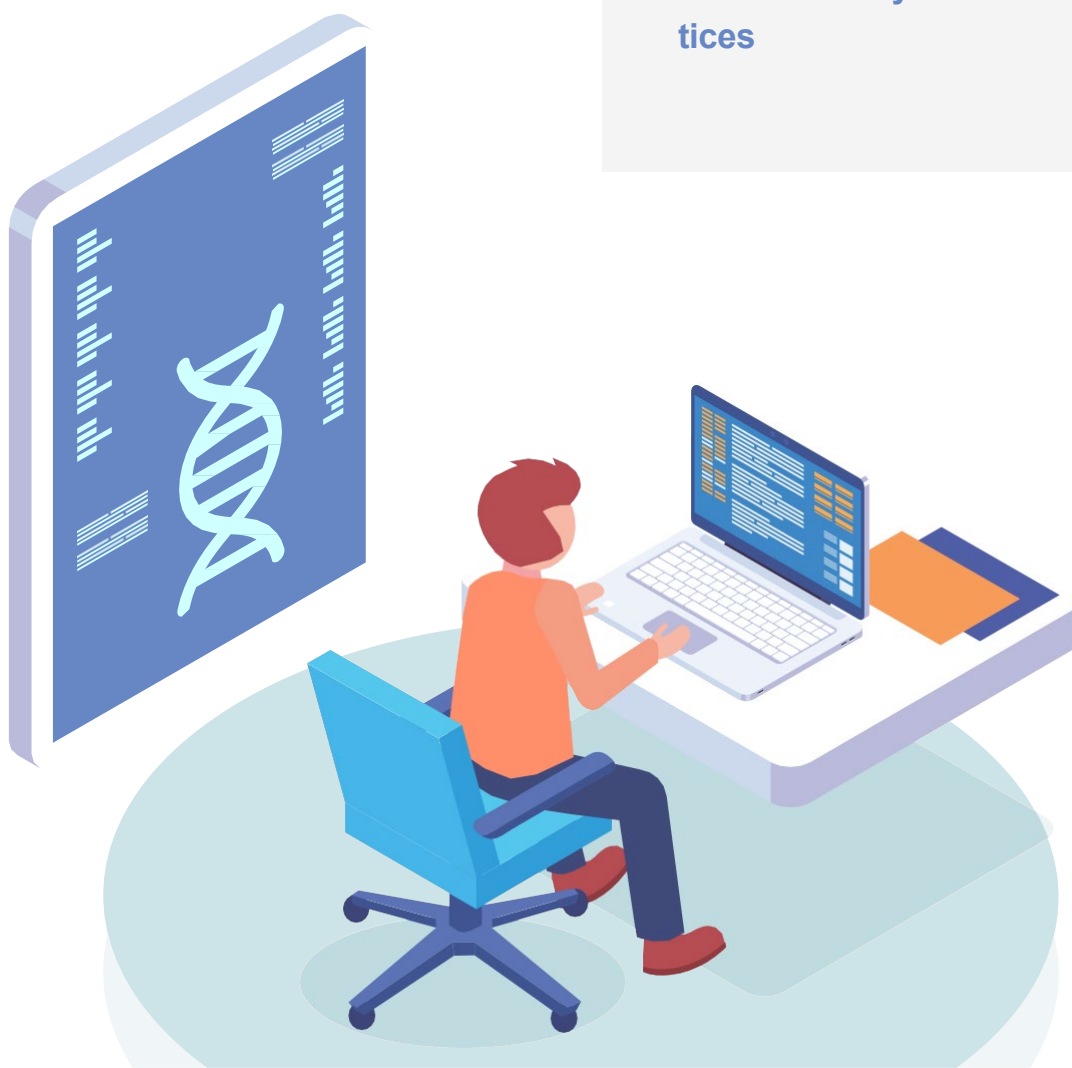
- Analyze and provide examples of Responsible Research Practices (RRPs).

4. Analysis level

- Analyze and provide examples of Responsible Open Science practices.

5. Synthesis level

- Foster a mindset of engagement and accountability in their research practices



3. HOW TO ACCESS THE COURSE ON THE MOODLE PLATFORM

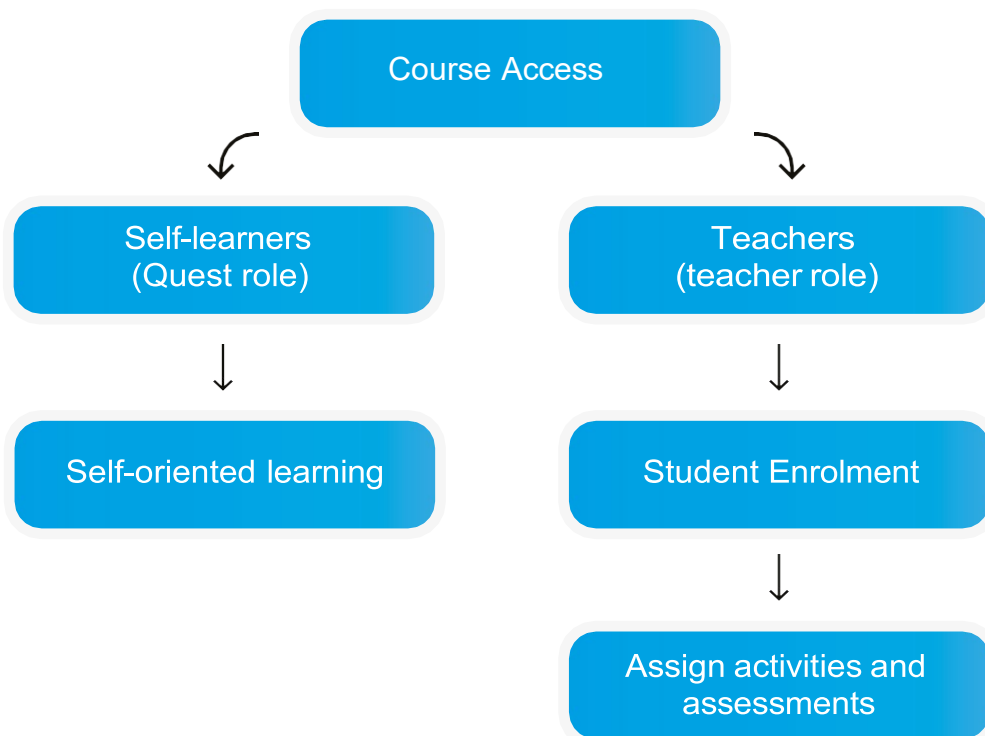
The course is designed to be accessed in two ways depending on the educational purpose. Self-learners who do not need teacher’s facilitation can access the course in a guest role. Teachers who want to use the course as a teaching resource can access the course through teacher role to enrol their students to the course and assign them activities and assessments.

The course access includes two primary paths for access: one for self-learners who access the course as guests and another

for teachers who enrol students and assign activities.

To access the course on Moodle as a guest, you do not need to log in or create an account. You can click on this link: (add link here) and start browsing the course contents and exploring course activities.

To access the course on Moodle as a teacher, you need to have a teacher role assigned by the site administrator. You can request a teacher role by contacting the administrator at (email). Once you have a teacher role assigned, you can log in to the site and enrol your students on the course. You can also create and assign activities and assessments for your students within the course.



4. ADDITIONAL MATERIALS AND LEARNING RESOURCES

This chapter provides additional teaching and learning resources that can be used to expand the course contents.

FOSTER project

<https://openscience.eu/foster-open-science>

Budapest Open Access Initiative

<https://www.budapestopenaccessinitiative.org/>

Open innovation, open science, open to the world: A vision for Europe

<https://op.europa.eu/en/publication-detail/-/publication/3213b335-1cbc-11e6-ba9a-01aa75ed71a1>

GO FAIR Initiative

<https://www.go-fair.org/go-fair-initiative/>

COMMISSION RECOMMENDATION (EU) 2018/790 of 25 April 2018 on access to and preservation of scientific information

<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018H0790&from=HU>

European Open Science Cloud (EOSC)

https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/our-digital-future/open-science/european-open-science-cloud-eosc_en

EU Open Science Policy

https://ec.europa.eu/info/research-and-innovation/strategy/strategy-2020-2024/our-digital-future/open-science_en

OECD (2016), “Research Ethics and New Forms of Data for Social and Economic Research”, OECD Science, Technology and Industry Policy Papers, No. 34, OECD Publishing, Paris

<https://doi.org/10.1787/5jln7vnpxs32-en>

OECD Open Science

<https://www.oecd.org/sti/inno/open-science.htm>

OECD (2015), “Making Open Science a Reality”, OECD Science, Technology and Industry Policy Papers, No. 25, OECD Publishing, Paris

<https://doi.org/10.1787/5jrs2f963zs1-en>

OECD (2017), “Co-ordination and support of international research data networks”, OECD Science, Technology and Industry Policy Papers, No. 51, OECD Publishing, Paris

<https://doi.org/10.1787/e92fa89e-en>

OECD (2017), “Digital platforms for facilitating access to research infrastructures”, OECD

Science, Technology and Industry Policy Papers, No. 49, OECD Publishing, Paris

<https://doi.org/10.1787/8288d208-en>

INVEST4EXCELLENCE project (101035815) Deliverable D4.3 Open Science Training Materials

Dai, Q., E. Shin and C. Smith (2018), “Open and inclusive collaboration in science: A framework”, OECD Science, Technology and Industry Working Papers, No. 2018/07, OECD Publishing, Paris

<https://doi.org/10.1787/2dbff737-en>

OECD (2017), “Open research agenda setting”, OECD Science, Technology and Industry Policy Papers, No. 50, OECD Publishing, Paris

<https://doi.org/10.1787/74edb6a8-en>

Why open science is critical to combatting COVID-19

<https://www.oecd.org/coronavirus/policyresponses/why-open-science-is-critical-to-combatting-covid-19-cd6ab2f9/>

UNESCO Open Science

<https://www.unesco.org/en/natural-sciences/open-science>

Turning FAIR into reality: Final report and action plan from the European Commission expert group on FAIR data

<https://op.europa.eu/en/publication-detail/-/publication/7769a148-f1f6-11e8-9982-01aa75ed71a1/language-en/format-PDF/source-80611283>

Bethesda Statement on Open Access Publishing

https://archive.org/details/jlis_it-8628

Berlin Declaration

<https://openaccess.mpg.de/Berlin-Declaration>

The Cape Town Open Education Declaration

<https://www.capetowndeclaration.org/>

Plan S

<https://www.coalition-s.org/>

Boselli, B. and F. Galindo-Rueda (2016-09-22), “Drivers and Implications of Scientific Open Access Publishing: Findings from a Pilot OECD International Survey of Scientific Authors”, OECD Science, Technology and Industry Policy Papers, No. 33, OECD Publishing, Paris

<http://dx.doi.org/10.1787/5jlr2z70k0bx-en>

Policy guidelines for the development and promotion of Open Access

<https://unesdoc.unesco.org/ark:/48223/pf0000215863>

COPE Guidelines

<https://publicationethics.org/guidance/Guidelines>

The European Charter & Code for Researchers

<https://euraxess.ec.europa.eu/jobs/charter>

OpenAIRE

<https://explore.openaire.eu/>

<https://graph.openaire.eu/>

EOSC Secretariat

<https://www.eoscsecretariat.eu/about-us>

OpenDOAR

<https://v2.sherpa.ac.uk/opendoar/>

Sherpa Romeo

<https://v2.sherpa.ac.uk/romeo/>

ESFRI

<https://www.esfri.eu/forum>

Centre for Open Science

<https://www.cos.io/>

OSF

<https://osf.io/>

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<https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/>

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Water Bear Learning.

<https://waterbearlearning.com/addie-model-instructional-design/>

Toivonen, L. 2023. Open Science Training Materials. INVEST4EXCELLENCE wproject's deliverable 4.3.

