chaise

blockchain skills for Europe

D5.5.1:

Trainer's Guide

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3	Fujitsu Technology Solutions NV	FUJITSU	BE
4	Ministry of Education and Religious Affairs	YPEPTH	GR
5	ECQA GmbH	ECQA	AT
6	DIGITALEUROPE AISBL	DIGITALEUROPE	BE
7	IOTA Stiftung	IOTA	DE
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10	Associazione CIMEA	CIMEA	IT
11	INTRASOFT International S.A.	INTRASOFT	LU
12	Institute of the Republic of Slovenia for Vocational Education and Training	CPI	SI
13	European DIGITAL SME Alliance	DIGITAL SME	BE
14	University of Tartu	UT	EE
15	Univerza V Ljubljani	UL	SI
16	BerChain e.V.	BERCHAIN	DE
17	Italia4Blockchain	I4B	IT
18	Autoritatea Naţională pentru Calificări	ANC	RO
19	Akkreditierungs ,Certifizierungs- und Qualitätssicherungs- Institut e.V.	ACQUIN	DE
20	EXELIA	EXELIA	GR
21	INDUSTRIA Technology Ltd	INDUSTRIA	BG
22	Crypto4all	C4A	FR
23	Economic and Social Research Institute	ESRI	IE

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1 Executive Summary

The handbook serves as a complete guide for ICT trainers on how to deliver the CHAISE curriculum in formal and non-formal settings. The guide focuses on providing trainers with guidelines and instructional resources to provide an optimised and impactful learning experience on Blockchain and Distributed Ledger Technologies. The document encompasses various instructional resources, including training methodologies and lesson plans for all CHAISE modules, practical instructions on the use of CHAISE educational materials to support the attainment of the desired learning outcomes, and strategies for conducting remote training using the CHAISE Massive Open Online Course (MOOC).

The main references for this report are Deliverables: D5.2.1 "Curriculum Structure," D5.1.1 "Blockchain Learning Outcomes Report," and D5.3 "Learning Materials".

2 Introductory notes

2.1 Rationale of CHAISE

Blockchain technology is rapidly transforming all industries and public sectors, driving global economic change by reducing transaction costs and eliminating the need for intermediaries. Its ability to provide secure, transparent, and decentralized digital systems has made it an increasingly popular technology across the globe.

Given the fast-paced and emerging nature of blockchain, there is a growing demand for professionals with blockchain-related skills. It is therefore essential to equip ICT professionals with the knowledge and abilities necessary to understand, work with, and manage blockchain projects across all sectors of the EU economy. The CHAISE project aims to address this need by developing a comprehensive strategy and curriculum to educate individuals about blockchain technology. The goal of the consortium is to equip the European blockchain workforce with the necessary technical, non-technical, and cross-disciplinary skills to handle the various technical, business, and transversal aspects of the blockchain business value chain.

As blockchain technology has become increasingly prevalent in a wide range of sectors, the project aims to provide upper secondary and tertiary level training opportunities (EQF level 5) to support current and future blockchain professionals. This will involve eliciting and exploring customer needs and perspectives, designing, planning, testing, and deploying custom blockchain solutions, and promoting the uptake and use of relevant applications by potential adopters. Ultimately, the CHAISE project aims to play a pivotal role in preparing the European workforce for the future of blockchain technology.

2.2 Programme duration and learning units

The proposed duration of CHAISE course is 1200 teaching hours divided in twelve modules. The specific hours per modules can be summarised as follows:

MODULE 1: INTRODUCTION TO BLOCKCHAIN TECHNOLOGY

- Lectures – 8 h
- Practical exercises – 8 h
- Case studies – 8 h
- 10 questions/answers – 4 h
- 20 multiple choice questions – 4 h

- Self-study – 18 h
- Review of lecture material using slides and videos
- Self-preparation for final test

MODULE 2: REGULATION, LEGAL ASPECTS, AND GOVERNANCE OF BLOCKCHAIN SYSTEMS

- Lectures – 24
- Practical exercises – 24 h
- Case studies – 24 h
- 60 questions/answers – 8 h
- 60 multiple choice questions – 8 h
- Self-study – 62 h
- Review of lecture material using slides and videos
- Self-preparation for final test

MODULE 3 – MODULE 12

- Lectures – 16
- Practical exercises – 16 h
- Case studies – 16 h
- 20 questions/answers – 4 h
- 40 multiple choice questions – 4 h
- Self-study – 44 h
- Review of lecture material using slides and videos
- Self-preparation for final test

2.3 Target audience

Target groups of learners include (i) ICT professionals employed in companies building and offering blockchain technology, who have some experience in blockchain technology and wish to improve themselves by taking suggested course; (ii) Students aspiring to get employed as blockchain application developers and architects; (iii) Project managers who need to understand the need for different blockchain applications and implications of blockchain technology in the key sectors of economy.

3 Trainer Handbook structure

This Handbook serves as a resource for all educators who conduct training on Blockchain technology, whether in person or online. The Handbook addresses CHAISE modules only and does not extend to other topics of interest in the subject area.

This Handbook is divided in six chapters, the first chapter is the Executive Summary, the second one an introductory note and the third one presents the structure of the document and details the items of the lesson plans.

Chapter four describes the different CHAISE learning units with their learning objectives and the expected knowledge and skills to be achieved. Detailed lesson plans for classroom sessions and online use are proposed based on the multimedia content and exercises available; together with the prerequisites to attempt the session.

Chapter five presents Work-based Learning (WBL) and describes its principles and characteristics.

Chapter six presents the CHAISE course, providing information on how to use a MOOC, on access and use the CHAISE MOOC, as well as how to facilitate the MOOC.

3.1 Items of lesson plans

Separate topics within the learning units of the MOOC module are described with specific lesson plan, if suitable.

Lesson plans consist of the following items as indicated in the Table 1.

Table 1 Items of Lesson Plans.

Item	Delivery specs/guidelines
Setting	Online or in classroom or both.
Duration:	Estimated duration for classroom and online session, split into lecture and practice/individual work.
Lesson beginning:	What meaningful activity will learners complete as soon as they enter the classroom or when started learning online?
Engage/motivation:	How could learners' interest be sparked? Is there a prior knowledge that should be tapped? Is there vocabulary that must be cleared? Is there brainstorming that students need to

Item	Delivery specs/guidelines
	complete before the lesson begins?
Evaluate understanding/assessment:	How will trainer know if learners have achieved lesson's objective?
Closing activities:	How will trainer tie up loose ends, reinforce/revisit the objective and connect the lesson to the learning unit?
Resources:	What does trainer need to teach the lesson? (Computer Lab, Equipment)

4 CHAISE Learning units (lesson plans)

The CHAISE course, consisting of twelve learning modules, is described in this section.

The learning modules are:

- MODULE 1: INTRODUCTION TO BLOCKCHAIN TECHNOLOGY
- MODULE 2: REGULATION, LEGAL ASPECTS, AND GOVERNANCE OF BLOCKCHAIN SYSTEMS
- MODULE 3: FUNDAMENTALS OF BLOCKCHAIN AND DISTRIBUTED LEDGER TECHNOLOGY
- MODULE 4: BLOCKCHAIN BUSINESS MANAGEMENT AND PLANNING
- MODULE 5: BLOCKCHAIN SECURITY AND DIGITAL IDENTITY
- MODULE 6: FUNDAMENTALS OF BLOCKCHAIN AND DISTRIBUTED LEDGER TECHNOLOGY
- MODULE 7: BLOCKCHAIN PLATFORMS
- MODULE 8: MARKETING AND CUSTOMER SUPPORT
- MODULE 9: APPLIED CRYPTOGRAPHY
- MODULE 10: SMART CONTRACTS
- MODULE 11: DEVELOPING USE CASES: FROM IDEAS TO SERVICE
- MODULE 12: GAME THEORY IN BLOCKCHAINS

Each learning module includes 2 or more learning outcomes.

4.1 M1: INTRODUCTION TO BLOCKCHAIN TECHNOLOGY

This module aims to introduce blockchain technology. The learning objectives of this module are to explain the main components of the blockchain technology, recognize its application sectors and discuss the key historical facts of blockchain technology development.

This learning module includes three learning outcomes:

- LO1.1: Describe the main concepts and components of the Blockchain technology.
- LO1.2: Recognize the sectors where the blockchain technology can be applied.
- LO1.3: Recall the main historical facts of the blockchain technology development.

After the completion of this module, the learners should know key blockchain technology components and application sectors and main historical facts of the blockchain technology development, be able to describe the main concepts and components of the blockchain technology, recognize the sectors where the

blockchain technology can be applied, and recall the main historical facts of the blockchain technology development, and be capable to share ideas about the blockchain application sectors and participate in discussion on the blockchain technology history.

4.1.1 Lecture 1.1: Introduction to Blockchain Technology

4.1.1.1 Targeted Knowledge and Skills

Knowledge	Skills
• Key blockchain technology components and application sectors	• LO1.1: Describe the main concepts and components of the Blockchain technology. • LO1.2: Recognize the sectors where the blockchain technology can be applied.

4.1.1.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (key blockchain technology components and application sectors) using “Who knows about…” questions.	

Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the vocabulary are understood.
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercises and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What are the key blockchain technology components?”, “What are the application sectors of the blockchain technology?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting on the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What are the key blockchain technology. components?”, “What are the application sectors of the blockchain technology?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on the main concepts and components of the blockchain technology, and sectors where the blockchain technology can be applied.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.1.1.3 Prerequisites

The learner should have basic knowledge on a few or several of these disciplines: business management, economics, business informatics, computer science, system engineering, mathematics.

4.1.2 Lecture 1.2: Blockchain History and Future

4.1.2.1 Targeted Knowledge and Skills

Knowledge	Skills
Knows / Aware of: • Main historical facts of the blockchain technology development	Able to: • LO1.3: Recall the main historical facts of the blockchain technology development.

4.1.2.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (Main historical facts of the blockchain technology development) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate understanding/	Online:	

Item	Delivery specs/guidelines
assessment	Individual task: Encourage learners to do practical exercises and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What are the main historical facts of the blockchain technology development?”.?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting on the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What are the main historical facts of the blockchain technology development?”.
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on blockchain history and future.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.1.2.3 Prerequisites

The learner should have basic knowledge on a few or several of these disciplines: business management, economics, business informatics, computer science, system engineering, mathematics.

4.2 M2: REGULATION, LEGAL ASPECTS, AND GOVERNANCE OF BLOCKCHAIN SYSTEMS

This module presents regulation, legal aspects, and governance of blockchain systems.

The learning objectives of this module are:

- Understand the blockchain main characteristics to identify blockchain governance and regulation context and requirements.
- Understand the difference between regulation and governance.
- Identify what is a blockchain ecosystem to understand the role of the different actors and the part they take in the blockchain governance as well as the interaction they have with their environment to set proper regulations.
- Identify the main governance strategies (on-chain / off-chain).
- Identify the main regulatory issues regarding blockchain, including GDPR compliance and securities regulation.

This learning module includes six learning outcomes:

- LO2.1: Describe blockchain-related legal environment in Europe and the World.
- LO2.2: Explain regulatory framework of blockchain based financial services.
- LO2.3: Recognize legal and regulatory issues and risks when dealing with cryptocurrency and blockchain technology.
- LO2.4: Discuss the interest of Blockchain technology to manage consent and data access.
- LO2.5: Explain implications of blockchain technology for governments, policy makers, law professionals, regulators, and society.
- LO2.6: Illustrate the impact of the blockchain governance on policy effectiveness.

After the completion of this module, the learners should have the **ability to:**

- Practice critical thinking of the blockchain legal environment and regulations.
- Take responsibility when deciding about the blockchain, cryptocurrencies and use of smart contracts.
- Identify consent management and data usage tracking requirements.
- Participate in discussion regarding blockchain technology impact and blockchain governance decisions.

4.2.1 Lecture 2.1: Blockchain basics to set the regulation and governance context and requirements

4.2.1.1 Targeted Knowledge and Skills

Knowledge	Skills
• Blockchain-related legal environment. • Legal underpins of Blockchain technology and smart contracts. • Blockchain and public policy, governmental regulations • Implications of blockchain technology for society, regulators, policy makers, governments, law professionals	• LO2.3: Recognize legal and regulatory issues and risks when dealing with cryptocurrency and blockchain technology. • LO2.5: Explain implications of blockchain technology for governments, policy makers, law professionals, regulators, and society.

4.2.1.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	3 12 1
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	6 4
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**

Item	Delivery specs/guidelines
Lesson beginning	Assess the awareness of the group of learners (different blockchain systems, identification of the main actors, how interactions are governed in the blockchain system, what may be the regulation rules) using “Who knows about…” questions, brain storming slide support, cloud of words. Student should prepare their own initial mind map on these topics.
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, ask students to work together (2 to 4 students) to adjust their own mind map after each part of the lecture. Use practical examples and ask open questions to ensure the basics and the terms/terminology are understood. .
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to read the extra material, the use case and to comment on their findings. Start a new topic in a forum with open questions like “What’s the future of blockchain system” or “Is there a unique governance / regulation model?”. Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting on the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What’s the future of blockchain system” or “Is there a unique governance / regulation model?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on the essentials of blockchain system organisation, governance, and regulation requirements. Ask learners to adjust their own mind-map on the topic
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.2.1.3 Prerequisites

The learner should have basic knowledge on blockchain and IT systems characteristics.

4.2.2 Lecture 2.2: Governance and regulation background

4.2.2.1 Targeted Knowledge and Skills

Knowledge	Skills
• Legal status of the decentralized autonomous organizations. • Implications of blockchain technology for society, regulators, policy makers, governments, law professionals.	• LO2.3: Recognize legal and regulatory issues and risks when dealing with cryptocurrency and blockchain technology.

4.2.2.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	3 12 1
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	6 4
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (meaning of governance and regulation, corporate governance, different fields involved in regulation) using "Who knows about…" questions, brain storming slide support, cloud of words. Student should prepare their own initial mind map on these topics.	

Item	Delivery specs/guidelines
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, ask students to work together (2 to 4 students) to adjust their own mind map after each part of the lecture. Use practical examples and ask open questions to ensure the basics and the terms/terminology are understood. .
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to read the extra material, the use case and to comment on their findings. Start a new topic in a forum with open questions like “What should be a distributed governance system” or “What may need regulation in a blockchain system?”. Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting on the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like What should be a distributed governance system” or “What may need regulation in a blockchain system?
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on the essentials of governance and regulation principles. Ask learners to adjust their own mind-map on the topic.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.2.2.3 Prerequisites

The learner should have basic knowledge on blockchain characteristics, traditional value models and digital economy.

4.2.3 Lecture 2.3: Blockchain ecosystem

4.2.3.1 Targeted Knowledge and Skills

Knowledge	Skills
• Blockchain-related legal environment. • Legal underpins of Blockchain technology and smart contracts. • Implications of blockchain technology for society, regulators, policy makers, governments, law professionals.	• LO2.1: Describe blockchain-related legal environment in Europe and the World. • LO2.5: Explain implications of blockchain technology for governments, policy makers, law professionals, regulators, and society.

4.2.3.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	3 12 1
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	6 4
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**

Item	Delivery specs/guidelines
Lesson beginning	Assess the awareness of the group of learners (meaning of ecosystem, ecosystem organisation, macro identification of different blockchain ecosystem) using “Who knows about…” questions, brain storming slide support, cloud of words… Student should prepare their own initial mind map on these topics.
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, ask students to work together (2 to 4 students) to adjust their own mind map after each part of the lecture. Use practical examples and ask open questions to ensure the basics and the terms/terminology are understood. .
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to read the extra material, the use case and to comment on their findings. Start a new topic in a forum with open questions like “What should be a blockchain ecosystem organisation” or “What can characterize a blockchain ecosystem?”. Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting on the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What should be a blockchain ecosystem organisation” or “What can characterize a blockchain ecosystem?”.
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on the essentials of ecosystem organization and blockchain ecosystem participants, including their role. Ask learners to adjust their own mind-map on the topic.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.2.3.3 Prerequisites

The learner should have basic knowledge on blockchain characteristics and requirements and on governance and regulation principles (associated to the knowledge and skills provided by lecture 1 + 2)

4.2.4 Lecture 2.4: Regulation strategy

4.2.4.1 Targeted Knowledge and Skills

Knowledge	Skills
• Blockchain-related legal environment. • Legal underpins of Blockchain technology and smart contracts. • Legal implications of cryptocurrencies. • Blockchain and public policy, governmental regulations	• LO2.1: Describe blockchain-related legal environment in Europe and the World. • LO2.2: Explain regulatory framework of blockchain based financial services. • LO2.3: Recognize legal and regulatory issues and risks when dealing with cryptocurrency and blockchain technology.

4.2.4.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	3 12 1
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	6 4
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**

Item	Delivery specs/guidelines
Lesson beginning	Assess the awareness of the group of learners (what are the regulation system characteristics, what are the main motivations for blockchain regulation) using "Who knows about…" questions, brain storming slide support, cloud of words. Student should prepare their own initial mind map on these topics.
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, ask students to work together (2 to 4 students) to adjust their own mind map after each part of the lecture. Use practical examples and ask open questions to ensure the basics and the terms/terminology are understood.
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to read the extra material, the use case and to comment on their findings. Start a new topic in a forum with open questions like "Can you explain what blockchain regulation changes in the international blockchain usage? "or "Why is there a dedicated regulation for crypto-currencies?". Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting on the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like "Can you explain what blockchain regulation changes in the international blockchain usage?" or "Why is there a dedicated regulation for crypto currencies?"
Closing activities	Summarize the main key elements learned and provide common feedback based on learners' input, focusing on the essentials of regulation requirements and current regulation evolution. Ask learners to adjust their own mind-map on the topic.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.2.4.4 Prerequisites

The learner should have basic knowledge on blockchain characteristics, governance, and regulation principles (knowledge and skills provided by lectures 1 and 2).

4.2.5 Lecture 2.5: Blockchain governance

4.2.5.1 Targeted Knowledge and Skills

Knowledge	Skills
• Implications of blockchain technology for society, regulators, policy makers, governments, law professionals.	• LO2.5: Explain implications of blockchain technology for governments, policy makers, law professionals, regulators, and society. • LO2.6: Illustrate the impact of the blockchain governance on policy effectiveness.

4.2.5.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	3 12 1
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	6 4
	Individual work (classroom or on-line)	**9**

Item	Delivery specs/guidelines	
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (What is the perimeter of blockchain governance, identification of the different decisions governing the ecosystem members interactions) using “Who knows about…” questions, brain storming slide support, cloud of words. Student should prepare their own initial mind map on these topics.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, ask students to work together (2 to 4 students) to adjust their own mind map after each part of the lecture. Use practical examples and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to read the extra material, the use case and to comment on their findings. Start a new topic in a forum with open questions like “What should be a private blockchain governance system” or “What may impact governance strategy in a blockchain system?”. Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting on the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What should be a private blockchain governance system” or “What may impact governance strategy in a blockchain system?”	
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on the essentials of governance principles and blockchain governance strategy. Ask learners to adjust their own mind-map on the topic.	
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.	

4.2.5.3 Prerequisites

The learner should have basic knowledge on blockchain characteristics, governance, and regulation principles as well as on blockchain ecosystem organisation (knowledge and skills provided by lectures 1, 2 and 3).

4.2.6 Lecture 2.6: Blockchain as a regulation mean for GDPR

4.2.6.1 Targeted Knowledge and Skills

Knowledge	Skills
• GDPR requirements and consent management	• LO2.4: Discuss the interest of Blockchain technology to manage consent and data access.

4.2.6.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	3 12 1
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	6 4
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**

Item	Delivery specs/guidelines
Lesson beginning	Assess the awareness of the group of learners (Blockchain impacts on data protection, GDPR) using “Who knows about…” questions, brain storming slide support, cloud of words… Student should prepare their own initial mind map on these topics.
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, ask students to work together (2 to 4 students) to adjust their own mind map after each part of the lecture. Use practical examples and ask open questions to ensure the basics and the terms/terminology are understood.
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to read the extra material, the use case and to comment on their findings. Start a new topic in a forum with open questions like “What should you check to set a GDPR compliant blockchain system?” or “How can you evaluate the blockchain compliance towards GDPR constraint?”. Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting on the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What should you check to set a GDPR compliant blockchain system?” or “How can you evaluate the blockchain compliance towards GDPR constraint?”.
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input; focusing on the essentials of data protection requirements. Ask learners to adjust their own mind-map on the topic
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.2.6.3 Prerequisites

The learner should have basic knowledge on blockchain characteristics, governance, and regulation, blockchain ecosystem (knowledge and skills provided by lectures 1, 2 and 3)

4.3 M3: FUNDAMENTALS OF BLOCKCHAIN AND DISTRIBUTED LEDGER TECHNOLOGY

This module aims to provide fundamentals of blockchain and distributed ledger technology.

The learning objective of this module is to learn how to use the blockchain terminology and discuss differences between the centralised databases and distributed ledger, explain blockchain characteristics, components, and main security principles.

This learning module includes four learning outcomes:

- LO3.1: Explain main terminology of blockchain and distributed ledger technology.
- LO3.2: Discuss mechanics of decentralized applications.
- LO3.3: Describe characteristics and components.
- LO3.4: Explain security features of the blockchain applications.

After the completion of this module, the learners should **know** blockchain terminology, differences between centralized database and distributed ledger, decentralized applications, network performance, smart contracts, public/private/consortium networks, blockchain-based application components (e.g., peer-to-peer network, smart contracts, consensus, etc.), and basic principles of the blockchain-based application security, **be able to** explain main terminology of blockchain and distributed ledger technology, discuss mechanics of decentralized applications, describe characteristics and components, explain security features of the blockchain applications, and **be capable to** present and discuss differences between the centralised and decentralised applications, share ideas about main blockchain characteristics, components and security features, express the professional attribute towards the blockchain technology and learn and self-reflect as a blockchain expert in the given environment, including the ability to leverage communities and digital learning activities for further development.

4.3.1 Lecture 3.1: ICT systems for decentralized solutions (part 1)

4.3.1.1 Targeted Knowledge and Skills

Knowledge	Skills
• Blockchain terminology, differences between centralized database and distributed ledger. • Decentralized applications, network performance, smart contracts, public/private/consortium networks. • Blockchain-based application components (e.g., peer-to-peer network, smart contracts, consensus, etc.) • Basic principles of the blockchain-based application security	• LO3.1: Explain main terminology of blockchain and distributed ledger technology. • LO3.3: Describe characteristics and components.

4.3.1.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3

Item	Delivery specs/guidelines	
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (Blockchain terminology, differences between centralized database and distributed ledger, decentralized applications, using “Who knows about?” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What are the concepts of Internet communications” and “what are their key configuration settings?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What are the concepts of Internet communications” and “what are their key configuration settings?”	
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on the key trends in information and communication technology.	
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.	

4.3.1.3 Prerequisites

The learner should have basic knowledge on:

- Running commands in CLI
- Installing software on their computer

4.3.2 Lecture 3.2: ICT systems for decentralized solutions (part 2)

4.3.2.1 Targeted Knowledge and Skills

Knowledge	Skills
• Blockchain terminology, differences between centralized database and distributed ledger. • Decentralized applications, network performance, smart contracts, public/private/consortium networks. • Blockchain-based application components (e.g., peer-to-peer network, smart contracts, consensus, etc.) • Basic principles of the blockchain-based application security	• LO3.1: Explain main terminology of blockchain and distributed ledger technology. • LO3.3: Describe characteristics and components.

4.3.2.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**

Item	Delivery specs/guidelines
Lesson beginning	Assess the awareness of the group of learners (client-server communication principle, web communications, Internet of Things and Cloud Computing) using "Who knows about…" questions.
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to read the extra material, the use case and to comment on their findings. Start a new topic in a forum with open questions like "What is the difference between distributed and decentralized systems?" and "What are the characteristics of Web communications?" Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting on the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like "What is the difference between distributed and decentralized systems?" and "What are the characteristics of Web communications?"
Closing activities	Summarize the main key elements learned and provide common feedback based on learners' input, focusing on decentralized applications, network performance, and smart contracts.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.3.2.3 Prerequisites

The learner should have basic knowledge on:

- Running commands in CLI
- Installing software on their computer

4.3.3 Lecture 3.3: Blockchain components and characteristics

4.3.3.1 Targeted Knowledge and Skills

Knowledge	Skills
• Blockchain-based application components (e.g., peer-to-peer network, smart contracts, consensus, etc.)	• LO3.3: Describe characteristics and components.

4.3.3.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (blockchain-based application components (e.g., peer-to-peer network, smart contracts, consensus, etc.) using "Who knows about…?" questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate	Online:	

Item	Delivery specs/guidelines
understanding/ assessment	Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What are the blockchain-based application characteristics?”, “What are the blockchain-based application components?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What are the blockchain-based application characteristics?”, “What are the blockchain-based application components?”.
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on blockchain components and characteristics.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.3.3.3 Prerequisites

The learner should have basic knowledge on blockchain technology, regulation, legal aspects, and governance of blockchain systems.

4.3.4 Lecture 3.4: Distributed information systems and their information security management principles

4.3.4.1 Targeted Knowledge and Skills

Knowledge	Skills
• Basic principles of the blockchain-based application security	• LO3.1: Explain main terminology of blockchain and distributed ledger technology. • LO3.4: Explain security features of the blockchain applications.

4.3.4.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (Basic principles of the blockchain-based application security) using “Who knows about...?” questions.	

Item	Delivery specs/guidelines
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What are the basic principles of the blockchain-based application security?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What are the basic principles of the blockchain-based application security?”.
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on distributed information systems and their information security management principles.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.3.4.3 Prerequisites

The learner should have basic knowledge on blockchain technology, regulation, legal aspects, and governance of blockchain systems.

4.4 M4: BLOCKCHAIN BUSINESS MANAGEMENT AND PLANNING

The aim of this module to indicate various use cases for the application of blockchain technology for business use cases, to introduce different process and business management methods and present the essential to a purposeful use of the Blockchain technology, criteria.

The learning objectives of this module are to learn how to use fundamental business management methods for blockchain products and services.

This learning module includes four learning outcomes:

- LO4.1: Explain what capabilities of blockchain technology enable innovating existing businesses and processes.
- LO4.2: Describe the fundamental business model of blockchain use cases.
- LO4.3: Analyse different implementations of blockchain business use cases.
- LO4.4: Examine when blockchain technology becomes a viable option for a business use case.

After the completion of this module, the learners should have the ability to demonstrate decision making confidence to use blockchain technology to business management and planning. Handle risks appearing within blockchain use case development. Generate innovative blockchain application ideas that create value and business processes. Critically analyse, ethical evaluate and assess the use cases of Blockchain application.

4.4.1 Lecture 4.1: The Blockchain Sector – An industry overview

4.4.1.1 Targeted Knowledge and Skills

Knowledge	Skills
• Fundamental principles of the blockchain technology suitability for business innovation. • Different application areas / industries for a meaningful use of blockchain technology	• LO4.2: Describe the fundamental business model of blockchain use cases. • LO4.3: Analyse different implementations of blockchain business use cases.

4.4.1.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (overview of the Blockchain sector) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What are interesting blockchain use cases for the finance sector” or “What is the benefit of blockchain for digital identity?”. Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them.	

Item	Delivery specs/guidelines
	Initiate a discussion around topics like “What are interesting blockchain use cases for the finance sector” or “What is the benefit of blockchain for digital identity?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input; focusing on the different application possibilities and the benefits of the technology for different industry sectors.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.4.1.3 Prerequisites

The learner should have basic knowledge on blockchain characteristics, traditional value models and digital economy.

4.4.2 Lecture 4.2: Fundamentals of business management – Part 1

4.4.2.1 Targeted Knowledge and Skills

Knowledge	Skills
• Fundamental principles of the blockchain technology suitability for business innovation. • Criteria of blockchain technology to be applicable in the business use cases. • Different application areas / industries for a meaningful use of blockchain technology	• LO4.1: Explain what capabilities of blockchain technology enable innovating existing businesses and processes. • LO4.2: Describe the fundamental business model of blockchain use cases. • LO4.3: Analyse different implementations of blockchain business use cases. • LO4.4: Examine when blockchain technology becomes a viable option a business use case.

4.4.2.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (Fundamentals of Business Management) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “How can I use Story Mapping to improve the performance of smart contracts?” or “What is the best decision model to use for the implementation of blockchain?”. Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them.	

Item	Delivery specs/guidelines
	Initiate a discussion around topics like “How can I use Story Mapping to improve the performance of smart contracts?” or “What is the best decision model to use for the implementation of blockchain?”. Initiate a discussion around topics like “What are interesting blockchain use cases for the finance sector” or “What is the benefit of blockchain for digital identity?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input; focusing on different business model methods and the usage of decision models.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.4.2.3 Prerequisites

The learner should have basic knowledge on blockchain characteristics, traditional value models and digital economy.

4.4.3 Lecture 4.3: Fundamentals of business management – Part 2

4.4.3.1 Targeted Knowledge and Skills

Knowledge	Skills
• Fundamental principles of the blockchain technology suitability for business innovation. • Criteria of blockchain technology to be applicable in the business use cases. • Different application areas / industries for a meaningful use of blockchain technology	• LO4.1: Explain what capabilities of blockchain technology enable innovating existing businesses and processes. • LO4.2: Describe the fundamental business model of blockchain use cases. • LO4.3: Analyse different implementations of blockchain business use cases. • LO4.4: Examine when blockchain technology becomes a viable option for a business use case.

4.4.3.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**

Item	Delivery specs/guidelines	
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (business management methods) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings Start a new topic in a forum with open questions like “What is a Value Proposition for Blockchain” or “What can a business model for Blockchain look like?”. Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What is a Value Proposition for Blockchain” or “What can a business model for Blockchain look like?”.	
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input; focusing on the different business management methods.	
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.	

4.4.3.3 Prerequisites

The learner should have basic knowledge on blockchain characteristics, traditional value models and digital economy.

4.4.4 Lecture 4.4: Technology Assessment for Blockchain

4.4.4.1 Targeted Knowledge and Skills

Knowledge	Skills
• Fundamental principles of the blockchain technology suitability for business innovation. • Different application areas / industries for a meaningful use of blockchain technology • Ethical and environmental aspects associated with blockchain.	• LO4.2: Describe the fundamental business model of blockchain use cases. • LO4.3: Analyse different implementations of blockchain business use cases. • LO4.4: Examine when blockchain technology becomes a viable option for a business use case.

4.4.4.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (Technology Assessment and Scenario Planning) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate	Online:	

Item	Delivery specs/guidelines
understanding/ assessment	Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “How do we explain the future” or “What could the future for Blockchain look like?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “How do we explain the future” or “What could the future for Blockchain look like?”.
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input; focusing on scenario planning methods and the basics of technology assessment.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.4.4.3 Prerequisites

The learner should have basic knowledge on blockchain characteristics, traditional value models and digital economy.

4.5 M5: BLOCKCHAIN SECURITY AND DIGITAL IDENTITY

This module aims to provide teaching on blockchain security and digital identity.

The learning objective of this module is to teach how to describe how blockchains may secure data and information by utilizing the transaction protection and validation principles of blockchains, access control and digital identity principles.

This learning module includes four learning outcomes:

- LO5.1: Describe how blockchains may secure data, information, and processes by utilizing the transaction protection and validation principles of blockchains.
- LO5.2: Recognize security vulnerabilities and emerging security challenges in blockchain-based applications, as well as the security flaws in smart contracts.
- LO5.3: Explain identity management principles and access control models within blockchain-based applications.
- LO5.4: Describe blockchain-based personally identifiable information, self-sovereign identity, and decentralized identifiers (DIDs) to address digital identity problems.

After the completion of this module, the learners should **know** information and data security principles, countermeasures to secure blockchain transactions, security challenges and smart contract vulnerabilities, blockchain access control principles and digital identity management principles, **be able to** describe how blockchains may secure data, information, and processes by utilizing the transaction protection and validation principles of blockchains, recognize security vulnerabilities and emerging security challenges in blockchain-based applications, as well as the security flaws in smart contracts, explain identity management principles and access control models within blockchain-based applications, describe blockchain-based personally identifiable information, self-sovereign identity, and decentralized identifiers (DIDs) to address digital identity problems, and **be capable to** integrate security and digital identity solutions to the blockchain application design, take responsibility of the proposed blockchain security solution, challenge new ideas towards blockchain security solutions, share and agree about the blockchain security solutions with project stakeholders, and demonstrate how security countermeasures and digital identity solutions change the trustworthiness level of blockchain application.

4.5.1 Lecture 5.1: Security risks analysis of blockchain-based applications

4.5.1.1 Targeted Knowledge and Skills

Knowledge	Skills
• Information and data security principles. • Countermeasures to secure blockchain transactions. • Security challenges and smart contract vulnerabilities. • Blockchain access control principles.	• LO5.1: Describe how blockchains may secure data, information, and processes by utilizing the transaction protection and validation principles of blockchains. • LO5.2: Recognize security vulnerabilities and emerging security challenges in blockchain-based applications, as well as the security flaws in smart contracts.

4.5.1.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (cybersecurity, blockchain security, different types of honeypots) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	

Item	Delivery specs/guidelines
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What are key trends in network security?” and “What is the importance of different types of honeypots for cybersecurity in general, and for blockchains in particular?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What are key trends in cybersecurity?” and “What is the importance of different types of honeypots for cybersecurity in general, and for blockchains in particular?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on network security and blockchain honeypots.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.5.1.3 Prerequisites

The learner should have basic knowledge on:

- Blockchain technology architectures and operation.
- The principles of smart contracts.

4.5.2 Lecture 5.2: Smart contract security

4.5.2.1 Targeted Knowledge and Skills

Knowledge	Skills
• Information and data security principles. • Countermeasures to secure blockchain transactions.	• LO5.1: Describe how blockchains may secure data, information, and processes by utilizing the transaction protection and validation principles of blockchains.

• Security challenges and smart contract vulnerabilities. • Blockchain access control principles.	• LO5.2: Recognize security vulnerabilities and emerging security challenges in blockchain-based applications, as well as the security flaws in smart contracts.

4.5.2.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (smart contract security) using "Who knows about…" questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings.	

Item	Delivery specs/guidelines
	Start a new topic in a forum with open questions like “What are the biggest smart contract exploits to date?” and “What are the specifics of smart contract security compared to the traditional software security?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What are the biggest smart contract exploits to date?” and “What are the specifics of smart contract security compared to the traditional software security?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on security considerations of smart contracts.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.5.2.3 Prerequisites

The learner should have:

- Familiarity with basic Solidity syntax and programming
- Basic understanding of transaction execution sequence in EVM
- Ability to use CLI to run commands.
- Familiarity with EVM wallets (e.g., MetaMask, MEW wallet, or Brave wallet)

4.5.3 Lecture 5.3: Security risks analysis of blockchain-based applications

4.5.3.1 Targeted Knowledge and Skills

Knowledge	Skills
• Information and data security principles • Countermeasures to secure blockchain transactions	• LO5.2: Recognize security vulnerabilities and emerging security challenges in blockchain-based applications, as well as the security flaws in smart contracts.

4.5.3.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (information and data security principles, and countermeasures to secure blockchain transactions) using “Who knows about…” questions.	

Item	Delivery specs/guidelines
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What are information and data security principles?”, “What are countermeasures to secure blockchain transactions?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What are information and data security principles?”, “What are countermeasures to secure blockchain transactions?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on security risk analysis in blockchain applications.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.5.3.3 Prerequisites

The learner should have basic knowledge on blockchain technology, regulation, legal aspects, and governance of blockchain systems, fundamentals of blockchain and distributed ledger technologies, and blockchain business management and planning.

4.5.4 Lecture 5.4: Identity management and access control models of blockchain-based applications

4.5.4.1 Targeted Knowledge and Skills

Knowledge	Skills
• Blockchain access control principles • Digital identity management principles	• LO5.3: Explain identity management principles and access control models within blockchain-based applications. • LO5.4: Describe blockchain-based personally identifiable information, self-sovereign identity, and decentralized identifiers (DIDs) to address digital identity problems.

4.5.4.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**

Item	Delivery specs/guidelines
Lesson beginning	Assess the awareness of the group of learners (blockchain access control principles, and digital identity management principles) using “Who knows about…” questions.
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What are blockchain access control principles?”, “What are digital identity management principles?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What are blockchain access control principles?”, “What are digital identity management principles?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on identity management and access control models of blockchain-based applications.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.5.4.3 Prerequisites

The learner should have basic knowledge on blockchain technology, regulation, legal aspects, and governance of blockchain systems, fundamentals of blockchain and distributed ledger technologies, and blockchain business management and planning.

4.6 M6: BLOCKCHAIN SYSTEM ARCHITECTURE AND CONSENSUS PROTOCOLS

This module aims to explain what blockchain system architecture and consensus protocols are.

The learning objective of this module is to explain how to construct architecture of blockchain-based applications, apply design patterns, compare different consensus protocols.

This learning module includes five learning outcomes:

- LO6.1: Explain fundamental design and architectural primitives of DLT system architecture, e.g., trust-less, permissionless, asynchronous, sybil protection.
- LO6.2: Employ design patterns and reusable proved solutions to explain blockchain system development.
- LO6.3: Compare different consensus protocols.
- LO6.4: Evaluate the blockchain architecture solutions to different practical scenarios.
- LO6.5: Further develop existing blockchain architectures and apply them to new contexts in a creative way.

After the completion of this module, the learners should know design process for blockchain systems, blockchain design patterns, e.g., Merkel root for verifiable inclusion, longest chain, BFT for finality, consensus protocols (Proof of Work, Proof of stake, Proof of Capacity, Byzantine Fault Tolerance, etc.), infrastructure design, in particular P2P network, be able to explain fundamental design and architectural primitives of DLT system architecture, e.g., trust-less, permissionless, asynchronous, sybil protection, employ design patterns and reusable proved solutions to explain blockchain system development, compare different consensus protocols, evaluate the blockchain architecture solutions to different practical scenarios, further develop existing blockchain architectures and apply them to new contexts in a creative way, and be capable to utilize knowledge of the blockchain architecture to address customer needs in design solutions, practice different blockchain system architecture strategies to efficiently integrate solutions, communicate the blockchain architecture solutions with customers and developer team members.

4.6.1 Lecture 6.1: Basics in blockchain system architecture - part 1

4.6.1.1 Targeted Knowledge and Skills

Knowledge	Skills
• Design process for blockchain systems. • Infrastructure design, in particular P2P network.	• LO6.1: Explain fundamental design and architectural primitives of DLT system architecture, e.g., trust-less, permissionless, asynchronous, sybil protection.

4.6.1.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (design process for blockchain systems, and infrastructure design, in particular P2P network) using “Who knows about…” questions.	

Item	Delivery specs/guidelines
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What is design process for blockchain systems?”, “What are infrastructure design principles?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What is design process for blockchain systems?”, “What are infrastructure design principles?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on basics in blockchain systems architecture.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.6.1.3 Prerequisites

The learner should have basic knowledge on blockchain technology, regulation, legal aspects, and governance of blockchain systems, fundamentals of blockchain and distributed ledger technologies, blockchain business management and planning, and blockchain security and digital identity.

4.6.2 Lecture 6.2: Basics in blockchain system architecture - part 2

4.6.2.1 Targeted Knowledge and Skills

Knowledge	Skills
• Blockchain design patterns, e.g., Merkel root for verifiable inclusion, longest chain, BFT for finality.	• LO6.2: Employ design patterns and reusable proved solutions to explain blockchain system development.

4.6.2.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (blockchain design patterns, e.g., Merkel root for verifiable inclusion, longest chain, BFT for finality) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate	Online:	

Item	Delivery specs/guidelines
understanding/ assessment	Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What are blockchain design patterns?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analyzing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What are blockchain design patterns?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, design patterns and reusable proved solutions to explain blockchain system development.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.6.2.3 Prerequisites

The learner should have basic knowledge on blockchain technology, regulation, legal aspects, and governance of blockchain systems, fundamentals of blockchain and distributed ledger technologies, blockchain business management and planning, and blockchain security and digital identity.

4.6.3 Lecture 6.3: Different consensus protocols

4.6.3.1 Targeted Knowledge and Skills

Knowledge	Skills
• Consensus protocols (Proof of Work, Proof of stake, Proof of Capacity, Byzantine Fault Tolerance, etc.)	• LO6.3: Compare different consensus protocols

4.6.3.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (consensus protocols (Proof of Work, Proof of stake, Proof of Capacity, Byzantine Fault Tolerance, etc.) using "Who knows about…" questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate	Online:	

Item	Delivery specs/guidelines
understanding/ assessment	Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What are consensus protocols?”, “How to compare different consensus protocols?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What are consensus protocols?”, “How to compare different consensus protocols?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on different consensus protocols.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.6.3.3 Prerequisites

The learner should have basic knowledge on blockchain technology, regulation, legal aspects, and governance of blockchain systems, fundamentals of blockchain and distributed ledger technologies, blockchain business management and planning, and blockchain security and digital identity.

4.6.4 Lecture 6.4: DLT examples

4.6.4.1 Targeted Knowledge and Skills

Knowledge	Skills
• Design process for blockchain systems. • Infrastructure design, in particular P2P network.	• LO6.4: Evaluate the blockchain architecture solutions to different practical scenarios. • LO6.5: Further develop existing blockchain architectures and apply them to new contexts in a creative way.

4.6.4.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (Design process for blockchain systems, and infrastructure design, in particular P2P network) using “Who knows about…” questions.	

Item	Delivery specs/guidelines
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What are blockchain system architecture strategies?”, “What are design processes for blockchain systems?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What are blockchain system architecture strategies?”, “What are design processes for blockchain systems?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on different architecture solutions and lessons learnt form examples.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.6.4.3 Prerequisites

The learner should have basic knowledge on blockchain technology, regulation, legal aspects, and governance of blockchain systems, fundamentals of blockchain and distributed ledger technologies, blockchain business management and planning, and blockchain security and digital identity.

4.7 M7: BLOCKCHAIN PLATFORMS

This module aims to provide teaching on blockchain platforms.

The learning objective of this module is to explain the basic components and types of the blockchain platforms, and demonstrate the node creation, account management and transaction principles.

This learning module includes four learning outcomes:

- LO7.1: Describe different blockchain platforms (e.g., Ethereum, Hyperledger, IOTA, Corda, etc.).
- LO7.2: Explain blockchain technology ecosystem, underlying basic algorithms and essentials of trust.
- LO7.3: Describe how blockchain technology works, what are principles of operations/ transactions, blocks, smart contracts, and mining.
- LO7.4: Demonstrate the node creation on Ethereum, devise and unlock accounts, mine, transact, transfer, and check balances of Ethers.

After the completion of this module, the learners should **know** blockchain platforms, such as Ethereum, Hyperledger, IOTA, Corda, etc, principles of transaction, smart contract, and mining principles and network types and performance, **be able to** describe different blockchain platforms (e.g., Ethereum, Hyperledger, IOTA, Corda, etc.), explain blockchain technology ecosystem, underlying basic algorithms and essentials of trust, describe how blockchain technology works, what are principles of operations/ transactions, blocks, smart contracts, and mining, Demonstrate the node creation on Ethereum, devise and unlock accounts, mine, transact, transfer, and check balances of Ethers and **be capable to** follow the up-to-date advances in the blockchain platform development, change from the traditional centralized thinking to the decentralized (blockchain oriented) understanding of the system, understand the responsibility of creating new nodes and participating in the blockchain network.

4.7.1 Lecture 7.1: Overview of platform characteristics

4.7.1.1 Targeted Knowledge and Skills

Knowledge	Skills
• Blockchain platforms, such as Ethereum, Hyperledger, IOTA, Corda, etc. • Principles of transaction, smart contract, and mining principles. • Network types and performance.	• LO7.1: Describe different blockchain platforms (e.g., Ethereum, Hyperledger, IOTA, Corda, etc.). • LO7.2: Explain blockchain technology ecosystem, underlying basic algorithms and essentials of trust. • LO7.3: Describe how blockchain technology works, what are principles of operations/ transactions, blocks, smart contracts, and mining.

4.7.1.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**

Item	Delivery specs/guidelines
Lesson beginning	Assess the awareness of the group of learners (common characteristics of different blockchain platforms) using “Who knows about…” questions.
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What are the popular characteristics of blockchain platforms?” and “How are blockchain platforms different from each other?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What are the popular characteristics of blockchain platforms?” and “How are blockchain platforms different from each other?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on the different blockchain platform characteristics.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.7.1.3 Prerequisites

The learner should have:

- Good knowledge of general blockchain concepts
- Familiarity with main consensus types and other motivational mechanisms
- Familiarity with smart contracts infrastructure

4.7.2 Lecture 7.2: Performance scaling

4.7.2.1 Targeted Knowledge and Skills

Knowledge	Skills
• Blockchain platforms, such as Ethereum, Hyperledger, IOTA, Corda, etc. • Principles of transaction, smart contract, and mining principles. • Network types and performance	• LO7.2: Explain blockchain technology ecosystem, underlying basic algorithms and essentials of trust. • LO7.3: Describe how blockchain technology works, what are principles of operations/ transactions, blocks, smart contracts, and mining.

4.7.2.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (key building blocks in blockchain platforms, scaling, and performance in blockchain platforms) using “Who knows about…” questions.	

Item	Delivery specs/guidelines
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What is in your terms, the performance of a blockchain network?”, “What are the benefits and drawbacks of key building blocks in blockchain platforms in relation to scaling and performance?” and “What are the main, established optimization approaches toward scaling and performance in blockchain platforms?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What is in your terms, the performance of a blockchain network?”, “What are the benefits and drawbacks of key building blocks in blockchain platforms in relation to scaling and performance?” and “What are the main, established optimization approaches toward scaling and performance in blockchain platforms?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on performance scaling.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.7.2.3 Prerequisites

The learner should have:

- Good knowledge of general concepts of blockchain
- Familiarity with main consensus types
- Familiarity with smart contracts infrastructure
- Good knowledge of blockchain platform characteristics

4.7.3 Lecture 7.3: Overview of the Ethereum platform

4.7.3.1 Targeted Knowledge and Skills

Knowledge	Skills
• Blockchain platforms, such as Ethereum, Hyperledger, IOTA, Corda, etc. • Principles of transaction, smart contract, and mining principles. • Network types and performance	• LO7.4: Demonstrate the node creation on Ethereum, devise and unlock accounts, mine, transact, transfer, and check balances of Ethers.

4.7.3.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (characteristics of the Ethereum blockchain platform) using “Who knows about…” questions.	

Item	Delivery specs/guidelines
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What are the characteristics of the Ethereum blockchain platform?” and “What is the blockchain technology ecosystem?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What are the characteristics of the Ethereum blockchain platform?” and “What is the blockchain technology ecosystem?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on the Ethereum platform.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.7.3.3 Prerequisites

The learner should have good knowledge of general concepts of blockchain.

4.7.4 Lecture 7.4: Overview of the Hyperledger-fabric and Polkadot platforms

4.7.4.1 Targeted Knowledge and Skills

Knowledge	Skills
• Blockchain platforms, such as Ethereum, Hyperledger, IOTA, Corda, etc. • Principles of transaction, smart contract, and mining principles. • Network types and performance	• LO7.1: Describe different blockchain platforms (e.g., Ethereum, Hyperledger, IOTA, Corda, etc.). • LO7.2: Explain blockchain technology ecosystem, underlying basic algorithms and essentials of trust. • LO7.3: Describe how blockchain technology works, what are principles of operations/ transactions, blocks, smart contracts, and mining.

4.7.4.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**

Item	Delivery specs/guidelines
Lesson beginning	Assess the awareness of the group of learners (characteristics of the Hyperledger and Polkadot platforms) using “Who knows about…” questions.
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What are the key objectives of Hyperledger and Polkadot platforms?”, “How do they differ?” and “What are the characteristics of the Hyperledger and Polkadot platforms?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What are the key objectives of Hyperledger and Polkadot platforms?”, “How do they differ?” and “What are the characteristics of the Hyperledger and Polkadot platforms?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on the Hyperledger and Polkadot Blockchain platforms.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.7.4.3 Prerequisites

The learner should have:

- Good understanding of general distributed ledger concepts and technology.
- Familiarity with Ethereum-related networks, consensus mechanisms, transaction lifecycle, smart contract execution, and dApp design.

4.8 M8: MARKETING AND CUSTOMER SUPPORT

The aim of this module is to demonstrate marketing, customer support principles for the blockchain technology.

The learning objectives of this module are to learn how to use different marketing methods for Blockchain products, how to use blockchain for marketing and know the sustainable and ethical implications connected to blockchain technology.

This learning module includes two learning outcomes:

- LO8.1: Explain the role of Blockchain for marketing.
- LO8.2: Demonstrate strategies for customer support and service design.
- LO8.3: Analyse role of networks and customer relationship management for blockchain technologies.
- LO8.4: Illustrate products, prices, promotion, and sales strategies for blockchain technology.
- LO8.5: Create awareness for blockchain use among broader audience and communicate the benefits of the technology in an accessible way for different use cases.

After the completion of this module, the learners should have the ability to share blockchain-based marketing strategies, participate in the customer support activities, display a willingness to communicate well with customers, organise marketing campaigns for blockchain technology and critically analyse, ethical evaluate and assess the marketing strategy for Blockchain application.

4.8.1 Lecture 8.1: Introduction to Marketing

4.8.1.1 Targeted Knowledge and Skills

Knowledge	Skills
• Customer success design. • Affiliate marketing.	• LO8.2: Demonstrate strategies for customer support and service design. • LO8.3: Analyse role of networks and customer relationship management for blockchain technologies.

	• LO8.4: Illustrate products, prices, promotion, and sales strategies for blockchain technology.

4.8.1.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (Marketing methods for Blockchain) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What could a persona for a	

Item	Delivery specs/guidelines
	blockchain product look like?" or "What are possible marketing objectives for a Blockchain solution?" Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like "What could a persona for a blockchain product look like?" or "What are possible marketing objectives for a Blockchain solution?"
Closing activities	Summarize the main key elements learned and provide common feedback based on learners' input, focusing on marketing methods for blockchain technology.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.8.1.3 Prerequisites

The learner should have basic knowledge on blockchain characteristics, traditional value models and digital economy.

4.8.2 Lecture 8.2: Ethical Design Framework

4.8.2.1 Targeted Knowledge and Skills

Knowledge	Skills
• Customer success design. • Affiliate marketing.	• LO8.2: Demonstrate strategies for customer support and service design. • LO8.5: Create awareness for blockchain use among broader audience and communicate the benefits of the technology in an accessible way for different use cases.

4.8.2.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (Blockchain ethical design) using "Who knows about…" questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like "What does ethical design mean for Blockchain?" or "What are Blockchain Use Cases with a positive social impact?" Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them.	

Item	Delivery specs/guidelines
	Initiate a discussion around topics like “What does ethical design mean for Blockchain?” or “What are Blockchain Use Cases with a positive social impact?”. Initiate a discussion around topics like “What could a persona for a blockchain product look like?” or “What are possible marketing objectives for a Blockchain solution?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input; focusing on ethical design for Blockchain.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.8.2.3 Prerequisites

The learner should have basic knowledge on blockchain characteristics, traditional value models and digital economy.

4.8.3 Lecture 8.3: Blockchain and Sustainability

4.8.3.1 Targeted Knowledge and Skills

Knowledge	Skills
• Customer success design. • Affiliate marketing.	• LO8.2: Demonstrate strategies for customer support and service design. • LO8.5: Create awareness for blockchain use among broader audience and communicate the benefits of the technology in an accessible way for different use cases.

4.8.3.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**

Item	Delivery specs/guidelines	
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (sustainable implications of blockchain usage) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “Is Blockchain a sustainable technology” or “How can blockchain sustainability be increased?”. Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “Is Blockchain a sustainable technology” or “How can blockchain sustainability be increased?”. Initiate a discussion around	

Item	Delivery specs/guidelines
	topics like “What could a persona for a blockchain product look like?” or “What are possible marketing objectives for a Blockchain solution?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input; focusing on sustainability of blockchain solutions..
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.8.3.3 Prerequisites

The learner should have basic knowledge on blockchain characteristics, traditional value models and digital economy.

4.8.4 Lecture 8.4: Blockchain in Marketing & Online Marketing Management

4.8.4.1 Targeted Knowledge and Skills

Knowledge	Skills
• Role of blockchain in marketing. • Customer success design. • Affiliate marketing.	• LO8.1: Explain the role of Blockchain for marketing. • LO8.2: Demonstrate strategies for customer support and service design. • LO8.3: Analyse role of networks and customer relationship management for blockchain technologies. • LO8.5: Create awareness for blockchain use among broader audience and communicate the benefits of the technology in an accessible way for different use cases.

4.8.4.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (the use of Blockchain for marketing) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “How can we use blockchain for marketing?” or “What is important to know for online marketing for blockchain?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them.	

Item	Delivery specs/guidelines
	Initiate a discussion around topics like “How can we use blockchain for marketing?” or “What is important to know for online marketing for blockchain?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on the usage of blockchain for online marketing.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.8.4.3 Prerequisites

The learner should have basic knowledge on blockchain characteristics, traditional value models and digital economy.

4.9 M9: APPLIED CRYPTOGRAPHY

This module aims to introduce applied cryptography to blockchain solutions.

The learning objective of this module is to apply major digital signature schemas, cryptographic protocols, and tools to protect blockchain-based applications.

This learning module includes three learning outcomes:

- LO9.1: Apply fundamental concepts of hash function, Merkle tree commitment scheme, proof of inclusion.
- LO9.2: Apply major signature schemes used in the blockchain technologies.
- LO9.3: Employ cryptographic protocols and public key infrastructure for enforcing practical security goals in the blockchain-based applications.

After the completion of this module, the learners should **know** the most used cryptographic primitives in BC, authentication and integrity protection methods and how to combine primitives to create secure protocol components, **be able to** apply fundamental concepts of hash function, Merkle tree commitment scheme, proof of inclusion, apply major signature schemes used in the blockchain technologies and employ cryptographic protocols and public key infrastructure for enforcing practical security goals in the blockchain-based applications, and **be capable to** apply the necessary techniques to secure transactions, access, integrity of the data, advise on the cryptographic protocols be used for designing a secure blockchain application and use the most relevant programming tools for implementing cryptography solutions.

4.9.1 Lecture 9.1: Basic Cryptography

4.9.1.1 Targeted Knowledge and Skills

Knowledge	Skills
• Most used cryptographic primitives in BC. • Authentication, integrity protection methods.	• LO9.1: Apply fundamental concepts of hash function, Merkle tree commitment scheme, proof of inclusion

4.9.1.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (key concepts of cryptography) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What is the symmetric-key concept cryptography?”, “What are the more important cryptography algorithms?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting on the use case, each learner in a group writing his own ideas and sharing them.	

Item	Delivery specs/guidelines
	Initiate a discussion around topics like “What is the symmetric-key concept cryptography?”, “What are the more important cryptography algorithms?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on the differences between cryptography algorithms.
Resources	Paper, pencil, board, and PC.

4.9.1.3 Prerequisites

The learner should have basic knowledge on a few or several of these disciplines: computer science, system engineering, mathematics.

4.9.2 Lecture 9.2: Hash Functions

4.9.2.1 Targeted Knowledge and Skills

Knowledge	Skills
• Cryptography measures used in transaction management, access control, privacy management. • Authentication, integrity protection methods	• LO9.2: Apply major signature schemes used in the blockchain technologies.

4.9.2.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**

Item	Delivery specs/guidelines	
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (digital signature previous knowledge) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What are the key digital signatures methods?”, “What are the hash functions?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting on the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What are the key digital signatures methods?”, “What are the hash functions?”	
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on, hash functions application and collisions.	
Resources	Paper, pencil, board, and PC.	

4.9.2.3 Prerequisites

The learner should have basic knowledge on a few or several of these disciplines: informatics, computer science, system engineering, maths.

4.9.3 Lecture 9.3: Hashes in blockchain

4.9.3.1 Targeted Knowledge and Skills

Knowledge	Skills
• Most used cryptographic primitives in BC. • Authentication, integrity protection methods. • Primitives to create secure protocol components.	• LO9.3: Employ cryptographic protocols and public key infrastructure for enforcing practical security goals in the blockchain-based applications.

4.9.3.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (commitment schemes) using "Who knows about…" questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate	Online:	

Item	Delivery specs/guidelines
understanding/ assessment	Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What are the commitment schemes?”, “What are the most important applications of hash functions in blockchain?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting on the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What are the commitment schemes?”, “What are the most important applications of hash functions in blockchain?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on commitment scheme and hash functions application in blockchain.
Resources	Paper, pencil, board, and PC.

4.9.3.3 Prerequisites

The learner should have basic knowledge on a few or several of these disciplines: informatics, computer science, system engineering, mathematics.

4.9.4 Lecture 9.4: Introduction to Zero Knowledge proofs

4.9.4.1 Targeted Knowledge and Skills

Knowledge	Skills
• Most used cryptographic primitives in BC. • Authentication, integrity protection methods. • Primitives to create secure protocol components.	• LO9.1: Apply programming tools to implement cryptographic constructions used in the blockchain-based applications.

4.9.4.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (zero-knowledge definition) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate	Online:	

Item	Delivery specs/guidelines
understanding/ assessment	Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What is a “Zero-Knowledge Proof (ZKP)”?”, “What does it even mean to be “zero-knowledge”? Other initial questions are included in the lecture slides. Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting on the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What is a “Zero-Knowledge Proof (ZKP)”?”, “What does it even mean to be “zero-knowledge”? Other initial questions are included in the lecture slides.
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on Zero-Knowledge concept and applications
Resources	Paper, pencil, board, and PC.

4.9.4.3 Prerequisites

The learner should have basic knowledge on a few or several of these disciplines: informatics, computer science, system engineering, mathematics.

4.10 M10: SMART CONTRACTS

This module aims to introduce Smart Contracts.

The learning objectives of this module is to employ programming language(s) to develop smart contracts and digital currency.

This learning module includes four learning outcomes:

- LO10.1: Apply good practices for developing smart contracts and describe the advantage of blockchain technology.
- LO10.2: Show how an application interacts with a blockchain infrastructure like Ethereum, how to deploy a Smart Contract on a real blockchain, and how to interact with it. To do this we introduce an additional tool like MetaMask to sign transactions.
- LO10.3: Introduce the notion of GAS consumption. Next introduce a development framework required to develop any serious project.
- LO10.4: Design, develop and deploy a smart contract for blockchain applications.

After the completion of this module, the learners should **know** Frontend and Backend development, user experience (UX) design principles, smart contract design and implementation and basic programming languages (e.g. Solidity, Rust, JavaScript, etc.), **be able to** apply good practices for developing smart contracts and describe the advantage of blockchain technology and design, develop and deploy a smart contract for blockchain applications, and **be capable to** relate the frontend and backend components of the blockchain-based application, integrate a creative environment to support observation, ideation, reflection, building and rebuilding of the blockchain-based application prototypes, coordinate with smart contract users and development teams to determine potential barriers and challenges and be capable to develop network of collaboration with other smart contracts and digital currency programmers

4.10.1 Lecture 10.1: Simple Smart Contracts

4.10.1.1 Targeted Knowledge and Skills

Knowledge	Skills
• Frontend and Backend development. • User experience (UX) design principles. • Smart contract design and implementation.	• LO10.1: Apply good practices for developing smart contracts and describe the advantage of blockchain technology.

4.10.1.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (key concepts of smart contracts) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What is a Smart Contract?”, “What are the main characteristics of a Smart Contract?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting on the use case, each learner in a group writing his own ideas and sharing them.	

Item	Delivery specs/guidelines
	Initiate a discussion around topics like “What is a Smart Contract?”, “What are the main characteristics of a Smart Contract?”.
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on smart contract concept and writing.
Resources	Paper, pencil, board, and PC.

4.10.1.3 Prerequisites

The learner should have basic knowledge on a few or several of these disciplines: computer science, system engineering, mathematics.

4.10.2 Lecture 10.2: Interacting with the blockchain through smart contracts

4.10.2.1 Targeted Knowledge and Skills

Knowledge	Skills
• Smart contract design and implementation.	• LO10.2: Apply good practices for developing smart contracts and describe the advantage of blockchain technology.

4.10.2.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**

Item	Delivery specs/guidelines	
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (key concepts of smart contracts) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “How to interact with a Smart Contract?”, “What are the limits of a Smart Contract?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting on the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “How to interact with a Smart Contract?”, “What are the limits of a Smart Contract?”	
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on smart contract concept and writing.	
Resources	Paper, pencil, board, and PC.	

4.10.2.3 Prerequisites

The learner should have basic knowledge on a few or several of these disciplines: computer science, system engineering.

4.10.3 Lecture 10.3: Building advanced Smart Contracts

4.10.3.1 Targeted Knowledge and Skills

Knowledge	Skills
• Frontend and Backend development. • User experience (UX) design principles. • Smart contract design and implementation. • Programming languages (e.g., solidity, JavaScript, html, CSS)	• LO10.3: Design, develop and deploy a smart contract for blockchain applications.

4.10.3.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (GAS, Framework, and libraries) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	

Item	Delivery specs/guidelines
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What is GAS?”, “How does it impact a Smart Contract execution?”, “What is the advantages of using a framework?”, “Why we should use Open zeppelin libraries?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting on the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What is GAS?”, “How does it impact a Smart Contract execution?”, “What is the advantages of using a framework?”, “Why we should use Open zeppelin libraries?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input.
Resources	Paper, pencil, board, and PC.

4.10.3.3 Prerequisites

The learner should have basic knowledge on a few or several of these disciplines: computer science, system engineering.

4.10.4 Lecture 10.4: Tokenizing assets with blockchain

4.10.4.1 Targeted Knowledge and Skills

Knowledge	Skills
• Frontend and Backend development. • User experience (UX) design principles. • Smart contract design and implementation. • Programming languages (e.g., solidity, Rust, JavaScript, etc.)	• LO10.4: Design, develop and deploy a smart contract for blockchain applications

4.10.4.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (key concepts of tokenization) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What is the difference between a fungible or non-fungible token?”, “What are ER20 Tokens?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting on the use case, each learner in a group writing his own ideas and sharing them.	

Item	Delivery specs/guidelines
	Initiate a discussion around topics like “What is the difference between a fungible or non-fungible token?”, “What are ER20 Tokens?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on the differences between token types and usages.
Resources	Paper, pencil, board, and PC.

4.10.4.3 Prerequisites

The learner should have basic knowledge on a few or several of these disciplines: computer science, system engineering, mathematics.

4.11 M11: DEVELOPING USE CASES: FROM IDEAS TO SERVICE

This module aims to explain developing use cases: from ideas to service.

The learning objectives of this module is to explain Design heuristics for reaching customer needs, managing products, and creating services using the blockchain-based applications.

This learning module includes five learning outcomes:

- LO11.1: Analyse the customer profile, discuss different ways to innovate, and map the value proposition of a blockchain use case.
- LO11.2: Redesign heuristics and model the process flow of the blockchain use case.
- LO11.3: Collect and prioritize requirements for defining a minimal viable product (MVP) for the blockchain use case.
- LO11.4: Manage the roadmap for the blockchain use case.
- LO11.5: Transfer existing concepts of blockchain use cases to new contexts.

After the completion of this module, the learners should know principles to identify the blockchain application customers, processes and method to redesign the traditional process flows to the blockchain-based use cases, product development principles using blockchain applications, be able to analyse the customer profile, discuss different ways to innovate, and map the value proposition of a blockchain use case, redesign heuristics and model the process flow of the blockchain use case, collect and prioritize requirements for defining a minimal viable product (MVP) for the blockchain use case, manage the roadmap for the blockchain use case, transfer existing concepts of blockchain use cases to new contexts, and be capable to relate logical blockchain components for the business process, justify the adopted decision using measures, explain potential product or service's customer, including their goals, challenges, and aspirations, cooperate within diverse team to achieve goals of blockchain use cases, share and communicate knowledge about customers' needs, product specifics, and process heuristics among the use case team members.

4.11.1 Lecture 11.1: Business Model for Blockchain Use Case

4.11.1.1 Targeted Knowledge and Skills

Knowledge	Skills
• Principles to identify the blockchain application customers. • Product development principles using blockchain applications.	• LO11.1: Analyse the customer profile, discuss different ways to innovate, and map the value proposition of a blockchain use case. • LO11.5: Transfer existing concepts of blockchain use cases to new contexts

4.11.1.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (principles to identify the blockchain application customers, and product development principles using blockchain applications.) using “Who knows about…” questions.	

Item	Delivery specs/guidelines
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What are principles to identify the blockchain application customers?”, “What are product development principles using blockchain applications?”. Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What are principles to identify the blockchain application customers?”, “What are product development principles using blockchain applications?”.
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on business model for blockchain use cases.
Resources	Paper, pencil, board, and PC.

4.11.1.3 Prerequisites

The learner should have basic knowledge on blockchain technology, regulation, legal aspects, and governance of blockchain systems, fundamentals of blockchain and distributed ledger technologies, blockchain business management and planning, principles of blockchain technical or blockchain business aspects.

4.11.2 Lecture 11.2: Blockchain Use Case Redesign

4.11.2.1 Targeted Knowledge and Skills

Knowledge	Skills
Knows / Aware of: • Processes and method to redesign the traditional process flows to the blockchain-based use cases	Able to: • LO11.2: Redesign heuristics and model the process flow of the blockchain use case. • LO11.5: Transfer existing concepts of blockchain use cases to new contexts

4.11.2.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (processes and method to redesign the traditional process flows to the blockchain-based use cases) using “Who knows about…” questions.	

Item	Delivery specs/guidelines
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What are processes and method to redesign the traditional process flows to the blockchain-based use cases?”. Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What are processes and method to redesign the traditional process flows to the blockchain-based use cases?”.
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on blockchain use case redesign.
Resources	Paper, pencil, board, and PC.

4.11.2.3 Prerequisites

The learner should have basic knowledge on blockchain technology, regulation, legal aspects, and governance of blockchain systems, fundamentals of blockchain and distributed ledger technologies, blockchain business management and planning, principles of blockchain technical or blockchain business aspects.

4.11.3 Lecture 11.3: Blockchain Use Case MVP

4.11.3.1 Targeted Knowledge and Skills

Knowledge	Skills
• Product development principles using blockchain applications.	• LO11.3: Collect and prioritize requirements for defining a minimal viable product (MVP) for the blockchain use case.

4.11.3.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (product development principles using blockchain applications) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate	Online:	

Item	Delivery specs/guidelines
understanding/ assessment	Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What are product development principles using blockchain applications?”. Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What are product development principles using blockchain applications?”.
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on blockchain use case MVP.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.11.3.3 Prerequisites

The learner should have basic knowledge on blockchain technology, regulation, legal aspects, and governance of blockchain systems, fundamentals of blockchain and distributed ledger technologies, blockchain business management and planning, principles of blockchain technical or blockchain business aspects.

4.11.4 Lecture 11.4: Blockchain Use Case Roadmap

4.11.4.1 Targeted Knowledge and Skills

Knowledge	Skills
• Product development principles using blockchain applications.	• LO11.4: Manage the roadmap for the blockchain use case.

4.11.4.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (product development principles using blockchain applications) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results.	

Item	Delivery specs/guidelines
	Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What are customer needs, product specifics, and process heuristics among the use case team members?”. Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What are customer needs, product specifics, and process heuristics among the use case team members?”.
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on blockchain use case roadmap.
Resources	Paper, pencil, board. If possible, computer classroom for individual exercises.

4.11.4.3 Prerequisites

The learner should have basic knowledge on blockchain technology, regulation, legal aspects, and governance of blockchain systems, fundamentals of blockchain and distributed ledger technologies, blockchain business management and planning, principles of blockchain technical or blockchain business aspects.

4.12 M12: GAME THEORY IN BLOCKCHAINS

This module aims to introduce the concepts of game theory in blockchain.

The learning objectives of this module is to explain the main components of the blockchain technology, recognize its application sectors and discuss the key historical facts of blockchain technology development.

This learning module includes four learning outcomes:

- LO12.1: Illustrate basic concepts from game theory with a blockchain application for remote purchases.
- LO12.2: Describe and define advanced concepts from game theory.
- LO12.3: Discuss the theoretic game approach from the fees in a blockchain network.
- LO12.4: Illustrate the game theory behind proof of stake.

After the completion of this module, the learners should **know** game theory concepts used in blockchain applications and game theory models applied in blockchain-based solutions, **be able to** illustrate basic concepts from game theory with a blockchain application for remote purchases, describe and define advanced concepts from game theory, discuss the theoretic game approach from the fees in a blockchain network and illustrate the game theory behind proof of stake, and **be capable to** present game theory definitions and main concepts, explain game theory models applied in blockchain-based solutions, utilise the most adequate game theory models to illustrate blockchain investment strategies and advise business teams of the best solutions to employ blockchain technology.

4.12.1 Lecture 12.1: Application to a Basic Remote Purchase

4.12.1.1 Targeted Knowledge and Skills

Knowledge	Skills
• Game theory concepts used in blockchain applications.	• LO12.1: Illustrate basic concepts from game theory with a blockchain application for remote purchases.

4.12.1.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**

Item	Delivery specs/guidelines	
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (key concepts of game theory) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What is the game theory concept?”, “What is the relation between game theory and blockchain?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting on the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What is the game theory concept?”, “What is the relation between game theory and blockchain?”	

Item	Delivery specs/guidelines
Closing activities	Summarize the main key elements learned and provide common feedback based on learners' input, focusing on the application of game theory in blockchain.
Resources	Paper, pencil, board, and PC.

4.12.1.3 Prerequisites

The learner should have basic knowledge on a few or several of these disciplines: computer science, system engineering, mathematics.

4.12.2 Lecture 12.2: Extended Remote Purchase

4.12.2.1 Targeted Knowledge and Skills

Knowledge	Skills
Knows / Aware of: • Game theory concepts used in blockchain applications. • Game theory models applied in blockchain-based solutions.	Able to: • LO12.2: Describe and define advanced concepts from game theory.

4.12.2.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**

Item	Delivery specs/guidelines	
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (key concepts of remote purchase) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate understanding/ assessment	Online: Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What is the concept of remote purchase?”, “What is the application of purchase in blockchains?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting on the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What is the concept of remote purchase?”, “What is the application of purchase in blockchains?”	
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on the concept of remote purchase and its application to blockchain technology.	
Resources	Paper, pencil, board, and PC.	

4.12.2.3 Prerequisites

The learner should have basic knowledge on a few or several of these disciplines: computer science, system engineering, mathematics.

4.12.3 Lecture 12.3: Game Solutions and Fee Schemes

4.12.3.1 Targeted Knowledge and Skills

Knowledge	Skills
• Game theory concepts used in blockchain applications. • Game theory models applied in blockchain-based solutions.	• LO12.3: Discuss the theoretic game approach from the fees in a blockchain network.

4.12.3.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (beliefs and mixed strategies) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate	Online:	

Item	Delivery specs/guidelines
understanding/ assessment	Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What is a Belief?”, “How to use efficient strategies?”. Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting on the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What is a Belief?”, “How to use efficient strategies?”.
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on the application of efficient strategies in game theory.
Resources	Paper, pencil, board, and PC.

4.12.3.3 Prerequisites

The learner should have basic knowledge on a few or several of these disciplines: computer science, system engineering, mathematics.

4.12.4 Lecture 12.4: Proof of Stake

4.12.4.1 Targeted Knowledge and Skills

Knowledge	Skills
• Game theory concepts used in blockchain applications. • Game theory models applied in blockchain-based solutions.	• LO12.4: Illustrate the game theory behind proof of stake.

4.12.4.2 Lesson plans

Item	Delivery specs/guidelines	
Setting	Classroom or on-line	**Duration**
Format	**Lecture Delivery (classroom)**	**16**
	Presentation of theoretical background (presentation slides, lecture notes) Presentation of supplementary theoretical content (use cases, case studies, Q&As) Evaluation (multiple-choice questions)	4 10 2
	Practice	**10**
	Reflection on presented case studies, notes. Execution of practical exercises	5 5
	Individual work (classroom or on-line)	**9**
	Study of CHAISE lecture material Review of recommended bibliography Preparation for the final exam	3 3 3
	TOTAL	**35**
Lesson beginning	Assess the awareness of the group of learners (key concepts of Best Response and Weak Dominance) using “Who knows about…” questions.	
Engage/ motivation	Classroom: Make sure the fundamental technical elements are understood, use practical examples, and ask open questions to ensure the basics and the terms/terminology are understood.	
Evaluate	Online:	

Item	Delivery specs/guidelines
understanding/ assessment	Individual task: Encourage learners to do practical exercise and comment on the results. Encourage learners to read the use cases and to comment on their findings. Start a new topic in a forum with open questions like “What do best responses mean?”, “What is a partially mixed strategy Nash equilibrium?” Classroom: Individual task: Create groups of 3 or 4 individuals, each group analysing and commenting on the use case, each learner in a group writing his own ideas and sharing them. Initiate a discussion around topics like “What do best responses mean?”, “What is a partially mixed strategy Nash equilibrium?”
Closing activities	Summarize the main key elements learned and provide common feedback based on learners’ input, focusing on different examples explained in the slides.
Resources	Paper, pencil, board, and PC.

4.12.4.3 Prerequisites

The learner should have basic knowledge on a few or several of these disciplines: computer science, system engineering, mathematics.

5 Work-Based Learning (WBL)

5.1 Overview of Work-Based Learning (WBL)

5.1.1 Introduction

This chapter concentrates on Work-based learning (WBL), as the main pathway used to provide learners with workplace experience. This type of learning is hardly ever stand-alone but is usually combined with classroom-based learning.

This chapter has been written to help understand some of the ways in which learning in the workplace can be encouraged and how its quality can be improved. It is also intended to help understand some of the ways that such learning can be organized in a structured way so that it benefits learners, enterprises, and employees, and so that it provides wider benefits for the labour market and the economy. Policy makers, social partners, and vocational education and training (VET) institutions namely schools, colleges and training centres operate externally to individual enterprises. The chapter tries to show what they can do in a practical way to help learners to introduce and improve structured work-based learning. In particular, the present chapter:

- Concentrates on work-based learning that is part of VET but is not limited to this.
- Tries to focus on opportunities – on what is possible, not on problems and barriers.
- As far as possible it tries to suggest options rather than provide solutions.

5.1.2 What is work-based learning (WBL)?

Work-based learning refers to all forms of learning that take place in a real work environment. It provides individuals with the skills needed to obtain and keep jobs and progress in their professional development. This work can be paid or unpaid, but it must be real work that leads to the production of real goods and services. Learning at the workplace offers learners direct access to innovative practices and technologies. It directly exposes them to changes as they happen at the workplace. WBL can offer learners an opportunity to develop, while working, the skills needed– both technical and transversal ones.

Work-based learning (WBL) is a set of instructional strategies that engages employers and training institutions in providing learning experiences for learners. WBL activities are structured opportunities for

learners to interact with employers or community partners either at school, at a worksite, or virtually, using technology to link learners and employers in different locations.

The purpose of WBL is to build learner awareness of potential careers, facilitate learner exploration of career opportunities, and begin learner preparation for careers through authentic connections to business and industry in a field related to the learner's career interest. These awareness, exploration, and preparation activities help learners make informed decisions about education and training. Exposure to careers through an individual WBL activity can be beneficial, but learners attain the best results when WBL activities are structured and sequenced over several years.

WBL in VET can be part of the solution both in the short and in the longer term. It can help ease workers' current transitions to new jobs and alleviate the related social and economic costs; and, in parallel, prepare young(er) learners for future skill demands. In the short term, specific training modules that integrate WBL can be set up for certain occupations that will be most affected by the green transition. Such a modular approach may support the adaptation of the CHAISE curriculum and aid staff engagement in the change process. This should accompany the changes in jobs and skills: first, by mitigating identified skill mismatches, and second, responding to pressing (local) needs of employers and learners, including vulnerable groups (such as young people not in employment, education, or training (NEETs) and early school leavers). In the longer term, a more systematic and holistic approach to WBL will be needed, one that goes beyond its contribution to higher productivity, sustained growth, and competitiveness. WBL in both IVET and CVET can support the development of skills at all levels and across sectors and occupations, supporting the long-lasting ability of people to get quality jobs and of companies to innovate and be competitive while pursuing the goals of a climate-neutral society.

5.1.3 Principles of work-based learning

Work based learning is dependent upon three core principles. These are:

- Facilitating collaborative work and learning amongst co-workers, especially as peers.
- Sensing patterns and helping to develop emergent work and learning practices.
- Working with management to fund and develop appropriate tools and processes for workers.

5.1.4 Characteristics of work-based learning

Overall, the characteristics of work-based learning are multiple and diverse. The main ones include:

- Diversity with the use of time and place.

- Personalized learning.
- Free choice on variables (time, place, provider).
- Project based learning.
- Practical (raw material, equipment) experience.
- Different ways of checking knowledge gained.
- Learner ownership of the learning process.
- Connection with colleagues and promotion of teamwork.

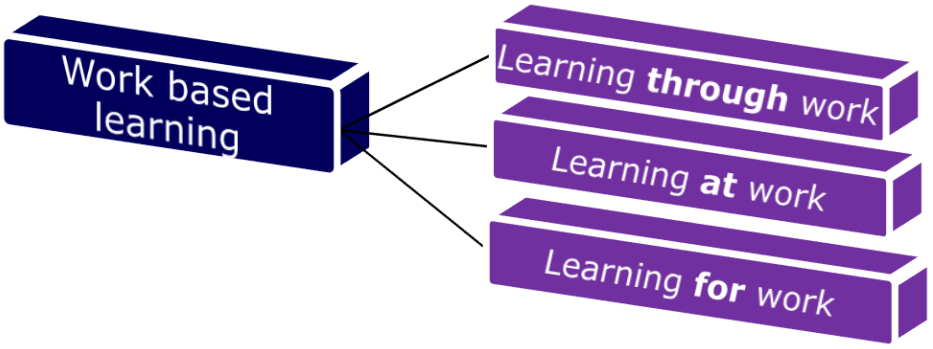
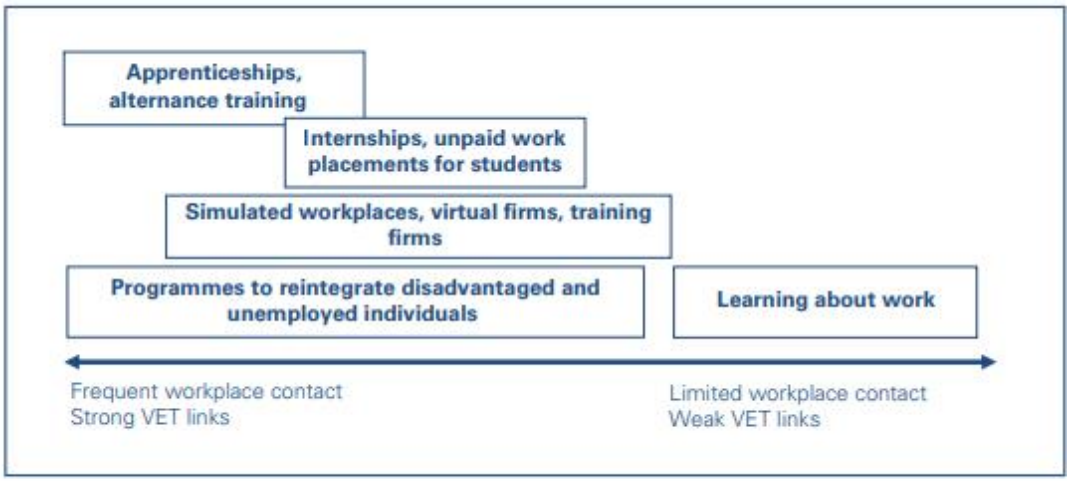


Figure 1. Aims of work-based learning

5.2 The main types of work-based learning programmes

It is helpful to classify work-based learning arrangements into four main types:

- Arrangements in which the learner is legally an employee, such as formal apprenticeships, and in some cases alternance; in some cases, informal apprenticeships may come under this heading.
- Arrangements in which the learner is legally a learner; these can be called by several names, including traineeships, internships, work placements and cooperative education.
- Borderline cases such as virtual firms, training firms, or 'real' firms that are attached to and part of educational institutions.
- Programs such as work shadowing and work experience, the main aim of which is to teach the learner about work rather than to teach them to do work.



Source: Adapted from ETF (2013)

Figure 2. Types of work-based learning programmes

The differences between these types of work-based learning programs are often not clear, as they can be quite similar. It is also important to be aware that wide variation can exist within each type.

5.3 Benefits of work-based learning

Well-planned WBL programs benefit all participants in multiple ways. There are several reasons for policy makers, individual companies, and social partners to be interested in introducing, expanding, and improving the quality of work-based learning.

Table 2 WBL benefits to Learners and Schools

Work-based learning benefits to:	
Learners	**Schools**

• Build relationships with adult role models other than families, friends, and teachers.
• Acquire experience and workplace skills.
• Set and pursue individual career goals based on workplace experiences.
• Engage parents in career planning.
• Get a “foot in the door” for possible future part-time, summer, or eventual full-time jobs.
• Become aware of career opportunities, explore those of interest, and start preparing for them.
• Build understanding of skills required to succeed in the workplace.
• Recognize the relevance of education to career success and increase motivation for academic success.
• Make their programmes of study more interesting and connect them more directly to the world of work.
	• Build relationships with the community.
	• Make classroom learning more relevant.
	• Enable learners to share their experiences with peers and teachers.
	• Provide staff development opportunities.
	• Increase staff understanding of the workplaces for which they are preparing learners.
	• Expand curricula by using workplaces as learning environments.
	  ○ Can be a powerful way to develop generic skills such as teamwork and problem solving, and basic work habits such as punctuality.
	  ○ Shows learners the relevance of their courses to future jobs, and so makes them more interested in studying; this can be important for increasing participation and outcomes for disadvantaged learners.

Work-based learning benefits to:	
Learners	**Schools**
• Can improve their job prospects by giving them more relevant work skills and by connecting them to employers who may offer them jobs after they graduate. This can be an important way of expanding opportunities and increasing social inclusion among groups that are disadvantaged in the labour market.	○ Can be used in career guidance programmes to teach young people about what is involved in jobs and careers. ○ Leads to better school-to-work outcomes: young people who have been involved in work-based learning are more likely to get jobs, as their skills are more relevant to employers' needs, they have better basic work habits, and their contacts with employers are stronger.

Table 3 WBL Benefits to Employers, Companies and Employees.

Work-based learning benefits to:		
Employers	**Companies**	**Employees**
• Build positive relationships with school staff and learners. • Help create a pool of better-prepared and motivated potential employees. • Strengthen employees' supervisory and leadership skills. • Improve employee retention and morale. • Learn about the knowledge and skills of today's learners and tomorrow's employees.	• Workplaces in which employees constantly learn new skills and new ways of doing things tend to be more productive and more profitable. They tend to be more innovative, be better at using employees' knowledge to improve product quality and customer service and have lower staff turnover.	• The chance to learn new things makes work more interesting. • Encourages employees to be more interested in improving their career prospects and increases the chances that they will undertake formal VET.

Work-based learning benefits to:		
Employers	**Companies**	**Employees**
• Generate favourable visibility in the community. • Derive value from learner work. • Make contacts with potential candidates for part-time, summer, or eventual full-time jobs.		

Table 4 WBL Benefits to Policy Makers

Work-based learning benefits to Policy Makers in:	
VET (Initial, post-secondary, continuous)	**Public Employment Services**
• Produces higher-quality skills that are more relevant to real work situations than does learning that occurs entirely in the classroom; and it produces skills that are likely to be more up to date with current practices in the workplace. • Helps to strengthen cooperation between education and business, and to create strong links, both for individual learners and for the system as a whole, between vocational education and the real demands of the labor market.	• Can re-motivate those who are long-term unemployed and maintain their motivation to seek work. • Increases unemployed people's contact with employers, and so can increase their chances of getting a job. • Is a way to develop new skills in a more interesting and relevant way than classroom-based training, particularly for people who have low levels of education.

Work-based learning benefits to Policy Makers in:	
VET (Initial, post-secondary, continuous)	**Public Employment Services**
• Increases the link between learners and the labour market and so improves their chances of getting a job after they complete their training. • Involves employers in designing and managing VET, thus increasing their confidence in the system. • Makes economic sense, with costs shared between employers and government rather than all being met from the public purse; this means that government budgets should go further. • Makes greater use of plants and equipment on employer premises for training, and so reduces the need to purchase expensive training equipment. • Can create learning opportunities that many publicly financed VET schools and colleges cannot afford.	

5.4 Skills developed through work-based learning.

One of the purposes of WBL is to help learners develop skills and behaviours that are essential to success in every workplace. When implementing WBL activities, it is important to build in opportunities for learners to develop these skills and to work with employer- partners to ensure that they address them in their work with learners.

The following table presents a typology of workplace skills. It is reprinted, with permission, from A Work-Based Learning Strategy: Career Practicum by ConnectEd: The California Center for College and Careers[1].

Table 5 Workplace Skills

CATEGORY	LEARNING OUTCOME
Learner...	
Collaboration and Teamwork	Builds effective collaborative working relationships with colleagues and customers; can work with diverse teams, contributing appropriately to the team effort; negotiates and manages conflict; learns from and works collaboratively with individuals representing diverse cultures, ethnicities, ages, gender, religions, lifestyles, and viewpoints; and uses technology to support collaboration.
Communication	Comprehends verbal, written, and visual information and instructions; listens effectively; observes non-verbal communication; articulates and presents ideas and information clearly and effectively both verbally and in written form; and uses technology appropriately for communication.
Creativity and Innovation	Demonstrates originality and inventiveness in work; communicates new ideas to others; and integrates knowledge across different disciplines.
Critical Thinking and Problem Solving	Demonstrates the following critical-thinking and problem-solving skills: exercises sound reasoning and analytical thinking; makes judgments and explains perspectives based on evidence and previous findings; and uses knowledge, facts, and data to solve problems.

[1] https://docplayer.net/139176662-Career-practicum-a-work-based-learning-strategy-june-2011.html , 12-09-2023

Information Management	Is open to learning and demonstrates the following information-gathering skills seeks out and locates information; understands and organizes information; evaluates information for quality of content, validity, credibility, and relevance; and references sources of information appropriately.
Initiative and Self-Direction	Takes initiative and can work independently as needed; looks for the means to solve problems; actively seeks out new knowledge and skills; monitors his/her own learning needs; learns from his/her mistakes; and seeks information about related career options and postsecondary training.
Professionalism and Ethics	Manages time effectively; is punctual; takes responsibility; prioritizes tasks; brings tasks and projects to completion; demonstrates integrity and ethical behaviour; and acts responsibly with others in mind.
Quantitative Reasoning	Uses math and quantitative reasoning to describe, analyse, and solve problems; performs basic mathematical computations quickly and accurately; and understands how to use math and/or data to develop possible solutions.
Technology	Selects and uses appropriate technology to accomplish tasks; applies technology skills to problem solving; uses standard technologies easily; and can access information quickly from reliable sources online.
Workplace Context and Culture	Understands the workplace's culture, etiquette, and practices; knows how to navigate the organization; understands how to build, utilize, and maintain a professional network of relationships; and understands the role such a network plays in personal and professional success.

5.5 Ensuring the quality of work-based learning

5.5.1 Quality framework

Ensuring that work-based learning is of a high quality requires a broader framework and a different approach than that required for ensuring the quality of classroom-based VET. This is because enterprises, unlike schools and colleges, are not directly under the control of governments. They cannot be compelled to do certain things in the same way that schools and colleges can. For this reason, some of the frameworks or guidelines that are applicable to quality in VET do not always apply directly to work-based learning. They often tend to focus very much on what happens in a classroom, college, or school, and on how educational institutions relate to governments and social partners; they have less of a focus on quality in the workplace. Policies to improve the quality of work-based learning can be thought of in several ways. A common way to look at all quality frameworks is in terms of:

- Ensuring that inputs are of a high quality.
- Putting in place processes that can result in quality outcomes.
- Assessing outcomes to judge whether they are of a high quality.

Examples in this case could include ensuring that enterprises have trained and qualified trainers (inputs); ensuring that the links between enterprises and schools are close ones (processes); and putting in place regulations requiring national practical tests to be held the end of apprenticeships (outcomes). These three dimensions of quality assurance are not exclusive: all can be adopted together, and in many of the best VET systems all are used.

An alternative framework that is somewhat more directly related to work-based learning contains three broad approaches to the quality of work-based learning, the first two of which are closely related:

- Working with enterprises to strengthen their capacity to provide and take part in work-based learning programmes.
- Developing practical tools that can assist enterprises and learners.
- Formal approaches that focus on regulations and supervision by external organisations.

These three approaches to quality assurance in work-based learning are not exclusive: all can be adopted together. In practice, of course, the two ways of looking at quality overlap a great deal. Whichever approach to policies for improving the quality of work-based learning is adopted, policy makers and social partners need to keep in mind two questions.

- Is there a trade-off between quality and what can be afforded?
- Is there a risk that measures to improve the quality of work-based learning will be seen as burdensome, will interfere with the ongoing business of enterprises, and will discourage participation? This question applies to measures that try to impose legal obligations or requirements on employers.

5.6 Work-based learning in the context of CHAISE (practical example)

5.6.1 CHAISE pilot seminars

CHAISE organized a series of on-site training seminars to offer upskilling opportunities to industrial partners' ICT/Blockchain workforce (IOTA, C4A, NETCOMPANY - INTRASOFT, INDUSTRIA, FUJITSU) and get valuable feedback on the effectiveness of the curriculum before delivered on a large scale. In total, the consortium successfully conducted 5 training seminars, which were hosted at the premises of the implementing partners or in a hybrid mode (onsite and virtually). Throughout these seminars, all 12 modules of the CHAISE curriculum were covered, with a special emphasis on hands-on, practical work-related tasks. The seminar received overwhelming participation from 125 individuals, who seized the opportunity to get a good grasp of the CHAISE curriculum and become empowered with essential Blockchain technical and non-technical skills, increasing their exposure and technical competency in Blockchain/DLT related operations. The CHAISE pilot seminars pursued the following training objectives:

- Introduce participants to the foundational concepts of Blockchain technology, including its decentralized nature, cryptographic principles, and consensus mechanisms.
- Explore real-world use cases of Blockchain technology across industries such as finance, supply chain, healthcare, and more.
- Explain the technical architecture of Blockchain including blocks, transactions, smart contracts, and nodes.
- Present the security features of Blockchain networks, such as immutability and encryption, as well as the challenges related to privacy and data protection.
- Guide participants on how to set up development environments, writing smart contracts, and interacting with Blockchain networks.
- Address the legal and regulatory aspects of Blockchain technology, including smart contract enforceability and data governance.

- Offer hands-on exercises or case studies to help participants apply their knowledge practically and understand real-world implementation challenges.
- Help participants develop a strategic approach to incorporating Blockchain technology into their business or organization, considering the potential benefits and risks.

5.6.2 Implementation process

The implementation of an on-site training seminar with a strong practical component involves several stages that contribute to the delivery of a comprehensive learning experience for participants, as demonstrated in the structure of the CHAISE pilot seminars. The process begins with the preparatory stage, where an overview of the training curriculum and seminar objectives are provided. This sets the foundation for the subsequent lecture delivery where the main conceptual aspects and case studies are presented to help learners build a good theoretical background and technical competency. Practical components are emphasized through the demonstration of practical work components and the organisation of joint working sessions, allowing learners to acquire hands-on experience. The “assessment and validation” stage is instrumental in safeguarding that learners have successfully attained the intended learning outcomes and will obtain a recognised status for new skills acquisition. Finally, the follow-up phase gathers feedback from participants and facilitators on the effectiveness of learning materials contributing to the continuous improvement and refinement of the training program in question. Together, these stages create a structured and effective framework for the implementation of work-based learning in the form of a training seminar.

Preparatory Stage

- Introduction of the CHAISE project
- Overview of the CHAISE curriculum and specialisation pathways
- Presentation of pilot seminar’s thematic coverage and training objectives

Lecture Delivery

- Overview of lecture’s content
- Presentation of lecture’s connection to other modules in the CHAISE curriculum, and its real work life implications
- Glossary and terminology explanation
- Delivery of didactic presentation file
- Questions and Answers (Q&A) session on theoretical content
- Presentation of case studies and demonstration of practical work components
- Guided joint working sessions on selected micro-projects

- Peer discussion

Learners' Assessment and Skills Validation

- Explanatory notes and guidelines for the completion of practical exercises
- Presentation of performance criteria and the evaluation/examination procedure
- Guidelines for the submission of practical work
- Guidelines for the use of the CHAISE examination portal (applicable to MCQ based assessment)
- Facilitation and helpdesk during exercise completion (applicable to practical exercises)
- Evaluation and provision of feedback on learners' practical work
- Presentation of examination results and issuance of micro-credentials for successful examinees

Follow-Up and Curriculum Evaluation

- Recording of learner's reactions and observations throughout the seminar's duration
- Distribution of the evaluation form to course participants
- Gathering of facilitators' feedback on the learning effectiveness of tested CHAISE educational resources
- Compilation and analysis of learners' feedback from the evaluation questionnaire
- Preparation of summary reports and delivery of suggestions for curriculum refinements

5.6.2.1 5.6.2.1 Delivery format and subjects covered in CHAISE training seminars

Partner	Module	Subjects covered	Delivery Format	Duration (h)	Participants
C4A	M1: INTRODUCTION TO BLOCKCHAIN TECHNOLOGY	• Blockchain Genesis from Blockchain 1.0 to Blockchain 4.0 • Blockchain fundamentals: core components & characteristics	Onsite	4	25
	M10: SMART CONTRACT	• Analysing Smart contract specificities and characteristics • Identification of functionalities and reading the code of smart contract	Onsite	4	25
FUJITSU	M2: REGULATION, LEGAL ASPECTS, AND GOVERNANCE OF BLOCKCHAIN SYSTEMS		Onsite	4	19
	M4: BLOCKCHAIN BUSINESS MANAGEMENT AND PLANNING	• Fundamentals of Business Management Planning I • Fundamentals of Business Management Planning II	Onsite	4	19

Partner	Module	Subjects covered	Delivery Format	Duration (h)	Participants
	M11: DEVELOPING USE CASES: FROM IDEAS TO SERVICE	• Use Case Re-design • MVP for Blockchain Use Cases • Roadmap for Blockchain Use Cases (11.3)	Onsite	4	19
INDUSTRIA	M5: BLOCKCHAIN SECURITY AND DIGITAL IDENTITY	• Blockchain Honeypots • Identity Management and Access Control Models of Blockchain-based Applications	Hybrid	4	33
	M9: APPLIED CRYPTOGRAPHY	• Basic Cryptography • Introduction to Zero-Knowledge Proofs	Hybrid	4	33
IOTA FOUNDATION	M6: BLOCKCHAIN SYSTEM ARCHITECTURE AND CONSENSUS	• Basics in Blockchain System Architecture I • Basics in Blockchain System Architecture: Consensus Protocols	Onsite	4	3
	M8 MARKETING AND CUSTOMER SUPPORT	• Introduction to Marketing • Blockchain and Sustainability	Onsite	4	3

Partner	Module	Subjects covered	Delivery Format	Duration (h)	Participants
	M12: GAME THEORY IN BLOCKCHAINS	• Application to Basic Remote Purchase • Proof of Stake	Hybrid	4	30
NETCOMPANY-INTRASOFT	M3: FUNDAMENTALS OF BLOCKCHAIN AND DISTRIBUTED LEDGER TECHNOLOGY	• ICT Systems for Decentralized Solutions I • ICT Systems for Decentralized Solutions II	Onsite	4	25
	M7: BLOCKCHAIN PLATFORMS	• Overview of platform characteristics • Overview of the Ethereum Platform	Onsite	4	25

5.6.3 Insights from IOTA training seminars

IOTA Foundation organised 5 training seminars, covering 3 out of 12 modules of the CHAISE curriculum, and following the procedure outlined above. The subjects covered and resources used are presented in the following table:

5.6.3.1 Topic Constellation of the pilot sessions

MODULE	SUBJECTS COVERED	RESOURCES USED
MODULE 6: BLOCKCHAIN SYSTEM ARCHITECTURE AND CONSENSUS	• Basics in Blockchain System Architecture I • Basics in Blockchain System Architecture: Consensus Protocols	• Informative presentation slides • Keynote speech • Case studies • Discussion on the components of a blockchain system architecture for a given use case. • Multiple choice questionnaire
MODULE 8: MARKETING AND CUSTOMER SUPPORT	• Introduction to Marketing • Blockchain and Sustainability	• Informative presentation slides • Keynote speech • Case studies • Discussion on the ethical implications of Blockchain • Multiple choice questionnaire
M12: GAME THEORY IN BLOCKCHAINS	• Application to Basic Remote Purchase • Proof of Stake	• Informative presentation slides • Keynote speech • Case studies • Discussion on practical applications in designing incentive models. • Joint working session on implementing a Proof of Stake system

5.6.3.2 Intended learning outcomes

The following learning outcomes were attained by learners, who attended the training seminars organised by IOTA Foundation.

Module 6

- Explain fundamental design and architectural primitives of DLT system architecture, e.g., trust-less, permission-less, asynchronous, sybil protection.
- Employ design patterns and reusable proved solutions to explain Blockchain system development.
- Compare different consensus protocols.
- Evaluate the Blockchain architecture solutions to different practical scenarios.
- Further develop existing Blockchain architectures and apply them to new contexts in a creative way.

Module 8

- Explain the role of Blockchain for marketing.
- Demonstrate strategies for customer support and service design.
- Analyse role of networks and customer relationship management for Blockchain technologies.
- Illustrate products, prices, promotion, and sales strategies for Blockchain technology.
- Create awareness for Blockchain use among broader audience and communicate the benefits of the technology in an accessible way for different use cases.

Module 12

- Illustrate basic concepts from game theory with a Blockchain application for remote purchases.
- Describe and define advanced concepts from game theory.
- Discuss the theoretic game approach from the fees in a Blockchain network.
- Illustrate the game theory behind proof of stake.

5.6.3.3 Delivery mode and training specifications

❖ **Lecture 6.1 Basics in Blockchain System Architecture**

Presentation:

After starting with an insight on the required features of a distributed ledger and layers of a Blockchain, the participants were introduced to the Blockchain architecture components such as the ledger,

transactions, nodes, and the network. The content was adjusted with consideration of the group work during the exercise.

Exercise:

The audience was divided into groups of 4-5 participants. The groups were given the same case study and were asked to determine the components of a Blockchain system architecture for the use case. The results were presented by each group and differences between approaches were discussed.

- **Lecture 6.3 Consensus Protocols**

Presentation:

After introducing the Blockchain trilemma and elaborating on its three pillars, four well-known consensus protocols used in Blockchain were presented: proof of work, proof of stake, proof of authority and practical Byzantine fault tolerance. Trade-off of each consensus protocol with respect to the trilemma was emphasized. While presenting the consensus protocols, the differences between them with respect to criteria such as scalability and energy consumption were hinted, to prepare the participants for the exercise.

Exercise:

The participants filled in a table that compares consensus protocols with respect to criteria such as scalability, energy consumption, Sybil attack vulnerability, etc.

- **Lecture 8.2: Ethical Design Framework**

Presentation:

Within this lecture the participants got an overview of Blockchain Use cases in Social Impact and the Blockchain Ethical Design Framework as a tool for creating an intentional design that incorporates key ethical questions for the development and use of Blockchain. Focus was put on the Decision Spiral with the following points: Governance, Identity, Verification and Authentication, Access, Data Ownership, Security.

Exercise:

Based on the presentation made on the decision spiral from the Blockchain Ethical Design Framework and Use cases provided in Blockchain projects for social impact the participants were to select a Blockchain project for social impact to apply the Matrix for “Access” from the decision spiral.

- **Lecture 8.3: Blockchain and Sustainability**

Presentation:

Introduction to relevant treaties and initiatives was given such as the Paris Agreement, the 17 SDGs and ESG factors. Emphasis was put on showing where Blockchain has potential to contribute to sustainability but also on what needs to be considered when using Blockchain technology, so it does not offset its impact on sustainability. For this purpose, different consensus mechanisms were described.

Exercise:

Based on the provided input on for example consensus mechanism the exercise was conducted where participants apply the Green Blockchain Decision Framework.

- **Lecture 12.1: Application to a Basic Remote Purchase**

Presentation:

Within the first pilot lecture of module 12 the participants were made familiar with Game Theory Definition and important aspects such as information sets in game theory, Extensive-form Representation (game trees). Subsequently an example was presented showing the game tree based on Staking or dApps. Lastly the Role of Profits, Preferences and Outcomes, Strategic/Normal form and Payoff Function in Game Theory was explained.

Exercise:

The exercise was oriented on the practical exercise described in the lecture notes. Within this exercise the participants committed and revealed smart contracts to solve the security problem in the prisoner's dilemma game outlined in the presentation.

5.6.3.4 Skills validation

The validation of acquired learning outcomes was conducted through an online examination, consisting of a MCQ test and practical exercises (to act as a proof of their practical capacities), hosted on ECQA's examination portal. To ensure transparency and validity, the examination material relied on a wide pool of questions/exercises of the same proficiency level that were automatically, randomly selected in the exam. The evaluation of practical exams was performed by seminars' facilitators.

Preparation and Planning

- The examination was implemented on-site and supervised by the seminar facilitator.
- The examiner/supervisor checked the ID of every participant and made sure that not more than the booked participants were in the room.
- The examiner/supervisor informed the participants about the examination procedure and the type of support they could receive during the examination.
- The examiner/supervisor made sure that all participants had a running PC/Notebook/Laptop in front of them with adequate power supply.
- The examiner/supervisor started the exam by sending out the links.
- No pictures or screenshots/-recordings were allowed while the exam was ongoing, and no questions were answered. Notes on paper were also not allowed as copying the exam question directly results in loss of exam/certification and being banned from all future attempts.

Visual documentation from onsite pilot session


1982: First Blockchain Protocol
Computer Systems Established, Maintained, and Trusted by Mutually Suspicious Groups
PhD dissertation, University of California 1982
• Distributed computer system
– established, maintained and trusted by mutually suspicious groups
• A public record-keeping system protects individual privacy through physical security
– group membership consistency
– private transaction computations
• The building blocks of this system
– physically-secure "vaults"
– cryptographic primitives
– threshold secret sharing


</One code to rule them all>

6 THE CHAISE MASSIVE OPEN ONLINE COURSE (MOOC)

6.1 What is a MOOC?

Massive Open Online Courses (MOOCs) are free online courses in different disciplines and fields of study, organised around an open, publicly shared curriculum, available for anyone to enrol. MOOCs provide an affordable and flexible way to acquire new skills, foster personal development and career advancement though informal quality educational experiences at scale. Typically, MOOCs integrate social networking, accessible online resources, and are either self-paced or facilitated by experienced trainers in the field of study. MOOCs build on the engagement of learners who are at the centre of the learning process and self-organize their participation according to their own learning goals and skill development needs, prior knowledge and educational background, and available time and resources.

- **Course**: A MOOC supports the attainment of learning outcomes after certain activities within in each period. It comprises learning materials and some kind of formative evaluation method to assess the knowledge acquired by learners. It involves facilitators and learners and enables the interaction among students and between students and facilitators.
- **Open**: On one hand, a MOOC should provide open and free access to educational resources and learning activities, which means that learners can enrol and attend the course without paying (however it is a common practice that some features such as obtaining a certificate, or the assessment of work assignments are provided with charge). On the other hand, a MOOC should be open to anyone without prerequisites such as country of origin, previous qualifications, or specific grades.
- **Online**: Course content is always available, over the internet, and through different devices. A MOOC does not require the physical attendance of learners at a classroom.
- **Massive**: A MOOC has no limitation on the number of participants, supporting the participation of thousands of learners from around the globe. Learners become part of the course by engaging with other people's work, and everybody learns from the work of the other participants.

6.2 The CHAISE MOOC: Scope and structure

The CHAISE Massive Open Online Course (MOOC) is a self-guided online course that acts as a wide access delivery method for the CHAISE curriculum. It has been designed to reflect the structure of the developed curriculum, as organized around learning units and lessons, and comprises the project's training and assessment materials, in an online form (text, presentations, multimedia files, interactive tools, and exercises). The CHAISE MOOC primarily relies on visual materials such as presentations, videos, info graphics, instructional mock-ups, and all textual descriptions are accompanied by visual aids to facilitate learners' understanding. The CHAISE MOOC integrates also additional pedagogical resources such as video units, case studies, practical exercises that support auto-assessment, and collaboration mechanisms, aiming to provide an optimal learning experience with increased collaboration opportunities. The CHAISE online course is structured around 12 learning modules, which are further broken down into 48 lectures, as described explicitly in Chapter 4.

6.3 The CHAISE MOOC: Pedagogical Principles

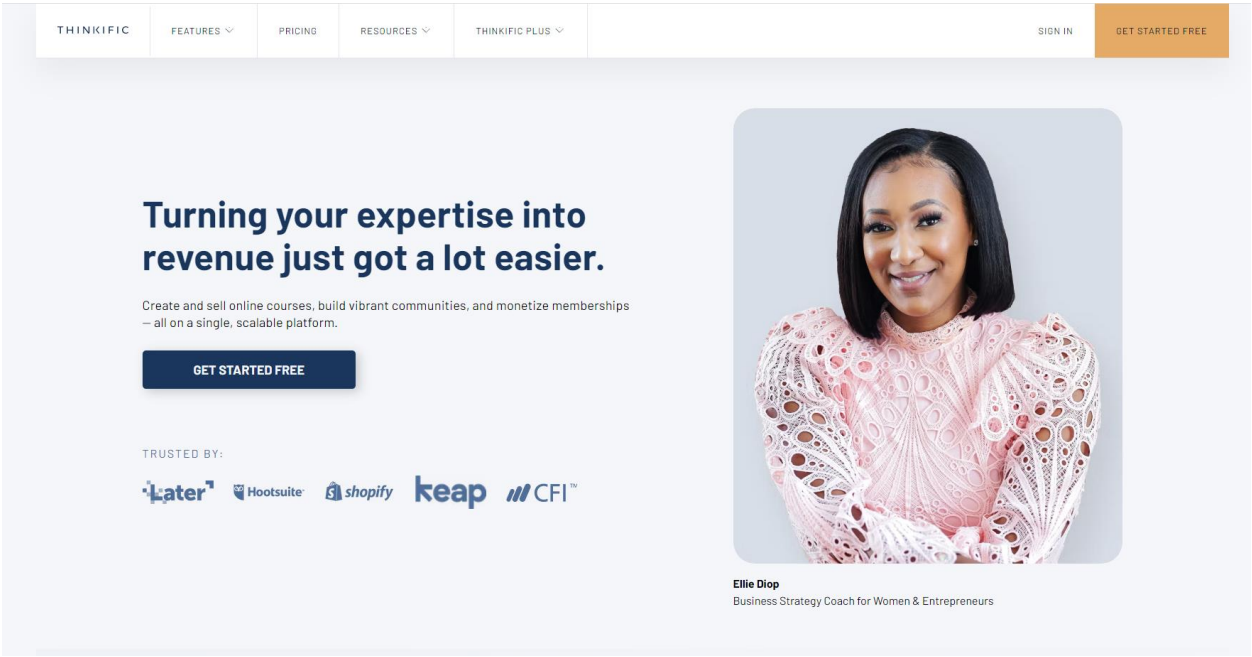
The CHAISE Massive Open Online Course is founded on the following pedagogical principles.

- **Learner-centeredness**: Learners are at the heart of the learning process, being able to establish individuals learning goals and a personal learning path based on available content and materials.
- **Flexibility:** Learners can arrange their own learning schedule according to their resources within the lifecycle of the course and decide their level of engagement.
- **Interactivity:** The CHAISE MOOC makes explicit mention on the value of interactivity and the multiplying effects it has on learning and capacity building. Learners are encouraged throughout the course to discuss with their peers, provide feedback on each other's work, and participate in joint activities, where possible.
- **Ubiquitous learning:** Learners can experience learning activities and content in any context and situation 24 hours 7 days per week through mobile devices such as laptops, tablets, and smart phones.
- **Teacher as facilitator:** In MOOCs, trainers should abandon their traditional role which is to convey information to learners and now act as facilitators, motivating learners to engage in course activities and providing feedback and assistance with their tasks.
- **Blended evaluation scheme:** One of the greatest challenges for a Massive Open Online Course is to establish an assessment model that works at a much larger scale, with potentially thousands of learners participating in the course. To respond to this challenge, the CHAISE MOOC has employed a blended evaluation scheme that incorporates different methods & tools to evaluate learners' performance, including a) auto-assessment, b) peer feedback, and c) self-checks.

6.4 How to access and use the CHAISE MOOC

6.4.1 THINKIFIC

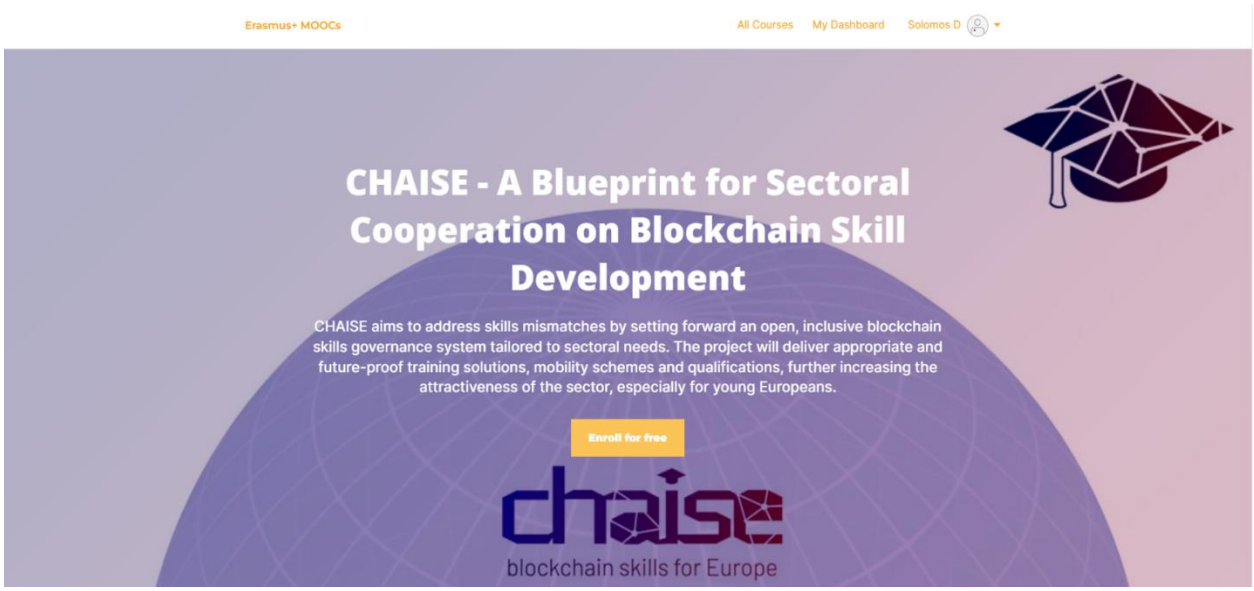
The CHAISE online course is hosted on THINKIFIC (https://www.thinkific.com/); an online learning platform that allows individual educators (e.g., individual trainers, universities, colleges, consortia and public institutions) to create and deliver Massive Open Online Courses (MOOCs) in a wide range of disciplines and subjects. THINKIFIC gives anyone the opportunity to offer truly interactive instruction without the need to write any code. Learning activities are combined with social mechanisms and facilitation/monitoring tools that allows to create engaging online learning experiences. The platform is designed to provide a community-based learning environment in which learners are actively involved in learning process and feel empowered, passionate communities of practice flourish, and deep learning experiences are fostered through carefully designed and interactive courses.



THINKIFIC provides a wide range of authoring tools to make the process of learning easier and more entertaining (e.g., auto-assessment, blog, discussion forum). Courses are structured into (individual) learning modules that are populated with text, images, videos, presentations, info graphics, and exercises that essentially enhance the learning process and enable students to evaluate their knowledge and skill acquisition. THINKIFIC employs a social media workflow with built-in galleries, announcements, wikis, blog pages, and discussion spaces to encourage commenting and liking throughout students' learning journey. These tools aim to support interaction with peers and facilitators and ultimately foster a community of collaborative learners. The platform also supports content in different languages. Finally, to support flexible and ubiquitous learning, all courses are compatible with

mobile devices such as laptops, smart phones, and tablets. THINKIFIC forms a global educational community with 35+ countries represented and more than 100 million course enrolments at the end of 2020.

CHAISE MOOC landing page



Course curriculum

- Learning Module 1: Introduction to Blockchain Technology
- Learning Module 2: Regulation, legal aspects and governance of Blockchain systems
- Learning Module 3: Fundamentals of Blockchain and Distributed Ledger Technology
- Learning Module 4: Blockchain Business Management and Planning
- Learning Module 5: Blockchain Security and Digital Identity
- Learning Module 6: Blockchain Systems Architecture and Consensus Protocols

Show more

chaise blockchain skills for Europe

About this course

- Free
- 376 lessons
- 0 hours of video content

6.4.2 Minimum system requirements

This section presents the minimum system requirements for using THINKIFIC. These requirements may change over time, following future programming improvements or amendments.

To make sure that THINKIFIC runs well, please make sure your desktop computer, laptop, tablet, smartphone, or smart device has the following:

- ✓ The most recent version of one of the web browsers listed below.
- ✓ JavaScript enabled.
- ✓ PDF plugin.
- ✓ Graphic and audio output capability.
- ✓ Broadband internet connection with a minimum speed of 5Mbps (recommended).
- ✓ TLS 1.2 supported by your web browser.

While the platform supports most of the browsers (Chrome, Firefox, Safari, Microsoft Edge), it is recommended using Chrome or Firefox on a desktop for best results while creating your courses.

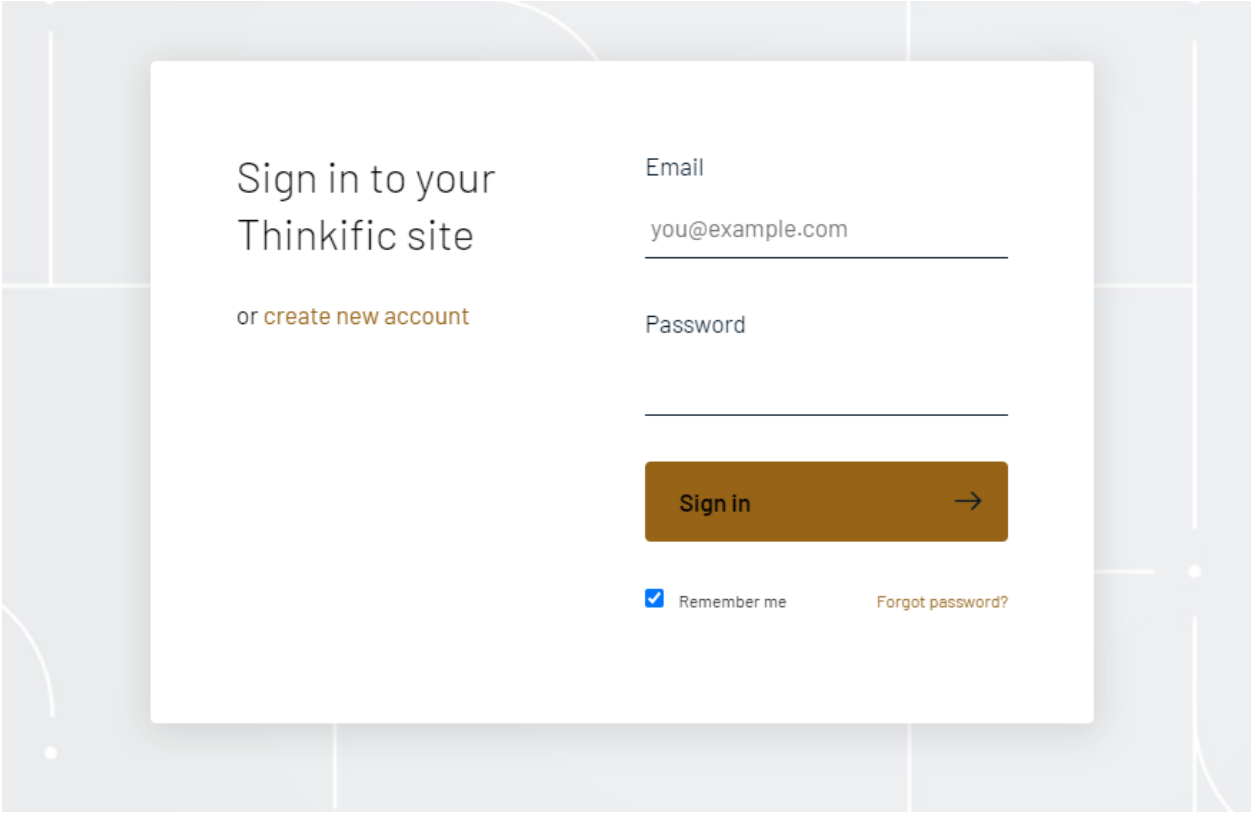
For more information on minimum system requirements, please visit:

https://support.thinkific.com/hc/en-us/articles/360030354954-System-Requirements-and-Supported-Browsers

6.4.3 Creating an account on THINKIFIC

All users (both educators and learners) on THINKIFIC need to create a user profile to get access to available courses and authoring tools. To create a new profile account, users must enter their full name, a valid e-mail address to use as the login and a profile name. The latter will be the name displayed on the platform.

To sign up, an account password is also required. It is recommended that users should create a strong password that will include a mix of uppercase letters, lowercase letters, numbers, and symbols to prevent unauthorised access and keep their profile secure.



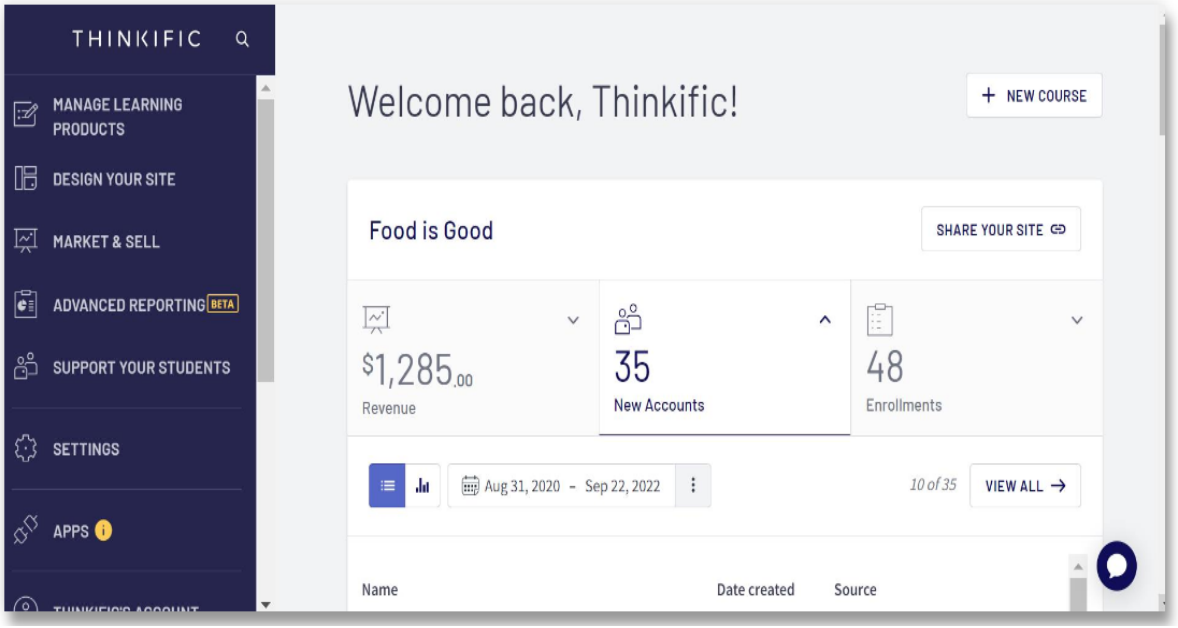
6.4.4 How to navigate within THINKIFIC

Once the user is logged in to site, there are a few main areas that he will want to become familiar with as he begins building products and site. These areas include:

Admin Dashboard

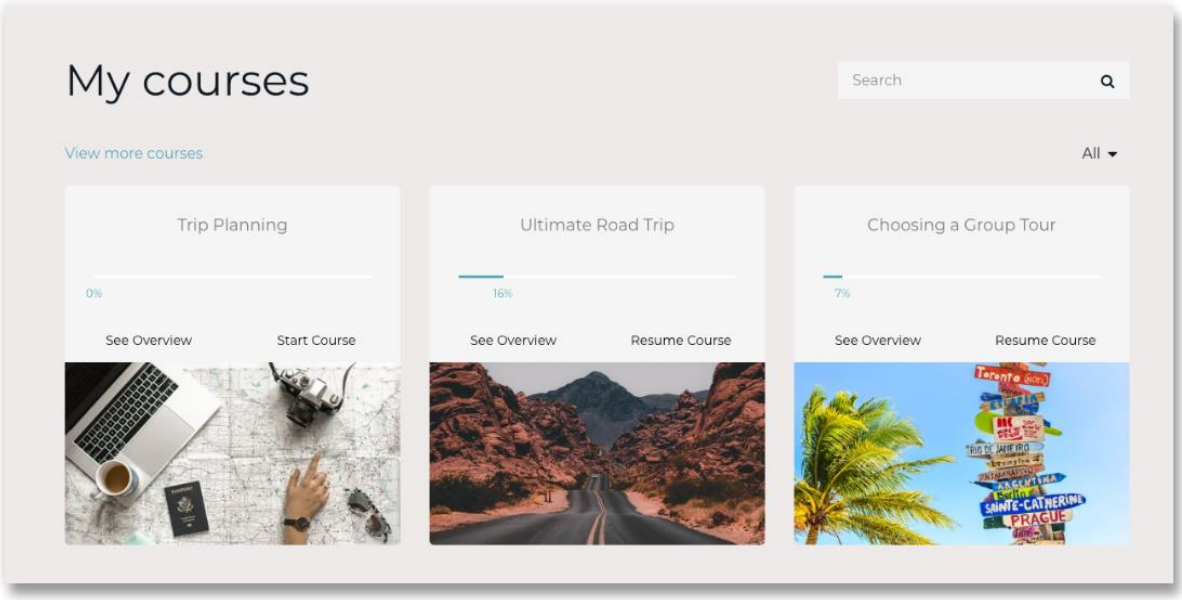
The Admin Dashboard is the first thing to see when login to the THINKIFIC site as the Site Owner or Site Admin.

The Admin Dashboard



Student Dashboard

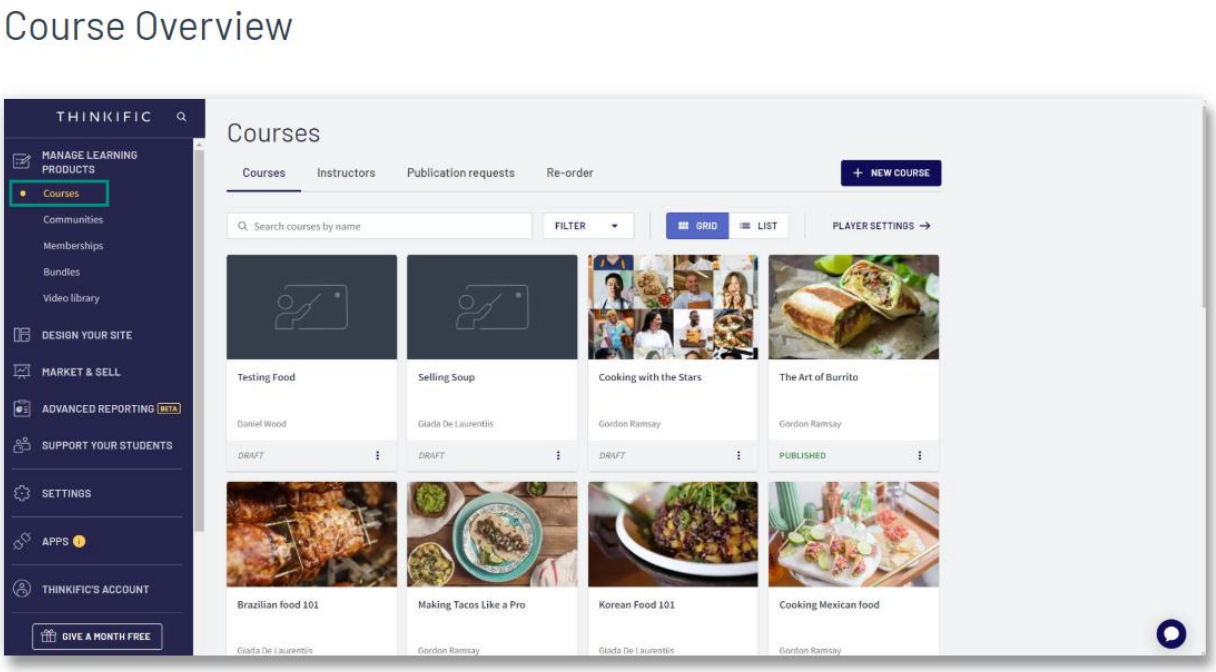
Students are immediately taken to their Student Dashboard when they login to your site. The Student Dashboard will display all product enrolments and students can simply click on any of the product cards available to access them or continue where they have left off!



Course Overview

The Course Overview is where you can create, view, edit, and manage all of your Courses and Bundles. To open the Course Overview:

- Go to Manage Learning Products
- Select Courses

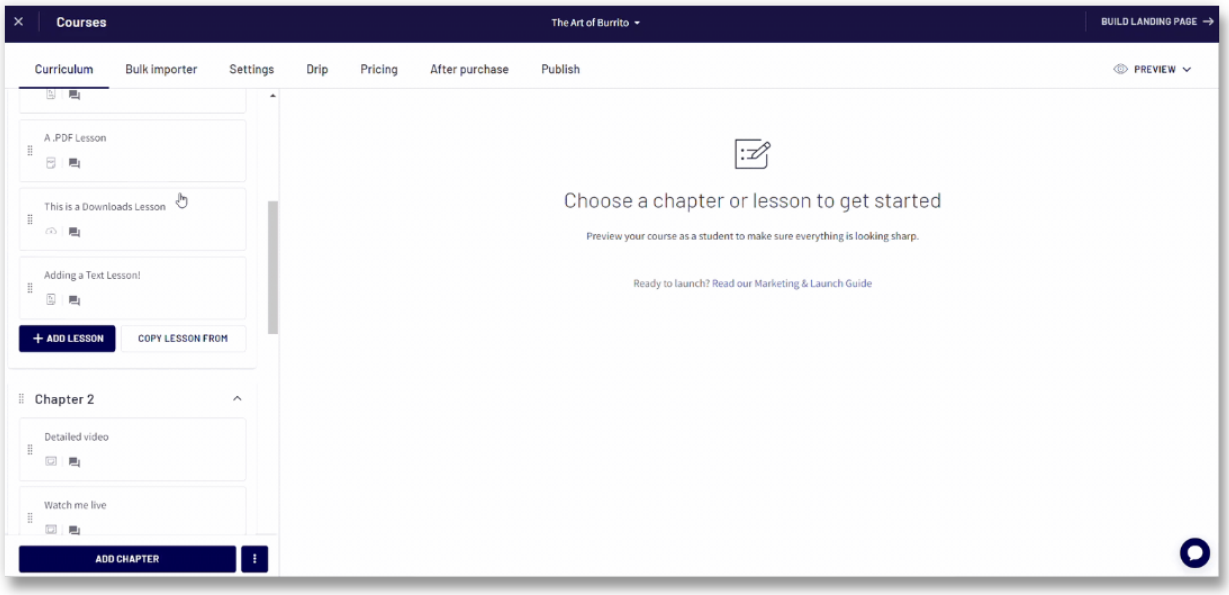


Course Builder

In Course Builder, you can create/import lesson content.

- Go to Manage Learning Products
- Select Courses
- Click on a specific course in the Course Overview to edit that course in the Course Builder.

Course Builder

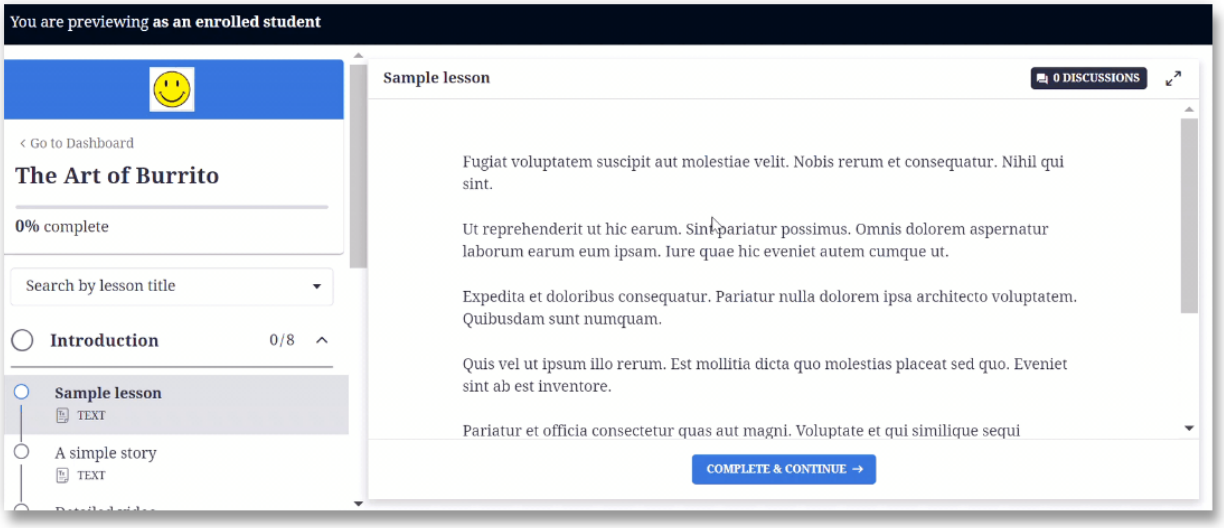


Course Player

The THINKIFIC Course Player is what enrolled students experience when they access the course via the Course Player. The Course Player is the course-taking environment itself - the part of the site where students can go to view the curriculum, watch videos, take quizzes, and more. There are 3 different preview options to choose from:

1. **Preview current lesson**: This will display the lesson that you currently have selected in the Course Builder. If the lesson is a draft, you will be able to see it for testing purposes.
2. **Preview all course lessons**: This will show you all your lessons starting from the very first lesson in the course. If any lessons are draft, you will be able to see them for testing purposes.
3. **Preview course as an enrolled student**: This will show you all your lessons starting from the very first lesson in the course. Just like how a student would experience your course, if any lessons are draft, you will not be able to see them!

Course Player



Troubleshooting Student Issues

The vast majority of the time when students have questions, they're product-specific. When they aren't, they're almost always a local computer issue.

The first to try is to reproduce the issue on admin's end - if it works for the admin it's likely device or browser-related. The Site Owner or Admin can first confirm the student's enrollment in the course from the Users page. Check if the student may have just created an account on the site, and not fully enrolled themselves in the product (or just enrolled in a free preview).

Next, the student us asked what browser they're using and what device. If possible, have them send over a screenshot or two of what they see on their end.

Then, the following troubleshooting steps can be sent to the student - these should help resolve a lot of student issues!

1. Clear cache and restart the browser
2. Try a different browser (we like Google Chrome)
3. Try an Incognito / Private Window (this will rule out an issue with browser extensions)
4. Restart the device
5. If possible, try a different device
6. If possible, try a different internet connection

Searching THINKIFIC

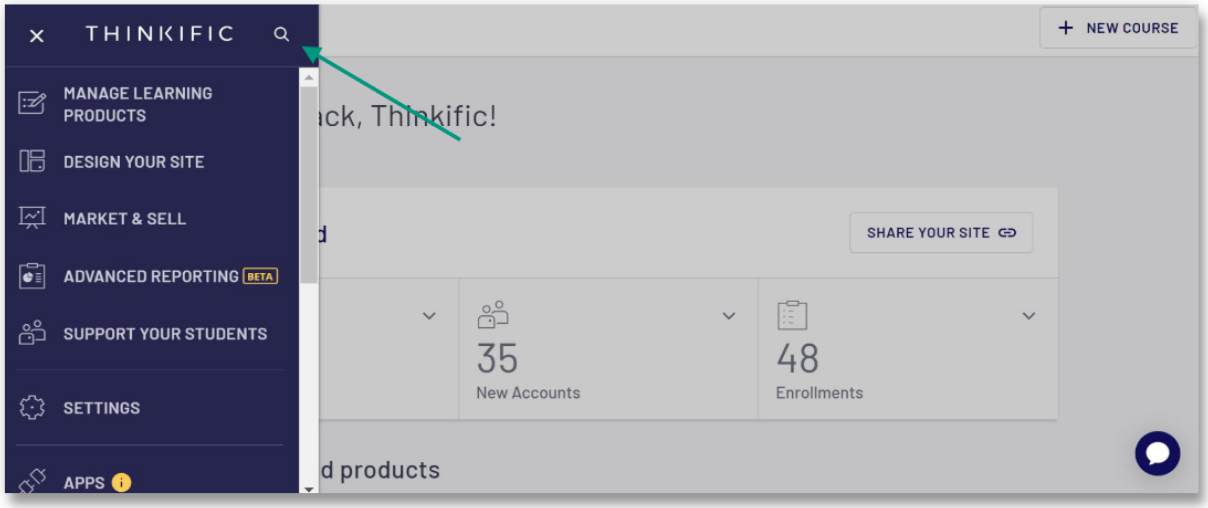
What you can search:

- Users - You can search users by their name and their email.
- Enrolments - You can search the enrolments of a single user by their name and email.
- Orders - Search orders by the order number as well as the user's name and email.
- Courses - Search a course by its name.
- Chapters - Search a chapter by its name.
- Lessons - Search a lesson by its name.

Search Thinkific

You can search your Thinkific site to quickly find the information that you need, and navigate to where you want to be.

Click the magnifying glass icon in the top left corner of your Admin Dashboard panel to get started!



6.5 How to facilitate the CHAISE MOOC

The CHAISE MOOC employs a learner-entered and personalised learning approach that places the learner at the heart of learning activities and educational process. Learner-centeredness is an educational approach that leads to high motivation and personal commitment to learn, deeper immersion in learning activities, and greater knowledge acquisition. In this context, learners can determine their own learning path, formulate individual goals, and select educational material and resources that address their distinct needs, preferences, and expectations.

When teaching with the use of a MOOC, educators need to abandon their traditional role, which is to be the main source of information, and become a facilitator and motivator of learning. They should be more focused on the development of skills, competences, and attributes and on comprehensive feedback, rather than on the dissemination of content. In MOOCs, the responsibilities of trainers include:

- Encouraging critical thinking.
- Fostering self-directed learning and curiosity.
- Motivating learners to engage in learning activities and collaborative mechanisms.

In addition, trainers should find ways to create a learning environment that stimulates all participants in the virtual classroom, generates deep understanding, and promotes collaborative learning throughout the course.

Consequently, the trainer in CHAISE MOOC must assume the role of facilitator a) providing regular and consistent feedback on tasks and exercises delivered by MOOC participants, b) encouraging learners to participate in learning activities, c) pinpointing learners' weaknesses and misconceptions, and d) responding to learners' questions and requests.

6.5.1 Introduce yourself to the class

Trainers are encouraged to introduce themselves to the class by presenting a short personal bio that demonstrates their educational background and area of expertise. From the very beginning, trainers need to set the tone for the course and describe their expectations in the virtual classroom. An interesting introduction will effectively increase participants' willingness to experience new learning opportunities and develop a sense of connection between trainer and learners. Trainers can prepare a welcome video to introduce the course and help learners get used to the format of the CHAISE MOOC. Introductory videos should answer initial questions and concerns and set the course expectations while assisting in creating a positive first impression.

6.5.2 Promote online discussions and collaborative learning

The CHAISE MOOC highlights the value of peer assistance and collaborative learning through the incorporation of discussion boards, online chat, social media links, and a students' area. The students' area (i.e., discussion forum) is the place where learners can share knowledge and information with other participants, discuss key concepts and problems associated with the course, exchange views and opinions with trainers, and cooperate with peers to complete tasks and exercises. Trainers should encourage learners to participate in the discussion forum by providing incentives (e.g., provision of access to additional learning materials and pedagogical resources). Also, trainers need to enhance learners' motivation by being explicit about expectations and ground rules for the online discussion forum, setting the framework for interaction, peer collaboration and dialogue. To moderate the forum, the trainer should become a facilitator and review the discussions without controlling or intervening in the dialogues. When it comes to questions, sometimes it is better to leave time for other participants to answer to encourage interaction among students.

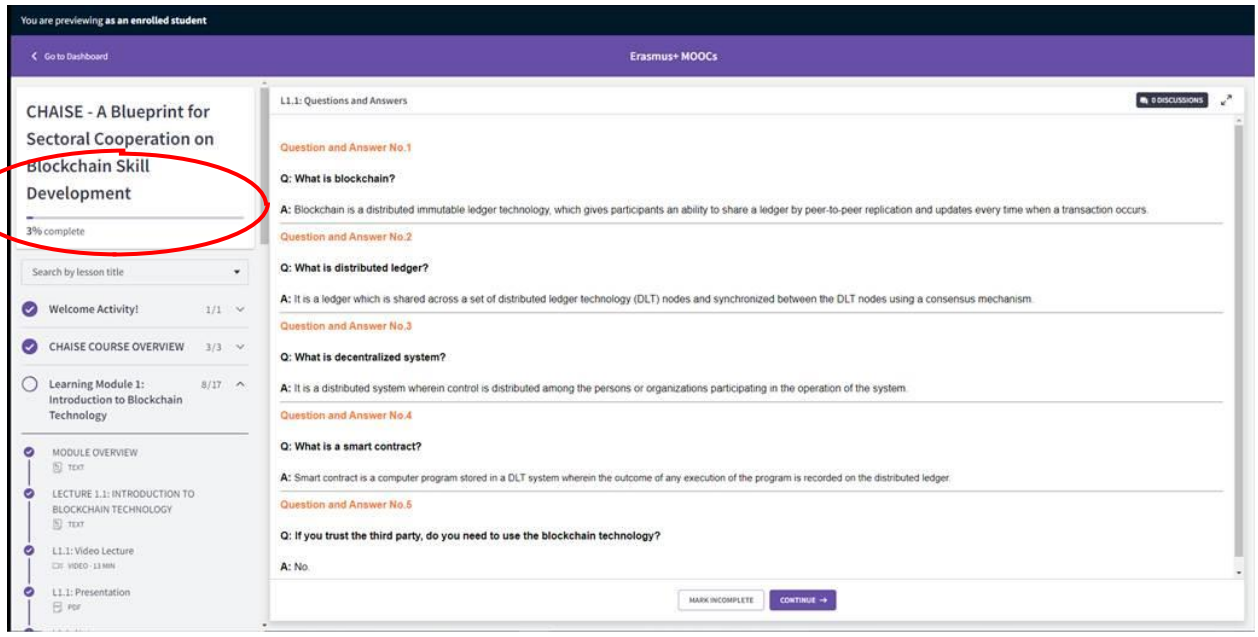
6.5.3 Establish a communication scheme

Trainers should establish a well-defined communication scheme to facilitate interaction with learners and support learning throughout the course. In addition, Trainers and Facilitators are encouraged to set/schedule online office hours once a week through the announcement section or the online chat, to engage in active discussions with learners, and help and clarifications, where needed. Strategic structured communication through regular emails and messages, including weekly feedback, announcements, and reminders will assist to maintain the engagement and focus of learners on the course experience and enhance the perception of a "teaching presence" by participants. Another channel to interact and communicate with learners is through the CHAISE student area (discussion forum). Trainers and facilitators need to monitor and interact in the forum as well.

6.5.4 Monitor learners' progress and engagement

THINKIFIC provides several options to monitor learners' activity throughout the course, providing analytics for all students such as enrolment and completion date, active time spent in the course, overall progress status, and comments posted in discussion boards. This allows facilitators to extract aggregate statistics for the course (e.g., dropout rate, engagement, interactivity) and most importantly to identify which students lag behind or demonstrate a low engagement so as to take remedial actions that increase their willingness to complete the course. For instance, facilitators can send reminder messages to students, indicating their progress and encouraging them to complete all sections. Another option is to issue badges for students that are actively involved in learning activities and have successfully completed work assignments and quizzes.

The performance of a learner can be tracked from the quizzes and the score achieved. To track the progress, every time a learner completes and continues to a next section, a progress bar appears on the top left sided (I.e., 3% completed), as shown on the following image.



6.5.5 Sharing the course

There are several options for sharing and disseminating the CHAISE MOOC.

- You can invite students by email through the platform.
- You can share the course in social media (Facebook, Twitter, and LinkedIn).
- You can email the link of the course.
- You can embed the CHAISE MOOC into your own blog or website.

6.5.6 Tips for trainers and facilitators

The following table indicates tips and best practises for trainers and facilitators, to effectively conduct and coordinate the CHAISE MOOC.

Table 6 Tips for MOOC trainers and facilitators

Before a MOOC starts:	During the MOOC	Post MOOC
• Prior to CHAISE MOOC release date, trainers should proofread the entire course, review all educational material, post an introductory announcement (or a welcome video), provide contact details, and set online office hours. • Encourage participants to explore the CHAISE MOOC content, course information, instructions, and prerequisites. • Suggest participants to choose the learning modules according to their interest and time allocation. • Get familiar with the MOOC environment, tools and features and encourage participants to do the same.	• Encourage participants to engage and interact through discussions conducted in the forum (share results of their exercises, ask and reply to questions). • Inform participants about the additional material for further study and suggest them to focus on resources that cover their interests. • Be prepared to deal with a lot of participants and inquiries. • Advise participants to search to see if someone has already posted the same question in the forum, to help reduce information overload. Towards this, the best approach is to reply within that thread rather than create a new one. • Login daily to interact with participants and/or monitor course activity.	• Upon the completion of the MOOC, encourage participants to stay connected through various channels, such as blogs, or social media, to exchange reflections and experiences or organise an ad-hoc working group to study and research topics of their interest.

	• Monitor learners' progress and send reminder messages to students indicating their progress status and encouraging them to complete all sections. • Respond to learners' emails, messages, and discussion postings within a day. • Schedule online office hours for learners that will take place once a week via the announcement section or the online chat. • Provide regular feedback on tasks and exercises submitted by learners and grade assignments (if relevant. Personalised feedback must be provided within forty-eight (48) hours after the submission of tasks due date.	

7 References

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