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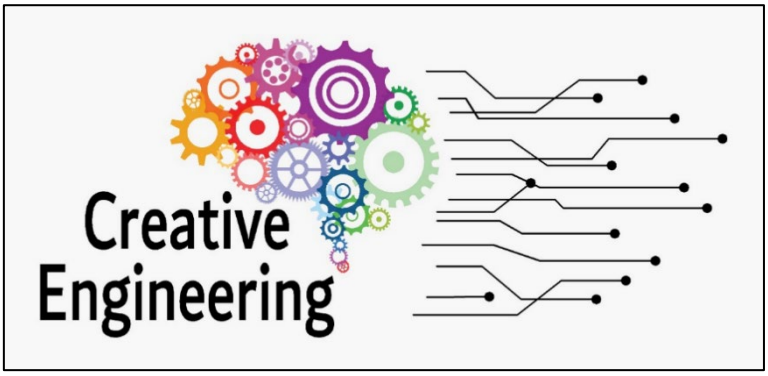

Curriculum “Digital Thinking: Exploring Digitalization and Artificial Intelligence”

2022-1-SK01-KA220-HED-000090102

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CONTENTS

1 Digital Thinking: Exploring Digitalization and Artificial Intelligence

Core Unit Title: Creative Engineering

Training Module Title: Digital Thinking: Exploring Digitalization and Artificial Intelligence

1.1 Competence Unit

The aim of this competence unit is to equip students with the knowledge and skills to understand and apply digitalization and artificial intelligence (AI) concepts in creative engineering contexts. It supports their ability to leverage digital technologies, analyze data, and integrate AI-driven solutions to foster innovation, solve complex problems, and communicate insights effectively.

- Digital Literacy: The student will be able to understand and utilize digital technologies to enhance engineering processes and outcomes.
- Data Analysis: The student will gain skills to collect, manage, and analyze data to derive actionable insights for decision-making.
- AI Application: The student will learn to apply AI principles and algorithms to address real-world engineering challenges.
- Critical Thinking: The student will develop the ability to evaluate digital and AI solutions critically, considering ethical and societal implications.
- Innovation Integration: The student will acquire skills to integrate digitalization and AI into business models and engineering practices to drive innovation.

1.2 Learning Outcomes

After successfully completing the module "Digital Thinking: Exploring Digitalization and Artificial Intelligence," students are able to demonstrate the following competencies, skills, and knowledge:

1.2.1 Competencies

A- Specific Competences (related to the core unit)

Code	Competence Description
A1	Ability to explain and apply digitalization concepts to transform engineering processes and business models.
A2	Capacity to analyze and interpret data using analytics tools to inform engineering decisions.
A3	Ability to implement AI algorithms and techniques to solve engineering problems.
A4	Capability to evaluate the ethical and societal impacts of digitalization and AI applications.
A5	Ability to integrate digital and AI-driven solutions into innovative engineering practices and business strategies.

B – Basic Engineering Competences

Code	Competence Description
B1	Understand and apply fundamental principles of digitalization and AI in engineering contexts.
B2	Use appropriate digital tools and platforms for data collection, storage, and analysis.
B3	Develop and interpret visualizations to communicate data insights effectively.

Code	Competence Description
B4	Demonstrate awareness of ethical considerations in the deployment of digital and AI technologies.
B5	Apply problem-solving skills to address challenges in digital transformation and AI implementation.
B6	Understand the role of data-driven decision-making in optimizing engineering processes.
B7	Identify barriers to digitalization and propose strategies to overcome them.
B8	Collaborate in interdisciplinary teams to design and implement digital and AI-driven solutions.
B9	Select suitable digital tools for synchronous and asynchronous collaboration in engineering projects.

C – Transversal Competences

Code	Competence Description
C1	Communicate complex digital and AI concepts clearly in team and stakeholder settings.
C2	Adapt digital and AI solutions to diverse engineering and business contexts.
C3	Provide and receive constructive feedback to enhance digital and AI project outcomes.
C4	Reflect critically on personal and team approaches to digitalization and AI adoption.
C5	Contribute to inclusive and ethical innovation in digital and AI-driven environments.

1.2.2 Knowledge

By the end of the module, students will have gained an understanding of:

- Fundamental principles of digitalization, including digitization, digital communication, and digital platforms.

- Core concepts of AI, including machine learning, deep learning, and types of learning algorithms (supervised, unsupervised, reinforcement).
- The role of data in digital transformation, including types of data (structured vs. unstructured) and data analytics processes.
- Tools and techniques for data visualization and interpretation to communicate insights effectively.
- Ethical and societal implications of digitalization and AI, including bias, privacy, and job displacement.
- Emerging digital technologies (e.g., IoT, blockchain, quantum computing) and their potential impact on engineering.
- Strategies for integrating digitalization and AI into business models and engineering practices.
- The importance of critical thinking and data-driven decision-making in the digital age.

1.2.3 Skills

Skill Description	Related Competences
Apply digitalization concepts to enhance engineering processes and business models	A1, B1, C2
Collect, manage, and analyze data using appropriate tools (e.g., Excel, Tableau, Python)	A2, B2, B6
Implement AI algorithms to address engineering challenges	A3, B5, B8
Create and interpret data visualizations to communicate insights effectively	A2, B3, C1
Evaluate ethical and societal implications of digital and AI solutions	A4, B4, C5
Collaborate within teams to design and implement digital and AI-driven solutions	A5, B8, C1, C3
Adapt digital and AI approaches based on context and feedback	B7, C2, C4
Reflect critically on personal and team contributions to digitalization and AI projects	A4, B9, C4, C5

1.3 Evaluation Criteria

Assessment in this module focuses on how well students can apply digitalization and AI principles in engineering contexts, both individually and collaboratively. The evaluation encourages practical application, critical reflection, and peer feedback as part of a continuous learning process.

- **Total: 100%**

The evaluation is divided into three complementary components:

1.3.1 Continuous Assessment – 20%

Ongoing engagement in class activities and group work.

Includes:

- Active participation in discussions, simulations, and hands-on exercises.
- Completion of preparatory tasks and micro-assignments (e.g., data analysis tasks, AI algorithm simulations).
- Peer-to-peer feedback tasks.

Assessed Competences: A4, B1, B8, C1, C3

Assessment Tools: Observation rubric, participation log

1.3.2 Group Project – 30%

Small teams (3–5 students) prepare and deliver a mini-project demonstrating the application of digitalization and AI to solve an engineering problem.

Includes:

- Development of a solution using digital tools and AI techniques (e.g., data analytics, machine learning model).
- Presentation of findings with visualizations (e.g., charts, dashboards).
- Team collaboration and integration of peer feedback.

Assessed Competences: A1, A2, A3, B2, B5, B9, C2, C5

Assessment Tools: Project evaluation rubric, peer feedback form

1.3.3 Final Individual Output – 50%

Each student submits an individual portfolio, including:

- 1 analytical report (e.g., data analysis summary or AI application case study).
- 1 visualization item (e.g., dashboard, infographic).
- 1 reflection (written or recorded) on personal learning and areas for improvement in digital and AI skills.

Includes:

- Demonstration of data analysis and AI application skills.

- Integration of visualizations and critical evaluation.
- Self-reflection based on feedback received.

Assessed Competences: A1, A2, A4, B3, B4, B6, C4

Assessment Tools: Scoring rubric, self-assessment questionnaire

Additional Notes:

- All assessment instruments are aligned with the **CEDE Evaluation Toolkit.**
- Rubrics ensure transparency and comparability across evaluators.
- Optional bonus points (up to +5%) may be awarded for outstanding creativity or innovative application of digital/AI solutions.

1.4 Pedagogical Methods

The module employs active, learner-centered teaching methods designed to develop both technical and transversal skills in digitalization and AI. These pedagogical approaches promote experiential learning, collaboration, and critical reflection, aligning with the constructivist principles of the CEDE Learning Model.

1.4.1 Interactive Lectures

Short inputs provide theoretical background (e.g., digitalization frameworks, AI algorithms) supported by real-world examples and case studies. These are interspersed with polls, quizzes, and open discussions to stimulate engagement.

Used for: Introducing key concepts, activating prior knowledge.

1.4.2 Role-Play and Simulation

Students simulate real-world scenarios, such as designing a digital transformation strategy or evaluating an AI-driven solution. These activities allow practice in critical thinking, decision-making, and ethical evaluation.

Used for: Developing problem-solving skills, ethical awareness.

Example: "Propose a digital solution for a manufacturing firm facing supply chain inefficiencies."

1.4.3 Peer Teaching and Feedback

Students present data visualizations or AI algorithm outcomes to peers and provide structured feedback using rubrics. This fosters analytical thinking and collaborative learning.

Used for: Reinforcing understanding, feedback literacy.

1.4.4 Visual Thinking and Communication Tools

Students experiment with data visualization tools (e.g., Tableau, Python Matplotlib) and digital platforms to present insights clearly. They learn principles of visual hierarchy and simplification.

Used for: Digital literacy, effective communication.

Example Tools: Tableau, Power BI, Python with Matplotlib.

1.4.5 Reflective Practice

Journaling, self-assessment checklists, and guided reflection questions help students monitor their progress, identify challenges, and internalize feedback.

Used for: Developing metacognition, self-awareness.

Example Prompt: "What was your most significant insight from applying AI in this module?"

1.4.6 Collaborative Problem Solving

Students work in interdisciplinary groups to tackle realistic challenges, such as analyzing a dataset to optimize an engineering process or designing an AI-driven solution.

Used for: Integrating technical and soft skills, fostering adaptability.

1.4.7 Digital and Hybrid Learning Tools

To support blended or remote delivery, instructors can use platforms such as:

- **Jupyter Notebooks** – Interactive coding and data analysis.
- **Mentimeter/Kahoot** – Quizzes and polling.
- **Zoom/Teams** – Group discussions and breakout rooms.
- **Moodle/Google Classroom** – Sharing tasks and portfolios.

2 RECOMMENDED OR REQUIRED READING:

2.1 Basic

- *"The Fourth Industrial Revolution" by Klaus Schwab*, is an overview of key technologies driving the current industrial revolution, including AI and digitalization.
- *"Technical Communication" by Paul V. Anderson, c*overs principles of technical communication, essential for presenting digital and AI insights.
- *"The Visual Display of Quantitative Information" by Edward R. Tufte, e*xplores effective data visualization techniques for engineering and analytics.

2.2 Recommended

- *"AI Superpowers: China, Silicon Valley, and the New World Order" by Kai-Fu Lee*, is an analysis of global AI advancements and their implications.
- **"***Life 3.0: Being Human in the Age of Artificial Intelligence" by Max Tegmark*, this work explores AI's future impact and ethical considerations.
- *"Digital Transformation: Survive and Thrive in an Era of Mass Extinction" by Thomas M. Siebel*, is a Guide for leveraging digital technologies in business and engineering.

- *"Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die" by Eric Siegel*, introduces predictive analytics applications across industries.
- *"Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies is Changing the World" by Don Tapscott and Alex Tapscott*, explores blockchain's potential in digital transformation.

2.3 Online Resources and Journals

- *MIT Technology Review:* Latest news on emerging technologies and their societal impacts.
- *Harvard Business Review – Digital Transformation:* Articles and case studies on digital technology in business.
- *Nature – Artificial Intelligence:* Research papers on AI and machine learning advancements.
- *Coursera and edX:* Online courses on digitalization and AI from top universities.
- *Orange Data Mining Documentation:* A comprehensive guide with examples for exploring and using the Orange Data Mining software.

3 DETAILED CONTENT FOR THE COURSE

Language of the course:

Names of the lectures:

Teaching hours: 30 hours

Mode of delivery: distance, online

Notes:

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1. **Introduction to Digitalization and AI (3h)**
    - Introduction to digitalization: key concepts and components.
    - Historical context and examples across various sectors (e.g., education, healthcare, industry, engineering).
    - The role and impact of Artificial Intelligence (AI) in modern society.
    - Theoretical frameworks for digital transformation (e.g., McKinsey 7S, Kotter's 8-Step).
2. **Digital Mindset, Critical Thinking, and Communication Tools (3h)**
    - Developing critical thinking in the digital age.
    - Overview of supervised learning algorithms.
    - Fundamentals of AI: machine learning vs. deep learning.
3. **Data and Artificial Intelligence in Practice (3h)**
    - Types of data (structured vs. unstructured) and management strategies.
    - Introduction to data analytics and visualization (e.g Orange Data Mining).
    - Hands-on data analysis activities and AI application examples.
4. **Bibliography**