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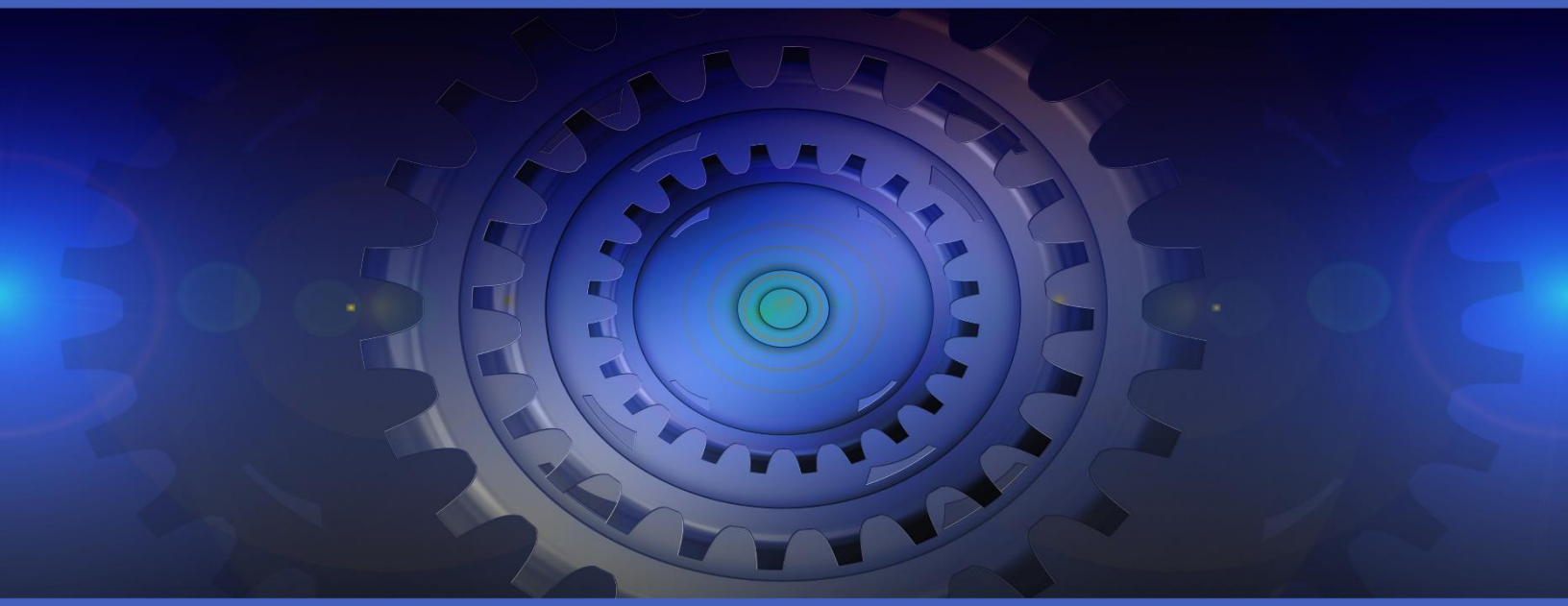
***ASSISTANT** - Challenge Based Learning in Ai Enhanced Digital Transformation Curricular*
No. 2022-1-LT01-KA220-HED-000086555

DIGITAL TRANSFORMATION CURRICULAR DESIGN METHODOLOGY



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METHODOLOGY AND TEMPLATE

(PR1/A1)

FOR **PR1 – DIGITAL TRANSFORMATION CURRICULAR**

R2.1 - Design of a methodology - the aim of this task is to prepare the template and methodology for the Digital transformation curricular design.

ASSISTANT, 2022

Version: 19/12/2022 - draft; 21/02/2023 - v1; 02/03/2023 - v2; 14/04/2023 - v3
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CONTENTS

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Terms dictionary

According to Cambridge dictionary, https://dictionary.cambridge.org/

Curriculum	Relating to the subjects studied in a school, college, etc. and what each subject includes.
Digital Transformation (DT) Program	A set of courses about a digital transformation subject, especially in an educational course or by reading books.
Course	A set of classes or a plan of study on a particular subject, usually leading to an exam or qualification.
Topic	A subject that is discussed, written about, or studied in the course.
Massive open online course (MOOC)	A course of study that is made available over the internet and that can be followed by a large number of people.
Virtual assistant	A computer program or device that is connected to the internet and can understand spoken questions and instructions, designed to help you to make plans, find answers to questions, etc.
Chatbot	A computer program designed to have a conversation with a human being, especially over the internet.
Big data	A very large set of data that is produced by people using the internet, and that can only be stored, understood, and used with the help of special tools and methods.
Internet of things	Objects with computing devices in them that are able to connect to each other and exchange data using the internet.
Robotics	The science of making and using robots (= machines controlled by computers that are used to perform jobs automatically).
Distance education	A way of studying in which you do not attend a school, college, or university, but study from where you live, usually being taught and given work to do over the internet.
Artificial intelligence	The study of how to produce machines that have some of the qualities that the human mind has, such as the ability to understand language, recognize pictures, solve problems, and learn.
Challenge Based Learning (CBL)	Provides an efficient and effective framework for learning while solving real-world challenges.

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1. INTRODUCTION

The aim of the document is to design a methodology and requirements for the Digital transformation curricular design.

Digital transformation (DT) has become a mandatory effort for all organizations, as the proliferation of technologies is driving a growing efficiency of business processes. However, such transformation can only be done with people, it is not enough to "throw technology" onto the processes: employees must be involved and be a part of the process. Training is needed at two levels: management level, where coordinators redefine and reengineer processes according to business needs and applicable technology; and at execution level, where employees must interact with technology in order to carry out the defined processes in the most efficient way.

The proposed digital transformation curriculum intends to familiarize learners with key subjects: big data, digital education, artificial intelligence, robotics and IoT. Each of these technologies is essential for DT, as they relate to emerging issues in contemporary organizations that drive change and have the potential to transform business models. We briefly describe the associated courses and contextualize them in DT scenarios:

Big Data

The course on "Big Data" provides an overview of the fundamental concepts, tools, and techniques used in the processing, analysis, and visualization of large amounts of data. The course will begin by introducing the concept of big data and its importance in various domains. It covers the basic principles of data management and preprocessing, as well as the latest technologies and tools, including API and web scraping, ETL (extract-transform-load) steps, R programming, and dashboard design.

To provide students with practical experience in big data analytics, the course uses a challenge-based learning approach. Students will seek to develop solutions for real-world big data problems using the latest tools and technologies to solve the micro-challenge. The course also emphasizes the importance of data visualization and storytelling, helping students to communicate their findings effectively to a non-technical audience.

Overall, the course on "Big Data" empowers students with the skills and knowledge necessary to work with large-scale data and leverage it to drive business value and societal impact.

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Digital Education

This course on "Digital Education" covers various topics related to digital education, starting with an introduction to defining digital education and the benefits and challenges associated with it. It covers different learning theories that apply to digital education, online learning strategies, and pedagogical approaches for online teaching. The course also explores digital tools for education such as learning management systems, social media, collaborative tools, interactive multimedia, and artificial intelligence. Students will learn about instructional design principles for digital education, multimedia content creation, and adaptive learning design. The course also focuses on assessing and evaluating online learning programs through different types of assessments, rubrics, and open digital badges. It highlights policies and ethical issues in digital education such as copyright and intellectual property, privacy, security concerns, and accessibility and inclusivity. Finally, the course provides insights into future trends in digital education such as emerging technologies, predictive analytics, learning analytics, microlearning, and gamification.

Problem-based learning (PBL) could be used in this course. Open digital badges are used in a course to support personalized learning providing customized learning pathways for students based on their interests and learning goals. For example, students can earn badges for completing specific modules or units of study, and these badges can be used to unlock additional learning opportunities or resources that align with their interests. Open digital badges can be also used to motivate and engage students in the learning process by recognizing their achievements and progress. Badges can be designed to appeal to different learning paths, styles and preferences, and can be used to encourage students to take ownership of their learning and strive for excellence.

Artificial Intelligence

The growing digitization of society is a reality that we have been witnessing, with the adoption of products and technologies that have transformed our personal lives, revolutionizing our relationship with information and communication. At the organization level, digital transformation is also motivated by the dissemination of several innovative technologies, potentially transforming business. This course addresses the main aspects of Artificial Intelligence (AI) and modern Machine Learning (ML) techniques, with a perspective of the impact on modern organizations, contextualizing them in business and organizational scenarios of digital transformation.

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The course will start by delimiting and defining the concepts of intelligence, AI and ML, followed by an overview of large areas within AI. Problem solving techniques are explored: decision, search, optimization. Knowledge representation, as a key aspect, is introduced, focusing on up-to-date methods. Besides the fundamental concepts of AI, studied since the 60s, recent developments in machine learning/deep learning and natural language processing are introduced, by showing and experimenting with computational systems that are becoming increasingly available.

To develop and consolidate practical skills, challenge-based learning is proposed to the students, with some micro and medium size challenges, founded on real problems, and, if possible, in the context of industry or research partnerships.

Robotics and IoT

The course on IoT and Robotics covers a wide range of topics related to Internet of Things (IoT) and robotics. It provides an introduction to the definition of IoT and robotics, and the benefits and challenges associated with their integration. The course covers different IoT and robotics technologies, their applications in various fields. It also covers the design and development of IoT and robotics systems, including hardware, software, and network architectures, user interfaces and control systems. The course explores the ethical and legal issues related to privacy, security and job displacement. The course also provides insights into future trends in IoT and robotics, such as cobots, swarm robotics, edge computing, autonomous vehicles, and smart cities. The course aims to equip students with the basic knowledge and skills needed to design IoT and robotics systems for simple applications and an overview about its development and implementation.

The program is organized in four courses, corresponding to the subjects described above, with 1.5 ECTS each (~40 hours), and is delivered in a MOOC format: online and open to everyone. Learning resources are open, based on an OER (open educational resources) philosophy. The format of the courses and learning resources allows integration of the courses (or parts thereof) into existing programs in the partners' institutions.

Pedagogical approach is founded on challenge based learning (CBL), and since student support must be kept to a minimum in MOOCs, automated mechanisms are introduced, in particular chatbots, in order to help learners in their learning path.

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In this document we describe the methodology for designing and developing the curriculum and each individual course in the Digital transformation study programme, as well as provide a template for the DT program and course descriptions.

We are planning innovative solutions for developing and implementing DT curriculum to be described below: (i) MOOCs methodology main issues, (ii) challenge based learning, (iii) virtual assistance.

(i) MOOCs methodology main issues

According to the Cambridge dictionary "A massive open online course (MOOC) is a course of study that is made available over the internet and that can be followed by a large number of people".

Massive open online courses (MOOCs) have been prominent since the early 2010s, assuming two main approaches: cMOOC, or connectivist MOOCs, and xMOOC (extended MOOCs). cMOOCs were proposed by Stephen Downes [2], focusing on connections among learners, being community based. On the other hand, xMOOCs relate to more traditional online course delivery, with a rigid structure and aimed at large numbers of students.

Several specific aspects related with the content to be designed according to the MOOC conception need to be defined.

MOOCs suggest very different pedagogical and technological models as well as various kinds of content: course material, readings, problem sets and place for communication such as interactive user forums for communication in a community of students, professors or teaching assistants, different tests and assignments [7]. Variations and particular models of the MOOC concept have been proposed, promoting pedagogical approaches, such as iMOOC [3], which addresses student-centered learning in a context of interaction in an open social context. MOOCs have been used mostly as stand-alone online courses without credits. However, some researchers, teachers, colleges, and universities have attempted to utilize MOOCs in blended format in traditional classroom settings. This paper reviews some recent experiments in the context of current trends in MOOCs by examining methodologies utilized in blended MOOCs in a face-to-face environment [6].

There are several general recommendations for MOOCs design. At the time when the course is designed, the platform should offer the possibility of uploading documents and video lectures (hosted in YouTube and afterwards linked to the platform) as the main learning resources, structuring the course (fig. 1). In addition, the platform should offer the possibility of adding multiple choice tests and peer-review assignments as assessment activities. There should also be built-in social tools supported

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by the platform and aimed at fostering students' participation and collaboration: a Questions & Answers (Q&A) tool, and a forum [1].

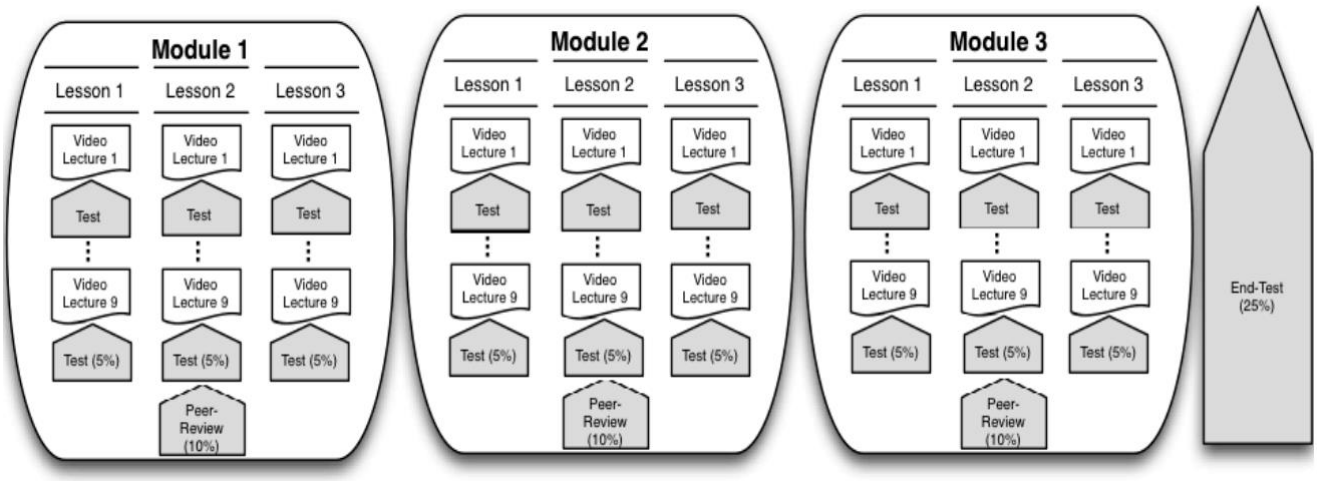

Fig. 1. Structure of the course, including video lectures, formative tests (not taken into account to calculate students' scores), summative tests and peer-review activities [1].

There are several quality factors directly related to the quality of MOOCs. This definition reduces Open Education not only on the open access but also includes further legal dimensions such as open licensing and open availability as well as operational dimensions such as open resources, open technologies and open standards as well as visionary dimensions such as open methodologies, open recognition and open innovations [8].

Quality of MOOCs is a subject of discussion, as phenomena such as high drop-out and non-completion rates are prominent.

(ii) Challenge based learning (CBL)

Challenge-Based Learning (CBL) provides an efficient and effective framework for learning while solving real-world challenges.

The application of CBL has increased in higher education institutions, fostering student transversal competencies, knowledge of sociotechnical problems, and collaboration with industry and community actors. However, a broad range of different frameworks, hybrid approaches, and educational interventions are using this term to define their approach [4]. Moreover, a challenge-based learning experience is a learning experience where the learning takes place through the identification, analysis and design of a solution to a sociotechnical problem. The learning experience is typically

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multidisciplinary, takes place in an international context and aims to find a collaboratively developed solution, which is environmentally, socially and economically sustainable [4].

Industry and community collaboration are also identified by institutions in strategic goals and research funding applications. Improving the link between academia and industry is crucial for the advancement of knowledge, innovation in design and development, and providing solutions to transdisciplinary societal problems (Trinity College Dublin [9]).

Both formative and summative assessment are used within CBL approaches, including workshop attendance and participation, oral presentations, hackathons, peer evaluations, conference paper reports, laboratory reports, open book exams, quizzes and progress reports can be used for assessment process implementation and assessment rubrics to be used to assess student performance.

Given the wide variability of CBL approaches, a conceptual framework (fig. 2) could be used to support CBL implementation and ensure that if CBL is being used, each of these characteristics are embedded, in some way, within the design. Ultimately, this framework may help standardization of the CBL term, currently lacking within teaching and academia and could be augmented in the future as CBL evolves.

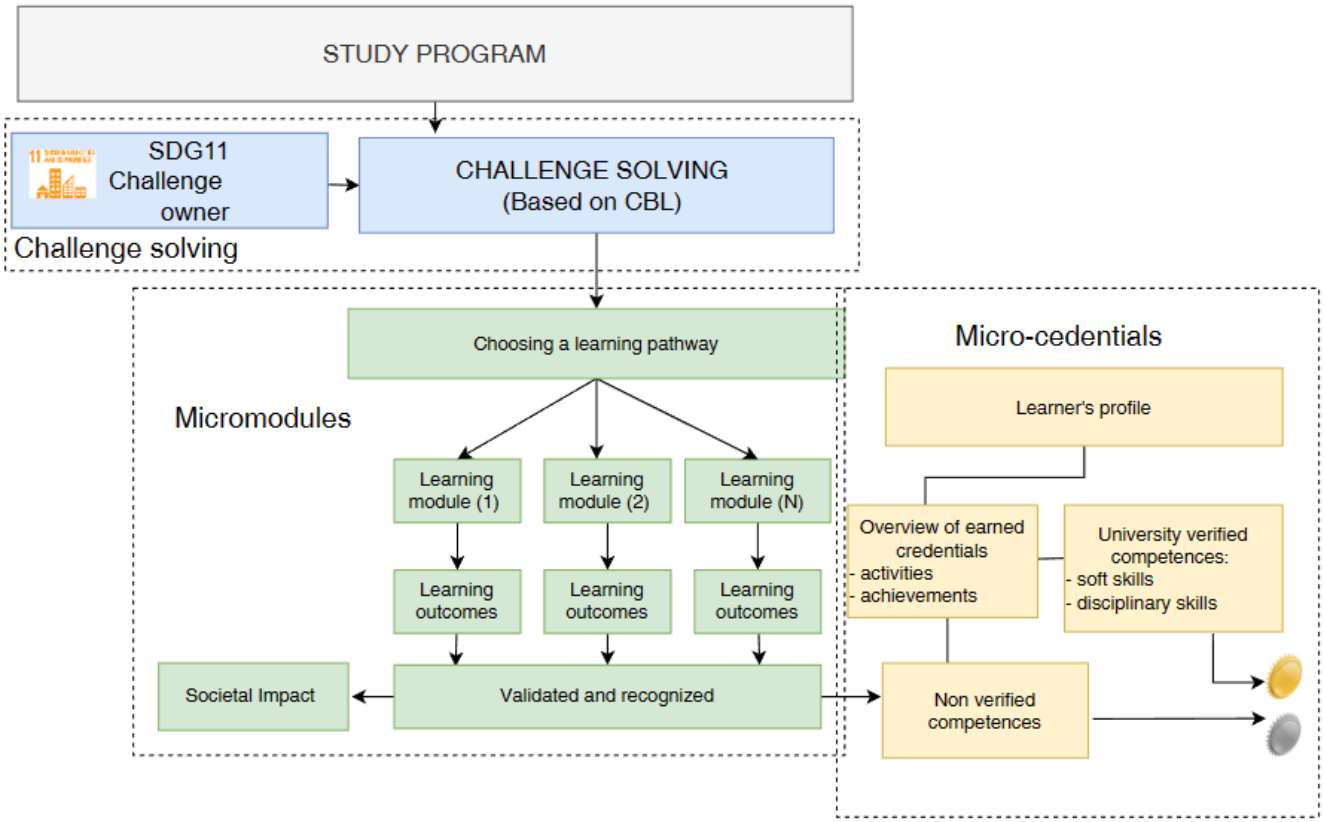

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Fig. 2. CBL in engineering education [5].

Global themes, real-world challenges, collaboration, technology, flexibility, multidisciplinary and discipline specificity, challenge definition, and creativity and innovation are the most common emerging themes from exploring CBL research definitions. Although there is variance between CBL practical approaches, these key themes were present in most research reviewed. However, what is notable is the lack of practical implementation of some themes described by the studies, such as multidisciplinary teaching. For example, the majority of CBL projects within higher level institutions were delivered to STEM students, even though CBL at its core is a multidisciplinary pedagogy. Using challenge-based teaching in non-STEM higher level courses appears to be a significant gap in the research and future should consider exploring multiple disciplines in the design, analysis and evaluation of CBL [4].

(iii) Virtual assistance

Virtual assistance plays a significant role in online education, providing support and guidance to students who are studying remotely. However, there are several challenges associated with virtual assistance in the online course context, including:

- *Technical difficulties:* Technical issues, such as slow response times, connectivity problems, and software malfunctions, can disrupt the virtual assistance experience and hinder student learning.
- *Lack of personal interaction:* In virtual assistance, the lack of personal interaction can make it difficult for students to build relationships with their instructors or receive the support they need. This can also make it harder for instructors to understand students' individual needs and challenges.
- *Quality control:* Ensuring the quality of virtual assistance can be difficult in an online course context, as there is often less direct supervision and less opportunity for real-time feedback.
- *Limited scope of services:* Virtual assistance in an online course may have limitations in terms of the type of support it can provide, such as not being able to provide hands-on demonstrations or in-person consultations.
- *Limited access to resources:* In some online courses, students may have limited access to resources, such as library materials or technology, which can impact their ability to receive virtual assistance effectively.

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- *Language barriers:* For students who speak a different language or are not fluent in the language of the virtual assistance service, language barriers can be a significant challenge.
- *Security and privacy concerns:* With virtual assistance in an online course, sensitive student information, such as personal and financial details, is often exchanged over the internet, which raises concerns about data privacy and security.

The use of chatbots to provide virtual assistance is a solution for providing virtual assistance in an automatic way, for instance to: support learning, assist students in administrative and campus issues, and mentoring [10]. In the Digital Transformation curriculum, several types of chatbots will be proposed, associated with the courses.

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2. METHODOLOGY

Each course must be designed to work in the framework of the DT curriculum, as well as separately. The design of the courses must always take into account that they follow an open online format, with CBL approach, and automated support mechanisms (chatbots).

Following steps are recommended, in articulation with the filling of the template presented in the next section.

- **Establish general goals for the course** - briefly describe the course and its objectives, as well as its place in the scope of DT curriculum;
- **Define course contents** - list every topic/lesson that is given in the course (5 to 10 topics), and its proper sequence;
- **Establish competencies and learning outcomes for each topic** - describe detailed learning outcomes and competencies to be acquired, drilling down from the main objectives described in step 1;
- **Define methodology and learning approach** - describe challenge based approach and its implementation connected to each learning outcome; also include other complementary approaches (self study, group discussions, lab practice, etc.);
- **Select and/or produce learning resources** - for each topic, select existing resources (appropriately licensed), or plan the production of own materials; focus on multimedia materials (especially videos), suitable for self-paced learning and following the technical guidelines in section 4;
- **Design educational activities** - plan and design online learning activities, according to the learning outcomes and the pedagogical approach(es); design challenge-based activities drawn from or applicable to real contexts;
- **Define support modes** - define ways to support students in their learning process, with emphasis on automated mechanisms, particularly chatbots;
- **Define assessment instruments** - plan and design online assessment activities, with focus on self-assessment (quizzes) and peer assessment; guided questions related to CBL;
- **Integrate** digital certificates/badges
- **Create Learning Plan** - draw a calendar for topics and activities; for each activity, give a brief description and what the student is expected to do; the full learning plan must be shared with students at the beginning of the course.

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TEMPLATE(s)

The design methodology described above must provide information for a template on the program [see annex B] and each course [see annex A].

For each course, a template should be filled out with a description of the main aspects, including title, synopsis, objectives and other information:

- **Course title**
- **Teacher / Author / Institution**
- **Language(s)**: English and project partners languages (may be automatically translated)
- **Synopsis**: 1 or 2 paragraphs
- **Keywords**: up to 5 keywords representative of the course contents
- **Calendar, working hours**: 40 working hours recommended
- **Contents**: list of topics/subtopics of the course
- **Objectives/competences**
- **Learning methodology**: standard description of CBL and other learning strategies
- **Resources**
- **Challenges list**
- **Virtual assistant/chatbot purpose**
- **Assessment/practical assignments**
- **Bibliography**

The template itself is presented in annex A, and can be extracted as a separate document, filled out accordingly.

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3. TECHNICAL SPECIFICATIONS

Learning resources for the DT curriculum must follow minimum specifications, in order to guarantee the contents' technical quality. Those specifications are described below, for each type of resource.

Documents

Document-based resources, even though they can be delivered to students in PDF format or provide contents for authoring tools described below, must be produced in editable format, in order to facilitate translation and adaptation:

- .docx – for e-book learning material
- .pptx – for presentations, animations or video production

Hypertext

The quality of hypertext (HTML) content depends on uniformity and coherence in text formatting, clear and accessible language and the proper use of other elements (images, tables, mathematical expressions). The application of the following best practices are recommended:

- Use styles instead of direct formatting. E.g. applying the defined styles for the title, multi-level headings, paragraph text, etc., instead of explicitly indicating the font, size or color;
- Avoid direct copying of content from word processors, as they usually contain HTML tags that are not suitable for presentation in a browser and make subsequent changes difficult. In these cases, it is recommended to copy only the text ("copy/paste as text") and later apply the tags using the platform's visual editor;
- Texts that include tables, mathematical expressions, multimedia elements, etc., use their own tags that make subsequent editing difficult in a visual editor, and the repeated updating of these contents should be minimized. If there is a need for frequent changes, consideration should be given to separating them into components (e.g. an HTML component for the frame text, another HTML component for the table).

The use of the Markdown1 notation is a good alternative to using full HTML tagging or the visual editor for formatting, with the additional advantages of maintainability and portability.

[1] https://docs.moodle.org/401/en/Markdown

Images

Static images illustrate the text, clarifying and complementing the exposition. As such, special care must be taken in the quality of its presentation, with the application of the following good practices:

- Use images with the appropriate size and resolution for the intended effect, not exceeding 500 px in width, and a resolution of about 72 PPI (Pixels Per Inch). This is the recommended resolution for images that are downloaded from the internet;
- Use images with a maximum size of 500KB and do not include too many images on the same page, thus keeping page load times within acceptable values;
- Depending on the type of image, use the JPG format (for photographs, as it optimizes the relationship between image quality and file size), PNG (for layouts, graphics, etc., as it reduces the file size without loss of information) or SVG (vector images, which do not lose quality when enlarged, ideal, for example, for maps);
- If you need to provide access to larger or better resolution images, in addition to a thumbnail image, immediately visible on the course page, provide an enlarged image, with better resolution and use the components available on the platform (e.g. H5P) to enlarge the image to full screen size and better perceive its details;
- Resize images outside the platform using an image editing program.

Audio

Audio content must be in one of the formats MP3, RAW or AAC, with adequate sampling frequency, to guarantee good quality in the perception of sound. It is not recommended to use more than 2 channels (stereo), as they are not reproducible with most equipment. For audio content, therefore, consider the minimum specifications listed in table 1.

Table 1: Audio technical specifications

Format	Bitrate	Frequency	Channels	File type
RAW	128kpbs	44.1 KHz	2	.wav
MP3	128kbps	44.1 KHz	2	.mp3
AAC	128kbps	44.1 KHz	2	.aac

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Video

Video files must be in MP4 format and with HD resolution (minimum) or Full HD (recommended), with appropriate geometry and frequency.

Consider the specifications in table 2:

Table 2. Specifications

Resolution	Format	Aspect ratio	Frames per second	Bitrate
1920x1080 (Full HD)	MP4	16:9	24	5.2Mbps
1280x720 (HD)	MP4	16:9	24	2.2Mbps
1024x768	MP4	4:3	24	2.0Mpbs

Videos must be uploaded to external platforms (Youtube or Vimeo) and embedded in the platform hosting the course. In general, it is not acceptable that a user has to download the entire video file before viewing it.

Videos should have 5-10 minutes maximum duration. Both video and audio resources must be subtitled, not only for the benefit of speakers of other languages, but also for accessibility to deaf and hard of hearing learners. Automatic subtitling and translation tools are available (e.g. within Youtube) that can speed up this otherwise demanding task.

Authoring tools

In order to produce learning resources, some tools with easy interfaces can be used by authors/teachers, allowing them to quickly generate files or embedded contents. Since Moodle is the main learning environment for the courses, the proposed tools have some degree of integration with that platform.

- Moodle itself – it has some built in tools, such as quizzes, as well as surveys, wikis and workshops. Workshops are a suitable tool for peer assessment;

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- H5P – rich media contents and interactive activities can be built through several content types2 provided through Moodle;
- Melibo3 – tool for building chatbots, with natural language processing abilities and machine learning. Authors may define the flow of the conversation and the result is embeddable in Moodle;
- Clipchamp4 – video editing tool, other resources (images, text, audio) can be used to compose an interesting video, that can be uploaded or embedded in the platform;
- Canva5 – tool for building presentations with rich graphic design;
- Genially6 – tool to build interactive presentations with animations and infographics.

Chatbots

Chatbots can enhance the MOOC experience for students by providing quick and convenient support, personalized learning, and interactive elements. They can also save instructors time and improve the efficiency of MOOCs by automating certain tasks and providing instant feedback.

Chatbots can be used to support Massive Open Online Courses (MOOCs) in the following way:

- Student support: Chatbots can answer students' frequently asked questions and provide 24/7 support. They can also assist with course enrollment and technical issues.
- Personalized learning: Chatbots can provide personalized recommendations and guidance based on a student's progress and learning style. They can also help students stay on track by setting reminders and goals.
- Assessment and evaluation: Chatbots can be used to automatically grade quizzes and assignments, freeing up instructors to focus on more important tasks. They can also provide instant feedback to students on their performance.
- Gamification: Chatbots can be used to add a gamified element to MOOCs by providing students with rewards, points, and open digital badges for completing certain tasks or reaching certain milestones.
- Social learning: Chatbots can facilitate discussion and collaboration among students by providing a virtual space for students to connect, share ideas, and ask questions.

[2] https://h5p.org/content-types-and-applications
[3] https://melibo.de
[4]
[5] https://www.canva.com
[6] https://genial.ly

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ANNEX A - Course description template

[Project Logo] [Institution Logo]	**[Course Name]** [Short description]

About this Course			
[Brief synopsis: What's it about...This course discusses...This course provides...This course focuses on….]			
Institution:	[Institution]	**Working Hours:**	40
Subject:		**Contact Hours:**	
Level:		**Language(s):**	
Prerequisites:		**Associated Programs:**	
Keywords:			
Learning Methodology:	[Standard description + specific course approaches]		
Assessment:	[Assessment description/methodology]		
Starting Date:		**End Date:**	

What you'll Learn	
[Discuss...Describe…Discover… (generic description of objectives)]	
Competencies:	
Learning outcomes:	
Syllabus:	

About the Instructor(s)	
Name:	[Instructor Name]
Web Page (URL):	[http://...]

About the Resources	
Bibliography:	
Other Resources:	

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ANNEX B - Program template

Program description - Digital transformation curricular

Training program title	
Description of the training program	[This program aims to fulfill a basic DT curriculum, with courses on…]
General objectives of the program	[1) to increase number of courses in DT…]
Target group	[Students and non formal learners from business and industry…]
Prerequisites	[Basics in IT, …]
ECTS or Hours	[160 h.]
Duration	[16 weeks]
Language(s)	[EN, LT, PT, DE, EE]
Link to the website	[https://www.assistant-erasmus.eu/]
Creators	

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Courses

Title/topic	Study programme module	Duration	Coordinator (Institution)	Authors
Big data	Data analytics and visualization	ECTS/h	KTU	Evaldas Vaičiukynas, Lina Čeponienė, Rita Butkienė
Digital education	Digital education	ECTS/h	TU	Sirje Virkus, Sigrid Mandre, Veronika Rogalevits
Artificial intelligence	Artificial intelligence	ECTS/h	UAb	José Coelho, Vitor Rocio, Henrique São Mamede
Robotics and IoT	Digital Innovation Lab	ECTS/h	FHM	Jochen Dickel, Olga Zubikova

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