FACILITATE-AI

GUIDELINES FOR FACILITATING THE LEARNING OF ARTIFICIAL INTELLIGENCE BY SCHOOL STUDENTS OF GRADES 7-12

RESULT 1

AI TEACHING GUIDE FOR TEACHERS FACILITATING THE LEARNING OF STUDENTS IN GRADES 7-12

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FACILITATE – AI:

Guidelines for facilitating the learning

of Artificial Intelligence (AI) by School Students of Grades 7-12

R1: AI Teaching Guide for teachers facilitating the learning of students in grades 7-12

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Contents

Introduction

The Industry 4.0 determines new challenges and tasks, for the solution of which artificial intelligence (AI) played an increasingly important role (Schwab, 2017). The White Paper on Artificial Intelligence of the European Community (WPAI-EU, 2020) sets out the main directions for its development. According to the document, it is necessary to develop skills needed to work in the field of AI and to adapt the educational systems of all European countries. The report of the Committee on Culture and Education (CULT) in the EU Parliament on the application of AI in education (Tuomi, 2020) makes a thorough analysis of the need to train specialists to develop and apply intelligent approaches in various areas of modern business and services. Based on these strategic documents, some main directions in the application of AI in school education have been identified:

- development of an appropriate curriculum for students from different classes, schools, profiles and professions;
- creating appropriate learning materials;
- training of teachers and facilitators;
- creating an intelligent educational platform.

(K Schwab, 2017), (CIUCCI, M. & GOUARDERES, F., 2020), (Ilkka Tuomi, 2020)

This first **Result** (R1) of the project: "**AI Teaching Guide for teachers facilitating the learning of students in grades 7-12**" produced a guide for the target group teachers to enable them to introduce AI to students of 7-12 grades). The AI Teaching Guide sets the Pedagogical and Learning Framework that describes among others the competences teachers need to acquire and develop in order to successfully facilitate AI learning. Furthermore, the guide includes:

- **National Reports** from each partner country that describes the current situation in relation to AI and education including Best Practices,
- an **AI Curriculum Design and Format**, and
- a set of **Creativity and Learning Plans** that provide teachers with the ideas, knowledge and resources needed to facilitate such activities in the classroom.

Additionally, this Result provides resources and develops the content of a **C1 Training Event** that aims to enable partners' staff to fully comprehend the concept of AI and how it can be best approached in secondary education.

To facilitate the training event, in the context of this Result, partners developed sample AI L&C Plans related to Competences for understanding the concepts of AI and how these can be used in the learning process of the Grades 7-12 in STEAME subjects and beyond determined and developed in the C1 training. The aim of the content for the C1 Training was to support teachers from partner organisations to develop knowledge and skills in preparing AI L&C Plans for schools. The training was organised before the development of L&C plans under R1. The main innovation of R1 is the creation of a model for an AI Learning and Creativity Plan (L&C Plan) that can be used by any teacher of any field to embed AI learning and thinking in their teaching for the best development of competence and skills in the students. To the best of our knowledge such AI L&C Plans did not exist. The need for transnational implementation lies in the need to collect information and explore the current AI in secondary education status to better address the needs of teachers and students at an EU level. Furthermore, the learning activities developed to suit the educational systems and teachers of all partner countries thus increasing the overall transferability of the project.

A C1 STT organized to support the needed training of partners for R1. Elements of C1 content and after their validation through the peer evaluation of the AI L&C Plans were used in a number of modules in the development of FACILITATE-AI Course under R2. The expected impact is the higher competence and skills of the partner participants to formulate the practical method of understanding AI and creating AI L&C Plans for school education and the impact on participants' experts in focus group discussions. The consortium partner participants generated a better expertise in the aims of the project by converging knowledge and competence in AI and Pedagogy together.

Partners collaboratively worked on the following 3 main chapters, as activities and tasks of this Result:

1. PEDAGOGICAL AND LEARNING FRAMEWORK AND NATIONAL REPORTS (R1/A1)

- Task 1: Pedagogical and Learning Framework and National Reports. Partners explored the set of competences that a teacher needs to have acquired/developed to be able to facilitate the introduction of AI in schools. The framework that developed was validated through an online Focus Group (FG) of experts. Each partner invited at least one local expert (education or AI) to the Focus Group.
- Task 2: National Reports with related practices. Partners explored the current status of AI in secondary education at a national level by conducting desk research. The partners explored the level of integration of AI in schools or the elements that were there and will be able to facilitate such an integration in the near future (e.g., teachers' professional development programs, etc.). Furthermore, for each partner country, partners collected at least 5 AI in education practices.

2. DYNAMIC CURRICULUM DESIGN AND FORMAT (R1/A2)

A1/T1 and A1/T2 results formed the basis of an on-line database with AI Curriculum for students ages 16-18. Partners explored how this database will incorporate the element of being dynamic. Meaning that teachers, during the project's implementation period and beyond, will be able to input to the database and play an important role in its continued development and adaptation to the developments of AI in education. It was important to carefully design the operation of the database to be dynamic, considering in parallel how its maximum sustainability can be achieved.

3. LEARNING AND CREATIVITY PLANS (L&C Plans) FOR THE USE BY FACILITATORS OF LEARNING (R1/A3)

Based on R1/A2 partners produced examples of Learning & Creativity (L&C) Plans ready to be used by teachers. As AI has to have an interdisciplinary approach, the L&C Plans were designed to be used by at least two teachers, teaching different STEAME subjects or beyond, in cooperation. After a C1 training activity to help partner participants to understand the AI concepts and how these can be applied through L&C Plans, each partner organization developed at least 2 AI L&C Plans. These AI L&C Plans will be uploaded to the **AI-Education Observatory** which is a part of the platform that will be developed in R3.

1. PEDAGOGICAL AND LEARNING FRAMEWORKS

Executive Summary of National Reports

These European & national reports with the related practices were created as part of a two-year European Commission-funded initiative called “Guidelines for facilitating the learning of Artificial Intelligence (AI) by School Students of Grades 7-12”. The project's goal is to prepare secondary school administrators and teachers to effectively integrate AI in education. To guarantee that the deliverables address current needs, each partner evaluated their country's national literature with the curation by Doukas Schools from the input of all partners. The partner’s countries that contributed to this report are Bulgaria, Cyprus, Greece, Italy, Portugal, and Romania. The report is divided on four parts which are:

- Part A: Level of Integration of AI in Secondary Schools (for Students)
- Part B: Elements facilitating an AI Integration in the near Future (for Teachers)
- Part C: AI in Education Practices
- Part D: Other AI Elements/Initiatives/Practices at National and/or European Level

The main findings are that in the field of education, the use of AI has not yet reached the level of widespread use, but the choice of its adoption by large companies in the field and the research that is done, give the certainty that soon teachers and trainees will see applications in their daily practice. In the European schools there are very few elements in AI with no specific focus, but only on Digital Skills in which it is indirectly included. AI is not identified in the curricula as a distinctive teaching field, but various organisations and schools are promoting activities in the area of robotics in the form of projects and other initiatives.

As far as the future of AI integration in education, there is a variety of AI tools and platforms that can be used for educational purposes along with online courses, MOOCs, training actions/workshops and seminars/webinars for teachers το engage. In addition, numerous AI educational practices and some other more generic AI elements, initiatives and practices were found by project’s partners making AI integration in education in the near future more likely to be a reality.

AI tools and platforms for education

Thousands of start-ups come up every single day based on AI or its AI tools ranging from Siri to auto-journalism. Everything is being operated with the help of AI and ML. And with AI entering all sectors it has also started to transform the educational sector which is traditional in nature. AI tools for education that are intelligent, adaptive, encouraging personalized learning systems are being deployed in all the educational institutions such as schools, colleges, and universities across the globe for analyzing huge amounts of data collected from the students that can significantly impact the lives of students and educators. Some examples of tools that can be used in education are PhotoMath, a free AI math tutoring app, and Seek by iNaturalist, an app which helps to identify species from photographs. Language classes can use Verse by Verse, where students can write a poem with the help of AI and learn about American poets. Social studies and art classes can use Newspaper Navigator, a tool for searching millions of historical newspaper photos, and MuseNet, for exploring and creating music. Moreover, Machine Learning for Kids, Learn about

Artificial Intelligence, COCO Common Objects in Context, Colab and TensorFlow (Google) are some useful examples of AI tools that can be used for educational purposes.

Recommendations for future AI literacy education

The findings of the Conceptualizing AI literacy: An exploratory review present a preliminary overview of empirical research literature on AI literacy studies in the education field. AI becomes a fundamental skill for everyone, not just for computer scientists. In addition to reading, writing, arithmetic, and digital skills, we should add AI to every learner's twenty-first century technological literacy in work settings and everyday life. Inspired by Bloom taxonomy, AI literacy possesses basic competencies to know and understand, use, and apply, as well as evaluate and create AI. People need to equip themselves cognitively for future technological challenges in their workplaces. At the same time, it is important to foster their social responsibility and ethical awareness to use AI for societal good.

Students are not only the end users but potentially be problem-solvers to use AI technologies in different scenarios, or even create possible AI-driven hardware and software solutions to make our society a better place to live in. AI literacy combines the ideas of data science, computational thinking and multi-disciplinary knowledge to interplay AI literacy and AI thinking.

To facilitate educators' teaching, the technological, pedagogical and content knowledge framework needs to be considered to provide a map for understanding how to integrate AI literacy into classrooms effectively. Age-appropriate learning artifacts and curricula need to be designed to scaffold K-12 students' AI conceptual understandings and stimulate their motivation and interest in learning AI. Educators should update their AI knowledge to solve teaching challenges such as knowing and using suitable AI-enhanced technologies such as adaptive learning systems that facilitate their daily teaching practice and management and promote personalized learning to understand students' learning progress and needs.

Future researchers and educators will develop pedagogical strategies (e.g., collaborative project-based learning, gamification) and to increase students' motivation and engagement, promote interaction and collaboration, enhance motivation and attitudes, and develop numerous learning skills in the context of AI literacy. Human-centered considerations are important to raise attention to educate citizens to become socially responsible and ethical users such as inclusiveness, fairness, accountability, transparency, and ethics, instead of merely enhancing students' AI abilities and interests. (Davy Tsz KitNg, Jac Ka Lok Leung, Samuel Kai Wah Chu, & Maggie Shen Qiao, 2023)

Executive Summary of Focus Group

For further investigation of the AI in education a focus group was held. The focus group was based on semi-structured interview questions that investigated key issues in the field of AI integration in education through an inquiry based and evidence-based approach. The focus Group was held on Tuesday, July 26, 2022, with **thirteen participants from different countries**. Participants included engaged instructors, persons with extensive educational background, and AI experts. Their areas of competence varied, encompassing a wide range of school-taught disciplines and AI knowledge. The titles of what was discussed during the meeting of the focus group are the following.

Why introduce AI in Secondary Education, with what objectives?

An important addition to the project's objectives would be to teach students about the ethical issues around AI, for example the AI bias, which can have a big impact in students' life in general. One of the main reasons young students should learn about AI ethics is to become critical consumers of this new technology that they will be unable to "avoid" in the future. They should be prepared for the "AI future" because AI is everywhere in our lives already. It would be also important to relate the AI with project-based learning such as STEAME activities which includes the entrepreneur element too. This could be done not only by IT teachers but also from physics, mathematics, or management teachers too.

Another objective is "*What is intelligence and what are the characteristics that portray it in the human condition?*". It can be a momentum for the understanding of the whole topic of AI and provide the context in which we are expecting digital means to develop and be applied in the future.

What elements/topics/modules for an AI Training can be included

There could be an emphasis on some statistics subjects such as linear concepts because AI involves a lot of data manipulation, and everything is about collecting the right data and analysing them in the right way with the right tools. These can be included in the "basics of AI" module with maybe the addition of some logical programming topics too. A proposal was the first module be the "basics of AI" and the renaming of "AI in our life" to "AI for life". It should be concerned with the level of the modules not to be too sophisticated but be presented in an attractive and popular way e.g., through practical games and game competition. Additionally, a module could focus on machine learning, but the problem is that there is needed linear algebra background knowledge. Perhaps some activities including basic data sets scenarios would be the key to address this matter.

What competences can be developed (for teachers and their students)

Regarding this matter, during the FG, the five agreed upon categories were presented as it would be very difficult to validate the framework online. With this 2-page document AI experts can provide their ideas and comments or/and express their level of agreement for each one of the 43 competences from lowest to highest, or/and suggest a new one. The Framework including Learning Modules is here.

How can AI be introduced, with which methodologies?

Some extra educational methodologies could be the serious games and the design learning (of products and projects for example) and thinking. Furthermore, a relation to huge, real life, technology companies that AI is essential for them - Google, Amazon, etc. - could introduce, engage, and draw student's attention regarding AI. Everyday AI tools can be used too, like face recognition, as practical examples to make AI familiar to students.

Additional recommended platforms, tools, digital content:

- Courses (intel.com)
  Learn AI concepts and follow hands-on exercises with free self-paced courses and on-demand webinars that cover a wide range of AI topics.
- Platform on AI ethics
  The Algorithmic Justice League's mission is to raise awareness about the impacts of AI.

- Teachable Machine
  Teachable Machine is a web-based tool that makes creating machine learning models fast, easy, and accessible to everyone.
- Paint with Machine Learning
  This web app allows you to create a landscape painting in the style of Bob Ross using a deep learning model served using a Spell model server.
- Great example of AI ethics curriculum
  This project seeks to develop an open-source curriculum for middle school students on the topic of artificial intelligence.
- AI in music examples
  Browser-based applications, many of which are implemented with TensorFlow.js for WebGL-accelerated inference.
- Dall-e mini (Craiyon, formerly DALL-E mini)
  AI model generating images from any prompt and AI model drawing images from any prompt.

Additional recommended resources, good practices, activities

- SAS Training: Data Literacy Essentials | SAS
  Fast-paced course follows the journeys of a concerned parent, a small business owner and a public health expert who rely on data to navigate the COVID-19 pandemic.
- Courses (intel.com)
  Learn AI concepts and follow hands-on exercises with free self-paced courses and on-demand webinars that cover a wide range of AI topics.

Ethical issues that should be considered

A computer does what is told to do and that makes it very reliable. AI models which are very successful in predicting patterns for example, most of the time do what they are made to do in contrast with human beings which are making more mistakes even ethical ones. Any type of model that is created in a technological way is less likely to make ethical mistakes.
Additionally, there was a suggestion that students should have a background on ethics in general and prerequisite on other subjects (e.g., mathematics) to transition smoothly to AI ethics. "Bad" examples of AI, like AI bias, can be presented as practical examples to help students understand the issues. A Harvard paper discussing these subjects is: How Ai Fails Us (harvard.edu), that contains the following quotes: (Divya Siddarth, et al., 2021)

When we see "internet of things", let's make it an internet of beings.

When we see "virtual reality," let's make it a shared reality.

When we see "machine learning," let's make it collaborative learning.

When we see "user experience," let's make it about the human experience.

When we hear "the singularity is near," let us remember:

the Plurality is here.

—Audrey Tang, Digital Minister of Taiwan

The expected impact of AI learning and teaching to teachers and students

The impact of AI learning and teaching can originate not only from the point of view of using pure applications, that have as origin the technological developments in the field of AI, but also from the consideration of the prospects of extending it as a tool in broader areas that the humans might need support and conceptions. In this consideration of intelligence, it can also be focused on the ingredients that lead to critical thinking, problem solving, innovation and creativity and thus providing a foundation for further expansion of AI. This requirement from the school students is fundamental because the future citizens must be prepared to be innovative and not just users of the existing creations.

A mission could also be to raise awareness about the impacts of AI, build the voice and choice of the most impacted communities, and stimulate researchers, policy makers, and industry practitioners to mitigate AI harms/biases. An example is to build a movement to shift the AI ecosystem towards equitable and accountable AI. (DR. JOY BUOLAMWINI, 2023)

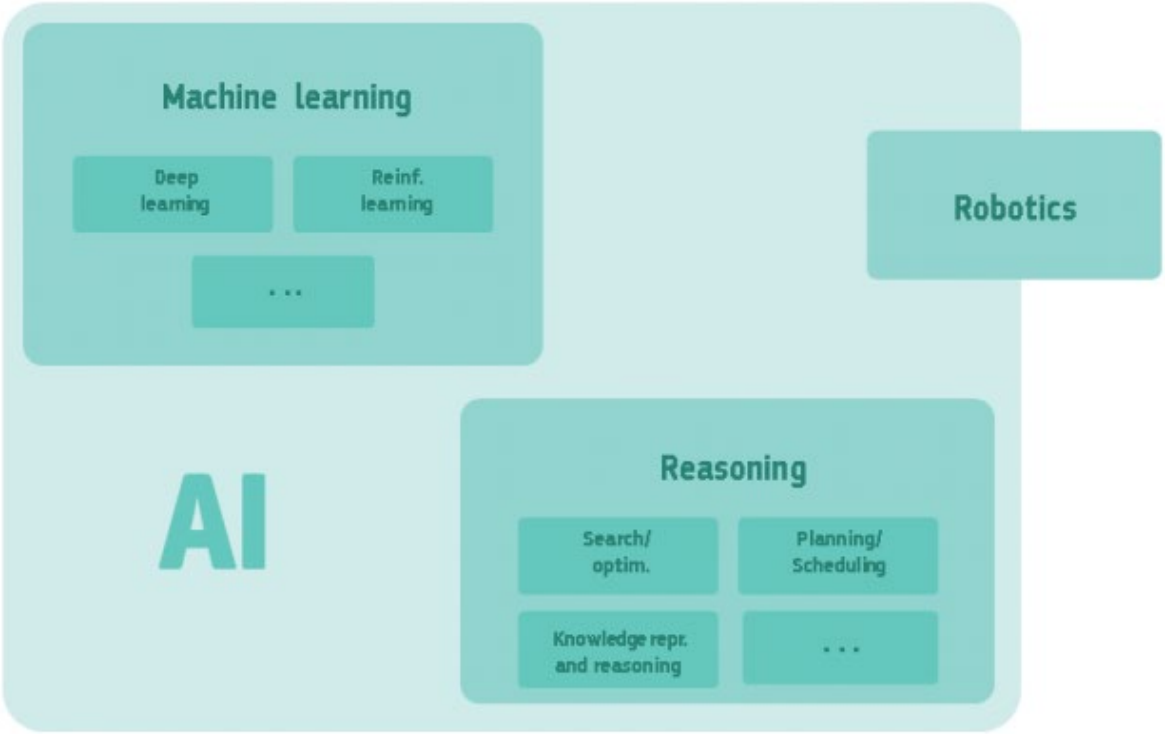
Source: The Algorithmic Justice League

2. DYNAMIC CURRICULUM DESIGN AND FORMAT

Executive Summary of AI Modules - Curriculum

What is AI?

Since there is no agreement among experts over what constitutes AI, this topic is difficult to answer. A computer system that can read and process information, learn, reason, solve problems, forecast outcomes, make decisions, and occasionally even create is referred to as an artificial intelligence (AI) system. Why is it difficult to define AI? According to the High Level Expert Group on AI, the term AI contains an explicit reference to the notion of intelligence. But since intelligence — in people and machines — is a nebulous concept, AI researchers mostly employ the idea of rationality. To accomplish a certain objective, one must be able to select the optimum course of action while taking into consideration the resources at hand and other optimization criteria. (High-Level Expert Group on Artificial Intelligence, 2019)



Source: High Level Expert Group on AI

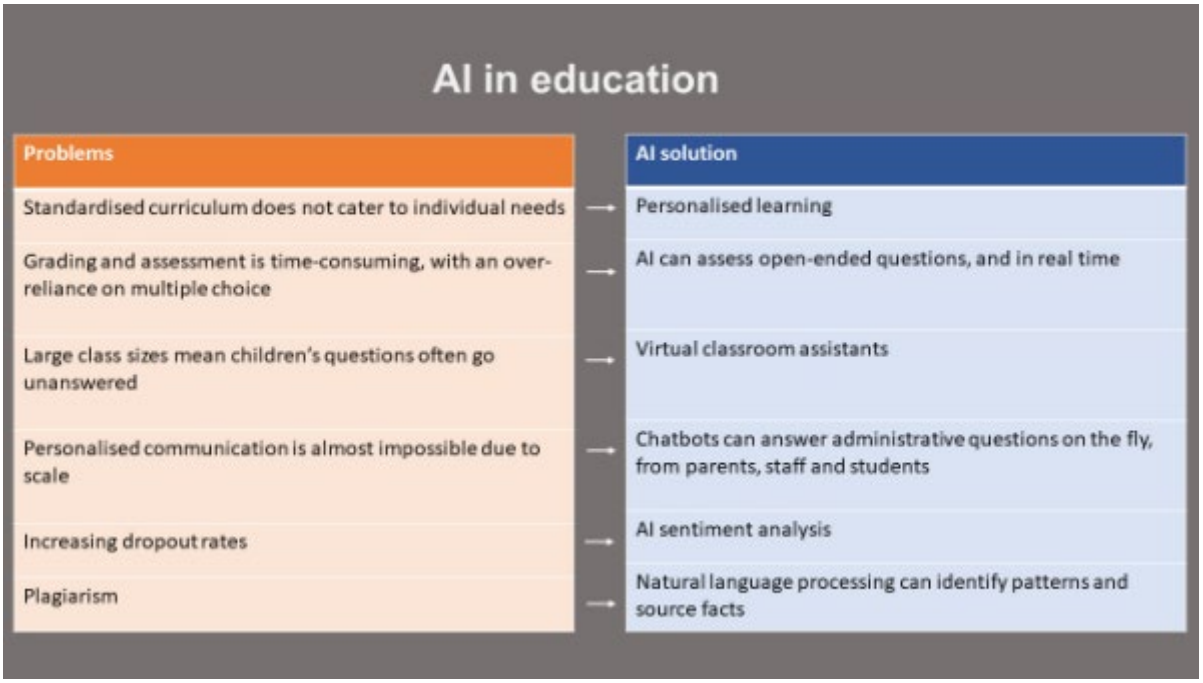
Four more challenging research questions about AI in the educational system are (Davy Tsz KitNg, Jac Ka Lok Leung, Samuel Kai Wah Chu, & Maggie Shen Qiao, 2023) :

1. How do researchers define the term “AI literacy”?
2. How do educators help learners develop AI literacy in terms of learning artefacts, pedagogical approaches and subject matters?
3. How do researchers evaluate students’ AI literacy skills?
4. What are the ethical concerns in the domain of AI literacy?

How can AI be integrated into education and be implemented in the classroom?

There are three following approaches to the implementation of AI in the classroom, depending on the learning objectives according to "How can artificial intelligence be embedded in education?" article (School Education Gateway, 2021):

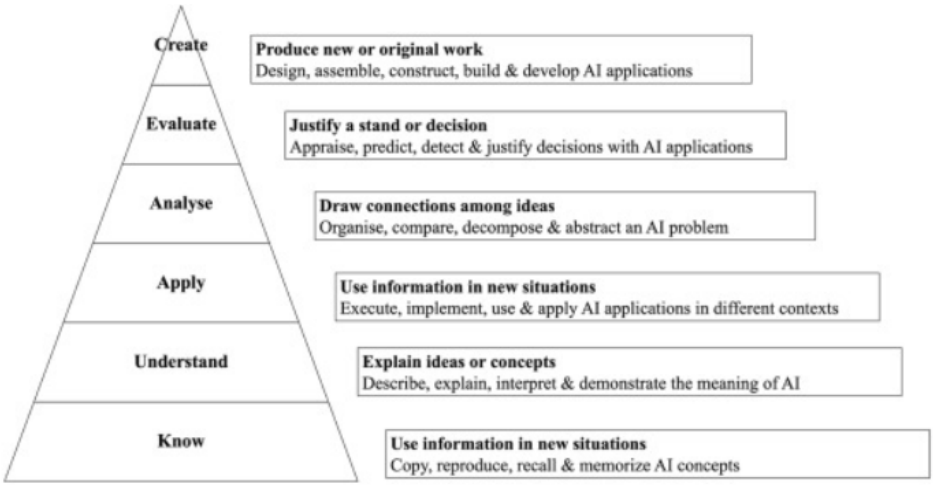
1. Learning with AI, in other words, integrating AI technologies into the classroom to enhance student learning and improve instruction. Although AI tools and technologies are primarily being developed for businesses and industries, there are already several AI tools available to teachers who want to use AI to enhance student learning.
2. Learning for AI, that is, acquiring new skills required for life and work in an AI-shaped world. To unlock the potential of AI and to deal with challenges in an AI-shaped world, students need to be equipped with computational thinking and problem-solving skills, as well as coding and data literacy skills. Code Week can provide teachers with a great variety of teaching and learning resources. (Miles Berry, 2023)
3. Learning AI or applying AI-related skills to effectively use AI and build new AI tools and technologies. Effective and appropriate use of existing AI systems may, for instance, include learning how to use AI systems by attending the AI Basics for Schools MOOC. (Academy, 2023)



Source: School Education Gateway

There are a lot of intriguing applications for AI that hint at how it can change education in the next decades. AI can speed up personalized learning, give students ongoing evaluation and feedback, and use learning analytics to differentiate the learning process so that it is immediately tailored to the needs of each individual student (UNESCO, 2020) By being sensitive to their talents, AI has already demonstrated tremendous potential for aiding pupils with unique needs. Assessment of new skill sets and predictive analysis to decrease dropout rates are two more interesting applications of AI (OECD), as well as improved metacognition and successful group learning. To create a group that is most appropriate for a certain collaborative work, AI collaborative learning assistance uses adaptive group formation, expert facilitation, virtual agents, and intelligent moderation. (Steven Duggan & Terawe Corporation, 2020), (Vincent-Lancrin, S & R. van der Vlies, 2020).

The four aspects of Conceptualizing AI literacy - know and understand AI, use and apply AI, evaluate and create AI and AI ethics – were assigned into the cognitive levels of revised Bloom's Taxonomy (Davy Tsz KitNg, Jac Ka Lok Leung, Samuel Kai Wah Chu, & Maggie Shen Qiao, 2023). “Know and understand AI” is assigned to the bottom two levels; “use and apply AI” in applying concepts and applications is assigned to the apply level “evaluate and create AI'' are assigned to the top three levels to analyse, evaluate, and create AI.



Source: Conceptualizing AI literacy: An exploratory review

Based on this Taxonomy six training modules were proposed in the beginning, but after some changes we concluded in the creation of eight training modules as listed below with their relationship with Bloom’s Taxonomy presented in the parenthesis.

#	Training Modules		Source 1	Source 2	Source 3
1	**AI STEAME models of Learning**	IT-School CY-CyMS			
2	**AI in our life…** *(understand)*	BG-School GR-IASA	Generation AI: Toolkit	Artificial Intelligence In Education (ISTE)	
3	**Basics of AI** *(know)*	BG Univ RO-univ	Generation AI: Toolkit	Artificial Intelligence In Education (ISTE)	An Integrative Framework for AI
4	**Teaching through games competitions – cooperation** *(apply, analyse)*	PT-UNiv BG-Univ GR-IASA	UNESCO Framework	Microsoft Training and events	Generation AI: Teaching Practices
5	**Digital Skills & Data Literacy** *(analyse)*	GR-Doukas CY-CyMS	DigCompEdu Online Testing Tool	Data Literacy Education Framework	Designing Digital Literacy Activities
6	**Building an AI model** *(use/apply)*	GR-IASA PT-Univ GR-Doukas	Cognimates Studio	Data Collection for Machine Learning	
7	**Innovation - Creativity - Entrepreneurship**	RO-Univ IT-School	Intel Skills for Innovation (SFI)	OECD Conceptual Learning Framework	
8	**Ethics about AI**	CY-Univ BG-School	A Guide on Ethics and AI	Ethics of AI in Education	https://www.elevenjournals.com https://www.buckingham.ac.uk

Module 1 - AI-Models of Learning

Introduction and Broad Description of the Context and Goal of the area/topic addressed

The intent of this module is to briefly introduce the classic learning models according to pedagogical theory, and then make a brief mention of the functioning of artificial intelligence and its applications. The second part intends to support teachers to implement PBL related to AI to help teachers who are not AI experts and students to understand what AI is and show some elements of how it works. Show how the human reasoning process that leads to making decisions, such as a decision tree, is the basis of some AI applications, showing how tools that use AI are able to analyze and organize data and use these data to make predictions. This can lead to a transformation in the way of teaching and learning.

Learning objectives and learning outcomes are described on the side of the descriptions of the different activities of this module:

1. To design, plan and implement the use of digital technologies in the different stages of the learning process

2. To use digital technologies to offer timely and targeted guidance and assistance
3. To use digital technologies to foster and enhance learner collaboration
4. To enable learners to use digital technologies as part of collaborative assignments, as a means of enhancing communication, collaboration and collaborative knowledge creation
5. To experiment with and develop new forms and formats for offering guidance and support
6. To use digital technologies to support learners' self- regulated learning i.e. to enable learners to plan, monitor and reflect on their own learning, providing evidence of progress, share insights and come up with creative solutions
7. To ensure accessibility to learning resources and activities, for all learners, including those with special needs.
8. To use digital technologies to address learners' diverse learning needs, by allowing learners to advance at different levels and speeds, and to follow individual learning pathways and objectives.
9. To use digital technologies to foster learners' active and creative engagement with a subject matter.
10. To use digital technologies within pedagogic strategies that foster learners' transversal skills, deep thinking and creative expression.
11. To open up learning to new, real-world contexts, which involve learners themselves in hands-on activities, scientific investigation or complex problem solving

Module 2 - AI for life…

Introduction and Broad Description of the Context and Goal of the area/topic addressed

Global adoption of AI technologies in education is transforming the way we teach and learn. Artificial Intelligence is one of the disruptive techniques to customize the experience of different learning groups - students and teachers. The module "AI in our life… (understand)" is encompassing training units focusing on teachers' understanding of what AI is and in what way it could be implemented in our life.

Learning objectives and learning outcomes are described in the following parts of this module and they are:

1. Industrial Revolution 5.0. What is artificial intelligence (AI)?
2. AI related, areas of knowledge
3. Application of AI (Machine Learning/Data science)
4. What is an AI algorithm?

Module 3 - BASIC AI / AI Fundamentals

Introduction and Broad Description of the Context and Goal of the area/ topic addressed:

This module aims to assist teachers in introducing the fundamental concepts, methods and techniques of classical and modern artificial intelligence. By the end of the module, teachers should be able to identify the basic underlying algorithms in AI and adapt teaching methodologies to introduce students to the basic applications of these theoretical foundations. In addition, the module addresses the issue of ways to represent and process semantic information, as well as the capabilities of Python and the logic programming language Prolog.

The module is organized into 4 main parts:
Part 1- Knowledge Representation, Processing, and Rationing
Part 2 - Logic programming. Introduction in Prolog
Part 3- Searching, planning, and decision-making. A* algorithm
Part 4- Basics of Python programming and AI projects

Learning outcomes and learning objectives

1. To modify and add learning content related to the main basic concepts and algorithms of AI using the most appropriate formats.
2. Create and modify learning content related to knowledge representation, logic programming and Python programming, use relevant examples and real-life situations.
3. Organize and share learning resources
4. To evaluate digital resources related to teaching and to interact through various digital technologies
5. To share data, information and digital content with other participants in the learning process
6. To use digital tools and technologies for collaborative learning processes and to co-create new data, resources and knowledge

Module 4 – Teaching through games

Introduction and Broad Description of the Context and Goal of the area/topic addressed

This module will provide teachers with training concerning how digital games and game elements can be used to intrinsically motivate students while making the learning process more enjoyable and engaging. By the end of the module, teachers should be able to autonomously identify useful games for teaching AI, and to adapt both the teaching methodologies and the contents to this new form of teaching. The module will also address the issue of competition vs. cooperation, and how students may be differently motivated by them.

The module is organized into 4 main parts:
1. Gamification & AI: basic concepts and taxonomy
2. Specification of the learning task and identification of suitable digital games
3. Development of digital learning resources and support material
4. Real-time feedback and progress mechanics

Learning objectives and learning outcomes

1. to select, identify and evaluate appropriate learning games for teaching and learning
2. to organize and share the learning resources
3. to evaluate digital resources, connected with teaching through games
4. to select games developed using various AI-technologies and algorithms
5. to interact through a variety of digital technologies
6. to understand appropriate digital communication means for a given context
7. to share data, information and digital content with other participants in the learning process through appropriate digital technologies
8. to use digital tools and technologies for collaborative learning processes, and for co-creation of new data, resources and knowledge
9. to use game elements to motivate students to participate in the learning process
10. to stimulate interpersonal relationships through collaboration and competition
11. to change and add content according to the requirements of the AI algorithm using the most appropriate formats.

Module 5 - Digital Skills & Data Literacy

Introduction and Broad Description of the Context and Goal of the area/topic addressed:

This module will develop digital skills and literacy on how we can search, select, identify, evaluate, organise, modify existing digital data and resources or create new in an already existing AI environment. The module is divided to the following four parts:

PART 1: Exploratory navigation and process of digital content & datasets for AI environments
PART 2: Processing and co-creation of digital content from trained machine or for training the machine
PART 3: Identifying needs, adapt methodologies and explore AI best practices
PART 4: Analysing, designing, implementing, and evaluating AI activities and projects

Learning objectives and learning outcomes

1. to identify, evaluate, select and structure digital resources for teaching and learning
2. to analyse, modify and sharing existing resources and process it in different formats
3. to process digital material for retrieving information from trained machine or for training the machine
4. to create or co-create new digital educational resources for training the machine
5. to identify technological needs and adapt strategies, educational methodologies, and responses
6. to turn ideas into action, designing, planning, implementing and evaluating activities and projects
7. to select and use digital devices and networks, tools and applications, for any educational
8. to enhance digital relevant activities and practices
9. to ensure continuous professional development

Module 6 - Building an AI model

Introduction and Broad Description of the Context and Goal of the area/ topic addressed:

This module will provide introductory knowledge on how to build an AI model including training, validation and testing tutorials and familiarization with APIs for python coding.

Learning outcomes and learning objectives are described in each of the five following parts of this module:

Part 1- Introduction to Machine Learning
Part 2- Introduction to Neural Networks
Part 3- Machine Learning Algorithms
Part 4- API for python coding
Part 5- Build an AI model example

Module 7 - Innovation - Creativity – Entrepreneurship

Introduction and Broad Description of the Context and Goal of the area/ topic addressed:

This module will provide introductory knowledge on basic aspects on how AI can be used for the innovation management system underpinning the design, and the development of innovative products or services as well as the understanding of its importance in the context of the other activities of business management.

Learning outcomes and learning objectives are described in each of the five following parts of this module:

Part 1- Introduction to AI Innovation
Part 2- Basic roadmap Conducting applied research in AI field, from creative minds to invention and business application (innovation)
Part 3- Basic business-oriented education in AI solutions, show cases
Part 4- Born global Innovation ecosystems, basic understanding regarding the power of cooperation of creative minds
Part 5 - Creation and Development of an innovative Startups, junior achievements pathway
Case study presentation

Learning Objectives

1. Understanding the need for innovation, its role at the company and society level and the strategic framework for innovation
    1.1. Understanding what creativity, invention and innovation in order is to make the difference
    1.2. Understanding the power of cooperation
2. Acquisition of basic knowledge on innovation management at the level company;
3. Knowledge of techniques and methods to stimulate creativity and innovation;
4. Acquiring some basic notions regarding property management intellectuals;
5. Understanding the basics of innovative projects and transfer technological;
6. Mastering the operation of innovation management by identifying leaders, innovative teams and innovative networks;
7. Knowledge of innovation management tools and techniques

Module 8 – AI Ethics

Introduction and Broad Description of the Context and Goal of the area/topic addressed

The development of AI needs to be informed and strongly guided by ethical requirements that would help avoid biases and generally ensure that systems offer fair services to citizens. For this purpose, AI systems need to adhere to several operational and technical requirements of which perhaps the most important is that of transparency. Systems need to be able to explain their decisions by giving in a non-technical language the reasons for their decisions so that they are contestable. The European Union has produced several documents, regulations and preparing the AI Act that aims to regulate these ethical matters.

Learning objectives and learning outcomes are as follows:

1. Understand the factors that create digital social cohesion and exclusion in society.
2. To be aware of the dangers of digital divide and exclusion of sectors of the society
3. To understand how AI can enable the cultural diversity in society
4. To understand the responsibility of using AI systems in a fair and non-discriminatory way.
5. To be aware of the unwanted side-effects that AI systems can have on the individual and societal level
6. To understand the main guidelines of transparency and accountability of systems needed for their ethical certification.
7. To be aware of the EU guidelines and regulations for building AI systems.

AI - Competences Framework for teachers

The European Digital Competence Framework for Citizens, also known as DigComp, offers a tool to improve citizens' digital competence. First published in 2013, DigComp has become a reference for the development and strategic planning of digital competence initiatives both at European and Member State level. The competences areas of the DigComp are the following: (Vuorikari, R., Kluzer, S., & Punie, Y., 2022)

- Competence area 1: Information and data literacy
- Competence area 2: Communication and collaboration
- Competence area 3: Digital content creation
- Competence area 4: Safety
- Competence area 5: Problem solving

The European Framework for the Digital Competence of Educators (DigCompEdu) is a scientifically sound framework describing what it means for educators to be digitally competent. It provides a general reference frame to support the development of educator-specific digital competences in Europe. The six DigCompEdu areas focus on different aspects of educators' professional activities: (Punie, Y. & Redecker, C., 2017)

- Area 1: Professional Engagement
- Area 2: Digital Resources
- Area 3: Teaching and Learning
- Area 4: Assessment
- Area 5: Empowering Learners
- Area 6: Facilitating Learners' Digital Competence

Utilizing these frameworks for digital competences as a starting point, a more specific framework of AI competences - with five areas - for the teachers was created for the project. The competences and the skills involved in each area could be potentially mapped to the cognitive domains in revised Bloom's Taxonomy. Bloom's Taxonomy is an approach to categorize the levels of reasoning skills and ordered thinking required across different learning contexts. There are six levels in the taxonomy, each requiring a higher level of complexity and ordered thinking from the students. The levels are understood to be successive, so that one level must be mastered before the next level can be reached. This model is a classic pedagogical theory that establishes the core foundation of AI taught to young learners.

1.Teaching & Learning (Strategies, Empowering Learners, Assessment)

Teaching

- Acquiring specific transferable achievements
- Adapting accessibility and inclusion
- Adapting differentiation and personalisation

- Adopting new methods of teaching and learning
- Creatively using digital technology
- Eliminating disadvantages
- Enhancing the effectiveness of teaching
- Ensure continuous professional development
- Identifying needs and technological responses
- Interacting through digital technologies
- Using assessment strategies
- Providing feedback to learners

Learning

- Self-regulated learning
- Enhancing the activities for learning
- Actively engaging learners
- Implementing learning plans

2. Information & Digital Literacy (Digital Sources, Digital Creation, Coding)

- Applying algorithms
- Critical navigation
- Developing digital content
- Evaluating information and digital content
- Exploring information and digital content
- Interacting through digital technologies
- Managing data and digital content
- Processing data and digital content

3. Communication & Collaboration (Motivation, Teamwork, Sharing, Promoting)

- Actively engaging learners
- Collaborating through digital technologies
- Communicating computational thinking
- Communicating technology responsively
- Identifying digital gaps
- Interacting through digital technologies
- Sharing through digital technologies

4. Creation & Innovation (Problem Solving, Creative Thinking, Reasoning)

- Actively enabling learners
- Adapting technology to create knowledge

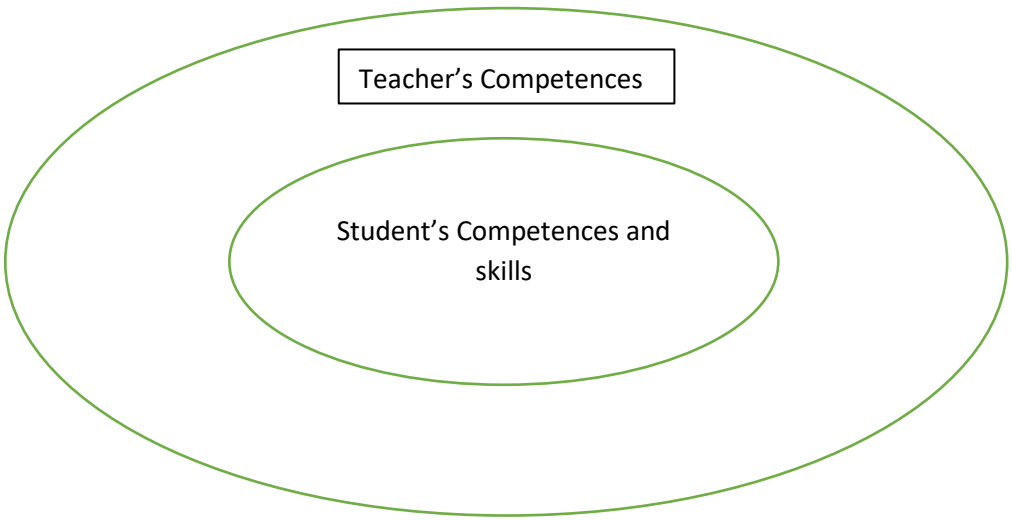
- Creating content responsively
- Creatively using digital technology
- Identifying digital gaps
- Knowledge existing innovation ecosystems
- Knowledge of the strategic framework of innovation
- Proposing creative solutions to problems
- Representation and reasoning
- Solving technical problems
- Using processes for implementing innovation management

5. Emotion & Ethics (Attitudes-Values, Social Emotional Skills, Privacy)

- Awareness of digital division and exclusion
- Awareness of guidelines for ethical systems
- Protecting privacy
- Respecting safety and well-being

AI - Competences Framework for students

A framework of AI competences - with five areas - for the students was created for the project based on the framework of AI competences for the teachers. The competences and the skills in the student's framework are almost the same as in the teacher's framework with the exclusion of the ones that are referring to teaching and managing skills.



1. Learning (Strategies, Empowering Learners, Assessment)

- Self-regulated learning
- Enhancing the activities for learning
- Actively engaging in learning
- Implementing learning plans
- Creatively using & interacting with digital technology
- Acquiring specific achievements

2. Information & Digital Literacy (Digital Sources, Digital Creation, Coding)

- Applying algorithms
- Critical navigation
- Developing digital content
- Evaluating information and digital content
- Exploring information and digital content
- Interacting through digital technologies
- Managing data and digital content
- Processing data and digital content

3. Communication & Collaboration (Motivation, Teamwork, Sharing, Promoting)

Actively engaging learners

- Collaborating through digital technologies
- Communicating computational thinking
- Communicating technology responsively
- Identifying digital gaps
- Interacting through digital technologies
- Sharing through digital technologies

4. Creation & Innovation (Problem Solving, Creative Thinking, Reasoning)

- Adapting technology to create knowledge
- Creating content responsively
- Creatively using digital technology
- Proposing creative solutions to problems
- Representation and reasoning

5. Emotion & Ethics (Attitudes-Values, Social Emotional Skills, Privacy)

- Protecting privacy
- Respecting safety and well-being
- Awareness of machine ethics

3. LEARNING AND CREATIVITY PLANS (L&C Plans Description)

During the development of this Result the Partners of the project created the following 16+1 L&C Plans (an introductory and 2 L&C Plans for the 8 Modules, mentioned at the previous Chapter):

Introductory L&C-Plan: Applications of AI in real world for improving the quality of life (ages 16-18)

In the context of the consideration of this topic, it is going to be useful to include the cooperation of several experts/ teachers covering a broad spectrum of the realms of meaning. Thus, it is suggested to involve a teacher of Sociology/ History, a teacher of Economics, a teacher in the area of STEAM and a teacher of IT. The students are expected to be involved in project activities that will provide the opportunity for philosophical meditation, consideration of ethical and practical questions relating to several applications, as well as the scientific background and technological know-how that forms the backbone of AI. In this process, the students will be required to indulge in identifying various applications of AI in real life and study their effects on various social, economic and political factors that form the term quality of life.

1: AI-Models of Learning

L&C-Plan 1.1: BYOD to improve your study method & boost your school success (ages 15-18)

The five activities allow searching for the right questions, interviewing and uploading data into the system to understand the students' study method and suggest appropriate modifications if necessary.

L&C-Plan 1.2: Guess Who? (ages 15-19)

The project aims at showing how information is classified in relation to a specific discipline or topic, in this example, Art. When we are in the presence of a large amount of data, the AI can classify it as a support in analyzing the information and be of help in making decisions regarding real problems. Students will come to create a riddle game based on topics from their disciplines.

2: AI for Life…

L&C-Plan 2.1: Artificial Gamer (ages 13-16)

The learning activities are meant to illustrate how AI is used in gaming, as computer games are very popular among young adults. Alongside that, students will also understand how the same algorithms are applied in real life, business, and the industry.

L&C-Plan 2.2: AI in STEAME (ages 14-19)

The learning activities are focused on doing and understanding. Students first understand the concept of AI and then use their tech knowledge to present the applications of AI with code. They are divided into teams and tasked with figuring out different ways to use AI in Science, Business, Engineering and Art.

3: BASIC AI and AI Fundamentals

L&C-Plan 3.1: Problem solving scenarios and route-finding applications (ages 16-18)

Students are initially taught together by the IT teacher, who introduces them to the theoretical frameworks of basic AI concepts and problem solving through search. After that, groups of 5-6

students visit a tourist center and study how a particular tourist site can be visited, in what way and by what means roads. Together with the IT and geography teachers, the groups apply different algorithms to generate different routes. In the next stage, the IT teacher presents the A* algorithm to them and the groups of students applying the algorithm by optimizing the previously created routes. They calculate the price of the cost function and suggest the cheapest, fastest, and shortest of the routes. Finally, they present their work.

L&C-Plan 3.2: Prolog in the service of AI (ages 16-18)

Students are initially taught by the IT teacher who introduces them to the representation of knowledge through logical rules and the Prolog language. The students then visit the school library with the literature teacher, where they look up information and discuss the family relationships of the Greek gods, according to "ancient Greek legends and myths". In groups of 5-6 students create different branches of the family tree of the gods. The next activity is for each group to program their family tree in Prolog, ask questions and get correct answers. At the last stage of training, each group presents the results of their work to their classmates, teachers, students and parents.

4: Teaching through games

L&C-Plan 4.1: Build the best, destroy the rest! (ages 14-18)

Students will learn about the structure of a dataset and the data collection process, and how a Machine Learning model can be trained, evaluated, and used in production to automate a decision-making process, while using a programming game.

L&C-Plan 4.2: Image Classification – Find the zombies (ages 14-18)

Students will learn about the structure of an image-based dataset, the data collection process and how a Machine Learning model can be trained, evaluated, and used to automatically classify images into categories using neural networks in a competition-based activity.

5: Digital Skills & Data Literacy

L&C-Plan 5.1: Image-Sound Recognition and Generation using Datasets (ages 12-15)

How to analyse a dataset. How a computer versus how a human analyses a picture. How computer vision and AI can have an impact in our day-to-day activities. Use face recognition and see its benefits with an interactive game in the classroom. Use image grouping technology in class to see first-hand how it can be a daily useful tool in our hands.

L&C-Plan 5.2: Digital Assistant in Class (ages 12-15)

Digital Assistants (e.g., ChatGPT, Alexa, Siri, Google Assistant) have already been part of our everyday life, so we need to teach & learn from our students the way to use them. Recently a break-through new tool – AI chatbot was presented and it was adopted by Education. Consequently, new educational scenarios were created, while accomplishing the objectives of efficient student learning. The learning plan is based on the collaboration of the Departments of Digital Education & Foreign Languages.

6: Building an AI Model

L&C-Plan 6.1: AI Virtual Doctor (ages 16-18)

Understanding data correlation can be a valuable knowledge for students. Such correlations are present between symptom data and disease diagnosis data. Students can learn the input-output concept of informatics though creating a Virtual Doctor. Most importantly they will be able to use NLP tools for developing a first prototype.

L&C-Plan 6.2: AI Profession Orientation Chatbot (ages 16-18)

Career guidance in the era of the fast-changing employment world is crucial for today's young students. So far, only limited research has been conducted on using artificial intelligence to support guidance across primary and secondary education and professions. This L&C Plan will provide a guide to create an AI chatbot that will help students explore professions that they might be interested in, according to their hard and soft skills and their personality. In this way students will value the importance of using artificial intelligence to support career guidance in education and get familiarized with cognitive intelligence.

7: Innovation - Creativity - Entrepreneurship

L&C-Plan 7.1: AI Innovation – Tools for teaching (ages 13-18)

Students are involved in a simulating innovation process using appropriate tools. The process is followed by the results evaluation. Basic issues and stages of the innovation process are taught, from the formulation of the problem and the goal to the final presentation of the results and conclusions.

L&C-Plan 7.2: Future Skills in AI (ages 16-18)

AI based product design for life asks for skills in robotics, natural language processing, computer vision, data science, modelling, and modern design. The fundamentals AI skills are related to programming languages (Python, R, Julia, C++, C#, Java, JavaScript, Shell, TypeScript, Scala etc.), frameworks (TensorFlow, Pytorch, etc.), data analysis methods and machine learning algorithms (based on linear algebra and statistics), signal processing techniques (required for implementing future extraction in deep learning and computer vision in general), neural networks architectures, service design techniques (like chatbots, expert systems), and cyber security. There are also soft skills to deal with, like: communication and visualization skills, collaboration, critical thinking and problem solving.

8: AI Ethics

L&C-Plan 8.1: What is AI Ethics and Trustworthy AI? (ages 15-17)

What is AI ethics? It's an umbrella term for many things such as moral agency, existential crisis/superintelligence, adherence (or not) to human moral values and trustworthiness. This learning and activity plan asks students to consider timeless ethical questions, diverse perspectives, and even gray areas as they begin to construct their own ideas about how to determine if an AI system is ethically developed, designed, and used. It makes the fundamental assumption that ethical AI is a shared responsibility. The two main activities are mainly based on the set of 7 key requirements of the "Ethics guidelines for trustworthy AI" presented by the High-Level Expert Group on Artificial Intelligence, set by the European Commission and the resources of the Erasmus+ project "Trustworthy AI".

L&C-Plan 8.2: Who is in Control? (ages 15-17)

Recognize that, using personal information gathered online, Artificially Intelligent algorithms and applications create profiles of individuals or groups of people who share characteristics (such as age, grade level, or club membership) in order to predict what online information - in the form of advertisements, search results, videos, or other information - people in these groups will find interesting or hold certain beliefs. The main methods used for this fall under the area of Machine Learning in AI A major problem with this process is that it can trap people in their current interests. It becomes an obstacle in opening up new interests.

Bibliography

Academy, E. S. (2023). *European Schoolnet Academy*. Retrieved from https://www.europeanschoolnetacademy.eu/courses/course-v1:CodeWeek+AI+2021/course/

CIUCCI, M., & GOUARDERES, F. (2020). *The White Paper on Artificial Intelligence, EPRS: European Parliamentary Research Service.* EU Commission.

Davy Tsz KitNg, Jac Ka Lok Leung, Samuel Kai Wah Chu, & Maggie Shen Qiao. (2023). Conceptualizing AI literacy: An exploratory review. *Computers & Education: Artificial Intelligence*.

Divya Siddarth, Daron Acemoglu, Danielle Allen, Kate Crawford, James Evans, Michael Jordan, & E. Glen Weyl. (2021). How AI Fails Us. *JUSTICE, HEALTH, AND DEMOCRACY IMPACT INITIATIVE &*.

DR. JOY BUOLAMWINI. (2023). *The Algorithmic Justice League*. Retrieved from The Algorithmic Justice League: https://www.ajl.org/

High-Level Expert Group on Artificial Intelligence. (2019). *A definition of Artificial Intelligence: main capabilities and scientific disciplines.* Brussels: INDEPENDENT HIGH-LEVEL EXPERT GROUP ON ARTIFICIAL INTELLIGENCE SET UP BY THE EUROPEAN COMMISSION.

Ilkka Tuomi. (2020). *Research for CULT Committee - The use of Artificial Intelligence (AI).*

K Schwab. (2017). *The fourth industrial revolution.* Crown Business.

Miles Berry. (2023). *Computational thinking and problem solving*. Retrieved from CodeWeek: https://codeweek.eu/training/computational-thinking-and-problem-solving

Punie, Y., & Redecker, C. (2017). *European Framework for the Digital Competence of Educators: DigCompEdu.* Luxembourg: Publications Office of the European Union.

School Education Gateway. (2021). *School Education Gateway*. Retrieved from https://www.schooleducationgateway.eu/en/pub/resources/tutorials/ai-in-education-tutorial.htm

Steven Duggan, & Terawe Corporation. (2020). AI in Education: *UNESCO Institute for Information Technologies in Education*.

Vincent-Lancrin, S, & R. van der Vlies. (2020). Trustworthy artificial intelligence (AI) in education: Promises and challenges. *OECD Education Working Papers, No. 218*.

Vuorikari, R., Kluzer, S., & Punie, Y. (2022). *DigComp 2.2: The Digital Competence Framework for Citizens - With new examples of knowledge, skills and attitudes.* Luxembourg: Publications Office of the European Union.

ANNEX 1 - EUROPEAN & NATIONAL REPORTS WITH RELATED PRACTICES

PART A: Level of Integration of AI in Secondary Schools (for Students)

Bulgaria

The level of Integration of AI in Secondary Schools as formal education for Bulgaria is synopsized by:

- The National Programme "Information and Communication Technologies (ICT) in the SYSTEM OF Pre-School and School Education" 2021 which comprises a set of activities to provide modern means of access to educational resources and training in the school education system, as well as sustainable development of the supporting educational network infrastructure with possibility of future expansion and phased coverage of each educational institution.

- The formal training in profiled classes in AI which is conducted from the academic year 2019-2020 at the Mathematical High School in Plovdiv. In 2021, experimental training began in vocational classes in the specialty "AI Programming" in vocational high schools in Varna and Burgas.

- Furthermore, for the new 2022-23 school year, admission has been announced in the specialty "AI Programming" in 7 high schools with admission after 7th grade.

As far as informal education is considered, in several schools it was introduced as an elective profiled discipline "Artificial Intelligence" for students in profiled classes "Software and Hardware Sciences". In the last two years, interest clubs in the field of Artificial Intelligence have been experimentally established, as well as robotics clubs in many secondary schools in Bulgaria. Development of a network of vocational schools with a focus on high technology (high-tech vocational schools) in close cooperation with business and higher education within the regional education ecosystem to create a critical mass of professionals and trained candidate students.

Cyprus

In the Cypriot schools (primary and secondary), presently, there are very few elements in the area of AI. But, in line with the decisions of the European Council, the following actions are in the planning of the Education system:

- Promotion of policies that will release resources in order to upgrade school equipment for the development of digital education. This means hardware, infrastructure, connectivity and software improvements, and the connection of Public Schools of all levels with high-speed networks.

- Promotion of academic and/or research projects at transnational level aimed at promoting research and innovation in the field of AI.
- Organization of Competitions at European level that will aim at the development of the interest and the involvement of the European Student Community with AI issues

Various organisations and schools are promoting activities in the area of robotics in the form of projects and other activities. Among these the Cyprus Computer Society has announced a competition on robotics.

There is only reference to the area on occasional cases e.g., in the context of projects in such areas as robotics and so on. Also depending on the initiative of the teacher there are suggestions for consideration of some areas of AI, through references or projects.

Greece

The following summarizes Greece's level of integration of AI into secondary schools providing formal education:

1. **Teaching Artificial Intelligence in Primary, Secondary and Post-Secondary Public Education in Greece**

"According to CEDEFOP's European Skills Index, Greece ranks last with 17% (with an EU average of 66%) in terms of skills matching, lagging significantly behind in terms of skills development. So, the proposals refer to digital skills development, always in line with AI as well as training activities at every level of Primary and Secondary Education."

0. Artificial intelligence in the field of education

In the field of education, the use of AI has not yet reached the level of widespread use, but the choice of its adoption by large companies in the field and the research that is done, give the certainty that soon (and perhaps much earlier than we would expect) teachers and trainees will see applications in their daily practice. Closer to implementation seems to be the automatic production of exam material, where, by providing a "body" of books, notes, presentations and giving some guidelines, a number of questions / exercises for practice / examination can be produced. Similarly, control systems of the work produced by the trainees. Apart from plagiarism detection systems, which are partly based on AI techniques, but mainly on fast data processing systems, the control will consist of detecting "abrupt" changes in the structure of the texts, the way of approaching issues, etc.

Italy

Italy has adopted, with the passage to the Council of Ministers, the Strategic Program for Artificial Intelligence (AI) 2022-2024, the result of the joint work of the Ministry of University and Research, the Ministry of Economic Development and the Minister for technological innovation and digital transition and thanks to the support of the working group on the National Strategy for Artificial Intelligence. In line with the European Strategy, the Program outlines twenty-four policies to be

implemented over the next three years to enhance the AI system in Italy, through the creation and enhancement of skills, research, development programs and AI applications.

Within the initiatives dedicated to talents and skills, interventions are planned to increase the number of doctorates and attract the best researchers to Italy, both in the fields of fundamental and applied research. At the same time, the program includes policies both to promote courses and careers in STEM subjects Integrate activities, methodologies and contents aimed at the development of STEM subjects in the curricula of all school cycles and to expand AI in ITS ("Higher Technical Institutes") Expand programming courses and include applied AI courses and internships across all ITSi curricula.

At the Piersanti Mattarella school in Modena, at lower secondary school level, artificial intelligence enters the curriculum. The agreement between the Institute 3 of Modena and the local Ammagamma company - called "Syllabus" - has already provided theory and laboratory for two years "through a path of several disciplines". Right from the start, the mathematical models that are the basis of AI are studied in depth and a first programming attempt is developed, then Informatics.

Blakeley H. Payne, who developed his own curriculum proposal to teach artificial intelligence at school involved more than two hundred students between the ages of nine and fourteen, to experiment with his teaching plan, which is public and also welcomes suggestions and proposals.

Portugal

In Portugal there is no specific focus on Artificial Intelligence, but on Digital Skills in which it is indirectly included. National Initiative for Digital Skills e.2030 (INCoDe.2030) had its public launch in early 2017 and has already had many results. INCoDe.2030, in its current format, is not exactly a program in the conventional sense. It is yet another agenda (or a mission) that seeks to stimulate a wide range of public and private partners, build or activate networks, with a view to improving the country's situation in relation to Digital, namely by promoting skills and access and working conditions. as well as specialized training and research in advanced areas.

Given the considerable breadth of the domains involved, INCoDe.2030 is organized into 5 axes: inclusion, education, qualification, specialization and research. Each of those axes has a coordination responsible for both the promotion of actions that fall within its scope, and the reporting of what has been achieved. Thus, what is described below is a succinct presentation separated by axis, referring, however, to other documents the descriptive expansion of these same activities. Here, particular emphasis will be given to education.

There are also references for:

1. Extension of ICT in basic education curricula
2. Development of digital educational resources
3. Promotion and dissemination of programming, robotics and digital literacy

Romania

The education system in the pre-university system did not identify in the curricula AI as a distinctive teaching field. The system has limited abilities in the schools and colleges to offer support to students in this area and even less to personalize it to their needs. Classroom teachers may use computers and the Internet, but they lack abilities for adaptive learning platforms in order to provide the opportunity to the students to add value and take creative benefits of learning with a class group. Personalized instruction is rare although we assess a range of abilities in the school systems through informal tests and more formal exams. The „passing exams'' mentality, combined with the lack of good practices and exchange of knowledge among colleges is acting as a barrier. Educators are skeptical that the focused curriculum is allowing powerful AI to encroach on their traditional role. Many of them distrust or do not understand AI properly. Therefore, skills and knowledge learnt by students is very limited and out of date or less relevant to a fast-changing workplace. Even more, besides teaching AI to the students, the teachers do not know how they cand use AI for pedagogical purposes.
In many other countries, digital transformation has brought about positive benefits through a network effect resulting from a larger and more connected system or good practice sharing but not too much in our case. Despite the rigidity of the public schools, there are alternative teaching opportunities in the private educational institutions which invest more in this area. Schools that are part of larger 360% educational integrated systems like USH or chains of schools and colleges better interconnected at regional level do manage to benefit from those close relationships, while the majority do not.

PART B: Elements facilitating an AI Integration in the near Future (for Teachers)

Europe

There is an integration of AI technologies in the classroom to enhance learning and improve teaching. Although AI tools and technologies are being developed primarily for businesses and industries, there is already a range of AI tools for teachers wishing to use AI to enhance student learning. Some examples of tools that can be used in STEM courses are PhotoMath, a free AI math application, and Seek by iNaturalist, an application that helps identify items from photos. Verse by Verse can be used for language lessons, with which students can write a poem with the help of AI and learn about American poets and Duolingo, for learning foreign languages. Newspaper Navigator, a tool for searching millions of historical photographs from newspapers and MuseNet, can be used for social science, art, and music lessons, to explore and create music. Tools such as Socratic and Brainly can be used for all subjects. Some more examples are:

- Kahoot
- MsScratch
- mBlock
- OpenRoberta
- codeBlock
- MBot robot
- VR glasses

Also AI Basics for Schools is an MOOC by the European Schoolnet Academy.

Bulgaria

The strategy for the development of artificial intelligence in Bulgaria until 2030, developed by the Bulgarian Academy of Sciences states: "Europe needs to overcome the shortage of qualified staff through adaptation of educational systems and raising the qualification of workforce. This is even more important for Bulgaria with the registered low level of digital skills of a large part of the Bulgarian population. In addition to the activity of the Ministry of Education and Science for introduction of disciplines related to acquisition of digital competencies in school education, and planned measures to increase the role of the so-called STEM disciplines, the following specific measures will contribute to the development of knowledge and skills needed to work in the field of AI.

Some examples:

- Training course for AI teachers, organized by Plovdiv University

- Two textbooks for secondary school on the first two topics of the curriculum of the Ministry of Education and Science have been developed and published. Three more textbooks related to "modern AI" are to be published.
    1. Artificial Intelligence. Solve problems through search
    2. Artificial Intelligence. Presentation of knowledge through logic. Logical programming

- AI Cluster Bulgaria

Cyprus

Courses and Curriculum

Master's degree in AI by the University of Cyprus: Master in Artificial Intelligence (ucy.ac.cy)

The aim of the new MSc Artificial Intelligence programme, starting in September 2022, and which will be delivered in English, is to be a modern programme, containing a strong interdisciplinary element as required by human-centric, explainable, and responsible artificial intelligence. Its compulsory courses include courses on artificial intelligence and ethics, as well as on artificial intelligence and entrepreneurship. Providing career counselling to students is a high priority, with the aim of helping all graduates to successfully pursue an AI-related career, possibly setting up their own start-ups.

Tools and Platforms

The Cyprus Computer Society (CCS) is a professional, scientific and independent non-profit organization, founded in 1984 with the aim of developing, upgrading and promoting the IT sector in Cyprus. CCS seeks to set high standards among industry professionals, recognizing the impact that

Information and Communication Technologies (ICT) has on employment, business, society and the quality of life of the citizen. Playing a key role in connecting academics with the professional sector, the Association promotes key issues in the industry, especially in the fields of digital literacy, professional skills, professionalism, education, training and research.

Greece

Courses and Curriculum

Artificial Intelligence in Secondary Education - Seminar of PEKES Western Macedonia

The Regional Directorate of Primary and Secondary Education of Western Macedonia and the Regional Center for Educational Planning (PEKES) of Western Macedonia are organizing a seminar which aims to present a comprehensive course through which teachers will be educated to manage successfully, at educational and learning level, new technologies and innovation in the classroom with emphasis on the utilization of Artificial Intelligence in Education (Artificial Intelligence in Education).

Artificial Intelligence Open Course (includes videos pdfs etc)

The course deals with the fundamental concepts and algorithms of traditional, otherwise symbolic, Artificial Intelligence. It delves into problem solving with search algorithms, competitive games, constraint satisfaction problems, propositional logic and first order logic. It thus prepares the student to proceed to more modern subjects of Artificial Intelligence, such as probabilistic reasoning and machine learning.

Seminar "Artificial Intelligence in Primary Education"

The Regional Directorate of Primary and Secondary Education of Western Macedonia and the Regional Center for Educational Planning (PEKES) of Western Macedonia are organizing a seminar which aims to present a comprehensive course through which teachers will be able to more successfully manage, at educational and learning level, new technologies and innovation in the classroom with emphasis on the utilization of Artificial Intelligence in Education (Artificial Intelligence in Education).

Webinar - NTUA in the Age of Artificial Intelligence and Big Data - Actions and Challenges in Research and Education

On April 13, 2022, NTUA organized a webinar entitled "NTUA in the era of Artificial Intelligence and Big Data: Actions and Challenges in Research and Education"

Italy

DeA School offers a course for teachers at the Secondary School of First degree, Secondary School of II degree. The course will focus on how to introduce Artificial Intelligence in secondary school. Project-based Learning will be the basis of the path. Teachers will be able to experience firsthand the training of Machine Learning algorithms and the construction of smartphone apps based on Artificial Intelligence.

Link: https://formazione.deascuola.it/offerta-formativa/evento/intelligenza-artificiale-e-machine-learning/

Mathematics and data science with digital technologies # 4 lower and upper secondary school
Link: https://scuolafutura.pubblica.istruzione.it/matematica-e-scienza-dei-dati-con-le-tecnologie-digitali-4-scuola-secondaria-di-primo-e-secondo-grado

There are software and apps to capture the level of concentration of the students.
Carnegie Learning was born as a startup app of the University of Pittsburgh. It offers schools digital platforms that use "AI" to provide students with learning material. Test and feedback, from kindergarten to university level. In addition, the platform creates tests / challenges for the various levels of education that identify gaps in knowledge. So, you know where and how students can catch up, before moving on to new topics.
Artificial intelligence tools can help make classrooms global and open to the active participation of all. Including those who speak different languages or who may have vision or hearing problems.

Another example: Presentation Translator is a free plug-in for PowerPoint that creates subtitles in real time while the teacher is explaining something.

Link: https://www.digitaleducationlab.it/blog/intelligenza-artificiale-e-apprendimento/

Portugal

In-service teacher training (in primary and secondary education)

a) Short-term Training Actions

• Collaborative work and digital citizenship, among other topics – more than 1000 teachers participated;
• Learning Laboratories: 84 training actions, which involved 1796 teachers;
• Regional events of the “Programming and Robotics in Basic Education” initiative: 5 events were held on the Continent and Islands, involving around 500 teachers

b) MOOC (Massive Open Online Course) in the following areas:

• Collaborative work on eTwinning: two editions, with a total of 1690 teachers, having completed 428;
• Learning scenarios and stories: three editions, in a total of 2671 teachers, having completed 616;
• Curricular Autonomy and Flexibility Project: two editions, with a total of 6426 trainees, having completed 1510.

Under development:
• Curriculum Guidelines for ICT in the 1st CEB, aimed at teachers of this cycle;
• Bullying and cyberbullying, aimed at all educational agents;
• Cybersecurity, involving security forces.

c) Training workshops:

• “Introduction to Basic Education Programming – train trainers” – 3 classes involving 60 teachers.
• “Learning laboratories: learning scenarios and stories” – 7 classes involving 108 teachers from the Mainland and Islands;
• “Active Learning Strategies using ICT” – 6 classes involving 80 teachers;
• “Collaborative work in eTwinning” - 3 classes involving 220 teachers.

d) Others:

• The “Programming and Robotics in Basic Education” initiative in the 2017/2018 school year developed a set of training activities (training of trainers and training of teachers):
• 12 webinars were held on topics related to the Curricular Autonomy and Flexibility project;

Link: https://www.incode2030.gov.pt

Romania

Courses Curriculum

ISB Primary follows the National Curriculum of English and Wales. This is supported by the Cambridge Curriculum. The curriculum is adapted to reflect the international nature of the school as well as the local Romanian setting. The Cambridge YLE programmes- Beginners Movers and Flyers as part of ESL programme are offered.

Student perspective

The demands placed on teachers in the classroom have undergone significant shifts (beyond things like the increasing paperwork burden). Teachers' expectations have shifted dramatically due to dramatic transformations in numerous national education policy frameworks and an increasingly diverse student body. As a result of these developments, Romania tends to introduce newer, more demanding national content standards, which require students to demonstrate mastery in the disciplinary practices that require them to use their knowledge rather than just understanding the concepts. In addition, the use of technology by teachers as a vehicle for learning, a means of communicating with parents, and a means of exchanging ideas with other educators has grown in importance. Romanian students and the younger generation seem to be more interested in AI, ML (machine learning) and XR (eXtended Reality) than some teachers as the research indicates.

https://www.mdpi.com/2071-1050/14/10/5842

PART C: AI in Education Practices

Bulgaria

Over the next 10 years, the Bulgarian state will invest BGN 170 million in the first of its kind in Eastern Europe **Institute of Computer Science, Artificial Intelligence and Technology INSAIT**. It is established in partnership between Sofia University "St. Kliment Ohridski" and two of the leading technological universities in the world - the Swiss ETH Zurich and EPFL. INSAIT was officially started in 2022 in Sofia. One of the goals of the Institute is to support the education system in the process of learning with AI and the implementation of curricula and AI study methodologies at all levels of education.

During the last two school years in Plovdiv district at the High School "St. St. Cyril and Methodius"- Asenovgrad and at the **High School "Prof. Dr. Asen Zlatarov"**- Parvomay was introduced the study of Artificial Intelligence as an optional module in the specialized training of XI and XII class, profile" Software and Hardware Sciences ".
Links: https://susskm.com/, sou-zlatarov.org

Formal training in profiled classes in AI is conducted from the academic year 2019-2020 at the **Mathematical High School in Plovdiv**. In 2021, experimental training began in vocational classes in the specialty "AI Programming" in vocational high schools in Varna and Burgas.

- Four innovative classes in Mathematical High School Plovdiv, 2019-2020 school year - https://www.omg-bg.com/
- One vocational class in "AI Programming" in Vocational School of Computer Programming and Innovation, Burgas: https://www.codingburgas.bg/
- One vocational class in "AI Programming" in Vocational School of Computer Modeling and Computer Systems, Varna, https://itpg-varna.bg.

IWD Hackathon 2022 - Teens in AI runs annual Global Hackathons. The objectives of the event are: Strengthen young people's understanding of/ exposure to AI, critical thinking, ethics and team collaboration; Use AI as a tool for social impact; Encourage young people to use AI for social good; Incubate new AI products, business, and project ideas.

Digital National Alliance (DNA) is an EC-led multi-stakeholder partnership created to tackle the lack of digital skills in Bulgaria. DNA was created in June 2014. As a result of the events, over 100 children from different backgrounds, with zero technical skills and with extensive experience in programming as well, developed nearly 20 innovative AI-based projects, the best of which were evaluated by the international jury of Tees in AI.

Cyprus

The Pancyprian Competition Robotex Cyprus is organized on an annual basis by the Cyprus Computer Society in collaboration with a plethora of organizations. The aims of the event are to upgrade the field of educational robotics, to introduce robotic technology in the educational

process, to upgrade the STEAM scientific fields (Science, Technology, Engineering, Arts, Mathematics) and to promote new forms of learning. The goals of the event are to attract students in STEAM areas, to develop 21st century skills, interdisciplinary analysis and problem solving, to develop a spirit of communication, teamwork and collaboration between pupils / students and teachers / academics and to learn basic code principles for solving problems.

The Pancyprian Educational Robotics Competition (WRO Cyprus) is a unique way for students to understand science, coding and automation, to learn to think like engineers, to develop their problem-solving skills and to expand their creativity. By exploring these skills in a practical and participatory way, children develop the supplies they need today and for the future, whatever career choice they follow. The competition is addressed to students at all school levels and each level has different educational goals, and therefore different competition categories and competition criteria. The competition is organized by the Cyprus Computer Society in collaboration with the educational robotics, science, technology and mathematics organization STEM Education.

Greece

Searching multiple libraries and search engines such as Google and scientific papers yielded a PD/Training Programme that comprises a collection of diverse games and software tools that may be used to promote AI and ML in elementary, secondary, and postsecondary education (e.g., Google Search, ACM Digital Library, IEEE Xplore, Science Direct, Google Scholar).

Link: http://learnml.eu/

Elements of AI

The Elements of AI is a free online course that combines theory with practical tasks and can be taken at your own speed with no difficult math or programming. The purpose of Elements of AI is to demystify AI. The project's goal is to educate as many people as possible about AI, including what it is, what it can (and can't) accomplish, and how to begin developing AI approaches.

Link: https://www.elementsofai.com/

A unique SciFY effort that brings together all of the country's forces to learn: what Artificial Intelligence (AI) is and is not, what opportunities and problems it presents, and how it influences

our present and future. How can we collaborate to co-create AI and make the future a better place for everyone? Learn how to comprehend Artificial Intelligence, identify partners to help you build new projects, and share your expertise and best practices.

Link: https://ai-in-greece.scify.org/en/

Creating mini games in arduino and C ++ and playing against the CPU, which uses an artificial intelligence algorithm. The A.I. algorithm is implemented in 40 lines of code with dynamic decision trees, without ready-made scripts or standard game / strategy moves. It is emphasized that no prior knowledge is required in the above fields.

Link: https://www.citylab.gr/en/blog.html

Italy

Artificial intelligence in education: The three paradigms

Artificial intelligence in education (AIEd) opens new opportunities, potentials, and challenges in educational practices. The research questions are what the different roles of AI in education are, how AI is connected to the existing educational and learning theories, and to what extent the use of AI technologies influence learning and instruction.

Link: Artificial intelligence in education: The three paradigms - ScienceDirect

Artificial intelligence in education

Artificial Intelligence (AI) has the potential to address some of the biggest challenges in education today, innovate teaching and learning practices, and accelerate progress towards SDG 4. However, rapid technological developments inevitably bring multiple risks and challenges, which have so far outpaced policy debates and regulatory frameworks. UNESCO is committed to supporting Member States to harness the potential of AI technologies for achieving the Education 2030 Agenda, while ensuring that its application in educational contexts is guided by the core principles of inclusion and equity.

UNESCO's mandate calls inherently for a human-centred approach to AI. It aims to shift the conversation to include AI's role in addressing current inequalities regarding access to knowledge, research and the diversity of cultural expressions and to ensure AI does not widen the technological divides within and between countries. The promise of "AI for all" must be that everyone can take advantage of the technological revolution under way and access its fruits, notably in terms of innovation and knowledge.

Furthermore, UNESCO has developed within the framework of the Beijing Consensus a publication aimed at fostering the readiness of education policy-makers in artificial intelligence. This publication, Artificial Intelligence and Education: Guidance for Policy-makers, will be of interest to

practitioners and professionals in the policy-making and education communities. It aims to generate a shared understanding of the opportunities and challenges that AI offers for education, as well as its implications for the core competencies needed in the AI era.

Link: https://en.unesco.org/artificial-intelligence/education

Examples of Artificial Intelligence in Education

In this article there are provided examples of ways in which AI is being pioneered and applied in education. While the applications included are in use in some form today, one could argue that most are still in a relatively "primitive" stage in terms of envisioned long-term objectives. Specifically:

- Smart Content – Technology that attempts to condense text books into useful tool for exam preparation such as true or false questions
- Intelligent Tutoring Systems – Personalized electronic tutoring customized to the learning styles and preferences of the pupil
- Virtual Facilitators and Learning Environments – Virtual human guides and facilitators for use in a variety of educational and therapeutic environments

Link: https://emerj.com/ai-sector-overviews/examples-of-artificial-intelligence-in-education/

How Is AI Used In Education — Real World Examples Of Today And A Peek Into The Future

While the debate regarding how much screen time is appropriate for children rages on among educators, psychologists, and parents, it's another emerging technology in the form of artificial intelligence and machine learning that is beginning to alter education tools and institutions and changing what the future might look like in education. It is expected that artificial intelligence in U.S. Education will grow by 47.5% from 2017-2021 according to the Artificial Intelligence Market in the US Education Sector report. Even though most experts believe the critical presence of teachers is irreplaceable, there will be many changes to a teacher's job and to educational best practices.

Link: https://bernardmarr.com/how-is-ai-used-in-education-real-world-examples-of-today-and-a-peek-into-the-future/

THE ROLE OF ARTIFICIAL INTELLIGENCE IN IMPROVING EDUCATION

Artificial intelligence (AI) has touched new heights in this century, and its impact can be felt in all parts of our life including education. The rise of AI in the education sector has been a topic of research for many professionals, including Ido Roll and Ruth Wylie, and Wayne Holmes, Maya Bialik, and Charles Fadel. Technology is changing the way education used to take place and AI is causing the much-needed disruption in this sector to ensure that learning becomes easy for the students, and teaching becomes easy for the teachers.

The objective of artificial intelligence at large is to optimize routine processes by increasing efficiency. Here are a few ways in which AI is bringing a revolution in the education sector.

Link: https://news.elearninginside.com/the-role-of-artificial-intelligence-in-improving-education/

Portugal

Pilot experiences and joint work around the integration of ICT in teaching and learning processes, with schools, municipalities, the Ministry of Education, higher education institutions and companies with some examples as:

• 10 ICT Competence Centers - CCTIC under protocols established between the Ministry of Education carried out, in 2018, more than 200 training and awareness actions, which involved more than 8000 teachers;
• eTwinning – collaborative projects between European schools using digital technologies: 1757 schools, 15907 teachers and 8314 registered projects in Portugal;
• Training of teachers in Digital Citizenship, in partnership with CPCJ, Sintra Ocidental covering 11 groups;

Link: https://www.incode2030.gov.pt

Digital inclusion for special needs in in-service education and training

There are 25 resource centers in mainland Portugal. The autonomous regions operate within the scope of their respective Regional Education Departments. In mainland Portugal, 981 students were evaluated and, of these, 719 were supported.1109 hours of training were given to a diverse audience made up of 162 parents, 956 students, 129 assistants, 255 technicians/therapists and 2547 teachers. MOOC for teachers on Inclusive Education - in testing phase, to start in January 2019.

Link: https://www.incode2030.gov.pt

Romania

The Pepper robot, this year completes the endowment with robotics for university activities in UVT by purchasing two SCOUT Mini Pro robots equipped with Nvidia AGX Xavier processor, with an Intel RealSense D435 camera and a VLP-16 lidar. They will play an important role in testing and developing algorithms and software solutions in the field of Computer Vision and Machine Learning, of great interest for both research and the IT production sector.

Link: https://sursadevest.ro/inteligenta-artificiala-vine-in-ajutorul-studentilor-de-la-uvt-care-aduce-doi-roboti-noi/

PART D: Other AI Elements/Initiatives/Practices at National and/or European Level

Europe

1. The policy recommendations of the EU on the topic as expressed in the 13297/19 Note of Council of EU in Oct 2019, under the title: Artificial intelligence in education and training - Policy debate (Public debate in accordance with Article 8(2) of the Council's Rules of Procedure) [proposed by the Presidency)

Well-coordinated use of AI can bring about significant improvements to society. It can help us reach climate and sustainability goals and will bring high-impact innovations in healthcare, education, transport, industry and many other sectors. At the same time, the uptake of AI entails a number of potential risks and will bring about considerable socioeconomic changes. The EU must act as one, based on European values, to promote the development and deployment of AI.

The Handbook of the Council of Europe:
Digital Citizenship Education Handbook

Digital citizenship competences define how we act and interact online. They comprise the values, attitudes, skills and knowledge and critical understanding necessary to responsibly navigate the constantly evolving digital world, and to shape technology to meet our own needs rather than to be shaped by it. The *Digital citizenship education handbook* offers information, tools and good practice to support the development of these competences in keeping with the Council of Europe's vocation to empower and protect children, enabling them to live together as equals in today's culturally diverse democratic societies, both on- and offline.
The *Digital citizenship education handbook* is intended for teachers and parents, education decision makers and platform providers alike. It describes in depth the multiple dimensions that make up each of 10 digital citizenship domains and includes a fact sheet on each domain providing ideas, good practice and further references to support educators in building the competences that will stand children in good stead when they are confronted with the challenges of tomorrow's digital world. The Digital citizenship education handbook is consistent with the Council of Europe's *Reference Framework of Competences for Democratic Culture* and compatible for use with the *Internet literacy handbook*.

The Unesco publication on AI in Education Policy.

Artificial Intelligence (AI) has the potential to address some of the biggest challenges in education today, innovate teaching and learning practices, and ultimately accelerate the progress towards SDG 4. However, these rapid technological developments inevitably bring multiple risks and challenges, which have so far outpaced policy debates and regulatory frameworks. UNESCO is committed to supporting Member States to harness the potential of AI technologies for achieving the Education 2030 Agenda, while ensuring that the application of AI in educational contexts is guided by the core principles of inclusion and equity.

UNESCO's mandate calls inherently for a human-centred approach to AI. It aims to shift the conversation to include AI's role in addressing current inequalities regarding access to knowledge, research and the diversity of cultural expressions and to ensure AI does not widen the technological divides within and between countries. The promise of "AI for all" must be that everyone can take advantage of the technological revolution under way and access its fruits, notably in terms of innovation and knowledge.

Bulgaria

Some examples of other AI Elements are the OFFICIAL GOVERNMENTAL PROGRAMS, the NATIONAL REPORTS and the PRIVATE SECTOR PROGRAMS.

EU Alliances and initiatives in Bulgaria

- Digital National Alliance (DNA) is an EC-led multi-stakeholder partnership created to tackle the lack of digital skills in Bulgaria.The mission is to attract more people to the world of new technology and support the development of the ICT sector in Bulgaria.

- Teens in AI is a multi-award-winning social impact initiative launched at the UN AI for Good Summit 2018. It exists to increase diversity and inclusion in Artificial Intelligence. The initiative aims to democratise AI and create opportunities for underrepresented talent and give young people early exposure to AI for social good. Since 2015 Teens in AI reached over 9000 young people in over 140 cities worldwide.

Teacher Training

1. One-week courses in AI for training with outstanding students and teachers at the base of the foundation in the village of Oryahovitsa.
2. Training of AI teachers under the national program "Motivated Teachers" in 2020-2021. year, organized by PU "P. Hilendarski".

Others

For the next school year more schools have announced admission to professional classes for the profession "Programmer of AI" with mandatory professional training in AI from 7th to 12th grade. For example:

1. Professional High School of Informatics and Computer Science "Academician Blagovest Sendov" Plovdiv
2. Vocational High School of Computer Modelling and Computer Systems, Varna
3. Paisii Hilendarski Secondary School, Plovdiv

Greece

ARIS PROJECT
AI SKILLS FOR ICT PROFESSIONALS

The project's major goal is to provide a complete and up-to-date training course in AI technologies and practical applications, with the goal of equipping ICT workers with initiative, entrepreneurship, and the latest digital skills needed in the workplace. Another objective of the project is to make it easier for AI skills to be included into EU certification and standards processes.

Link: http://www.aris-project.eu/

Curriculum Development in Data Science and Artificial Intelligence (DS & AI) is a Capacity Building in Higher Education Erasmus + KA2 Project. The Data Science and Artificial Intelligence (DS&AI) initiative intends to establish a new MSc program in Data Science and Artificial Intelligence in Asia. The goal of DS&AI is to produce highly competent Data Scientists and other related expertise to help the region's ICT economy, which is in desperate need of them.

Link: https://dsai-project.eu/site/en/index

Interreg Greece-Italy AI SMART
European Regional Development Fund
EUROPEAN UNION

The AI SMART Project intends to create a shared port network in the Adriatic-Ionian region based on the idea of "intelligent, green, and integrated ports," allowing for the creation of new green routes connecting regional minor ports in the cross-border nations involved.

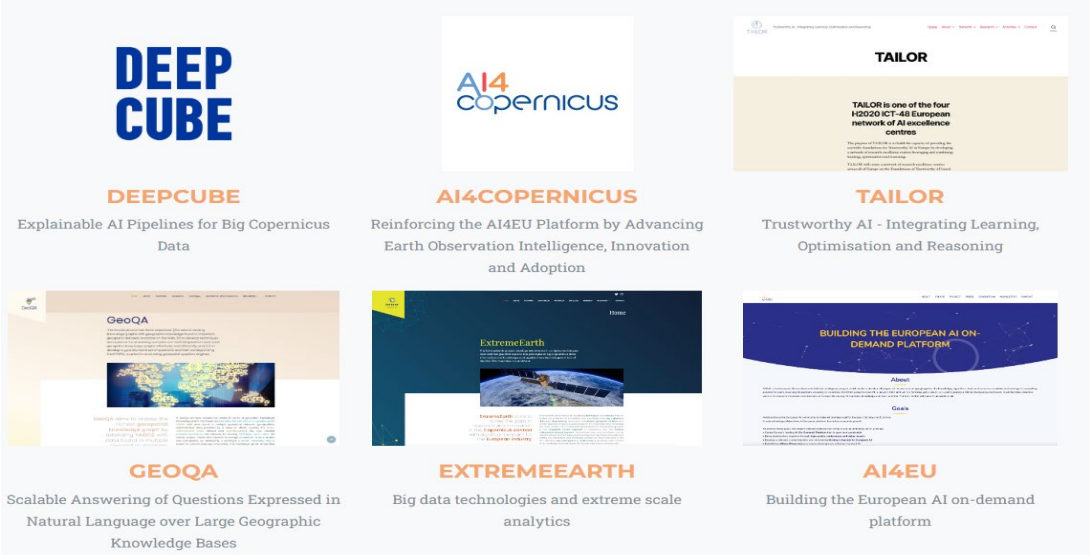
Link: https://greece-italy.eu/rlb-funded-projects/ai-smart/

Democratising AI

“This White Paper aims to set out the National AI Strategic Vision for Greece and to provide an initial plan of action on how to achieve this vision. It aims to accelerate the adoption and development of AI in both the private and public sectors in Greece and increase the relevant skills and the research and development (R&D) base through the provision of the necessary AI infrastructure and enablers that will facilitate the Democratisation of AI.

Link: http://democratisingai.gr/ai.html

Artificial Intelligence Team



"The team belongs to the Management of Data, Information and Knowledge Group (MaDgIK) of the Department of Informatics and Telecommunications of the National and Kapodistrian University of Athens. The recent research and development activities are in the following areas: Artificial Intelligence Technologies for Earth Observation, Question Answering for Knowledge Graphs, Artificial Intelligence for the Public Sector."

Link: http://ai.di.uoa.gr/

An artificial intelligence centre that will gather Greece's best minds in Greece

The initiative of the 'Archimedes' centre started as a thought and today is a real project which has guaranteed funding from the recovery fund in order to gather in Greece brilliant minds who work on this subject. The prime minister stated, among others, that many of the issues that arise from the application of artificial intelligence already have direct implications in the field of philosophy and especially ethics.

Italy

The first artificial intelligence school in Europe, which allows a completely free but very high-level course, Picampus, in Rome. It is a venture capital and start-up district, which started with the first school in the villa in 2007 and has now reached the sixth villa. The school is totally free for students, and a new business model has been invented in which companies - when they have an artificial intelligence problem - sponsor students. The advantage for the latter is that they will work on real and interesting problems, given by the best corporations in the world.

Link: https://www.youtube.com/watch?v=Uvl0IPUIn_U

With the intention of developing a good practice at national and European level for artificial intelligence (AI) education in the school context, the European project Edu4AI - Artificial Intelligence and Machine Learning to Foster 21st Century Skills was born and developed. in Secondary Education (Erasmus + program), coordinated in Italy by the Fondazione Mondo Digitale.

Link: https://mondodigitale.org/notizie/intelligenza-artificiale-i-vantaggi-la-scuola

Romania

XAION: one of the first platforms for Explainable Artificial Intelligence (XAI) competitions, created to meet the industry needs for outsourcing their AI challenges. Instead of hiring an intern to experiment with an AI prototype, why not create a competition and select the best possible solution from a large pool of participants.
XAIBOT: A trilingual chatbot (English, Romanian, Serbian) offering guidance related to the XAI concepts, dedicated to meet the needs of the users in the region.
XAI.Pro: A complete implementation and deployment of an XAI project with an intuitive visual interface, to understand the power of the explainable AI technology (in Romanian).

Conclusions

The primary conclusions are that while broad usage of AI in education has not yet been attained, large organizations' use of it in this area and the research that has been done provide confidence that it will soon be present in instructors' and trainees' everyday work. There are virtually few AI-related curriculum components in European schools, and the only one that does so indirectly focuses on digital skills. Although AI is not specifically mentioned in the curriculum as a teaching subject, several organizations and institutions of learning are pushing robotics-related projects and other efforts.

Regarding the integration of AI into education in the future, there are many AI technologies and platforms that may be utilized for educational purposes in addition to online courses, MOOCs, training actions/workshops, and seminars/webinars for instructors to participate. Additionally, the project's partners discovered a large number of AI educational practices as well as some other, more generic AI aspects, initiatives, and practices, increasing the likelihood that AI integration in education will take place in the near future.

A preliminary overview of the empirical research literature on AI literacy studies in the field of education is presented in an exploratory review. Everyone, not only computer scientists, has to be proficient in AI. We should include artificial intelligence (AI) as part of every learner's technical literacy for the workplace and daily life in addition to reading, writing, math, and digital skills. The concept of AI literacy, can be described as the ability to know and comprehend, utilize and apply, as well as analyze and build AI. For the cognitive demands of the job in the future, people must prepare themselves. In order to employ AI for the benefit of society, it is crucial to promote social responsibility and ethical consciousness in young people.

Students have the capacity to solve problems using AI technologies in many contexts and even develop AI-driven hardware and software to improve our society in addition to being the end consumers. Data science, computational thinking, and multidisciplinary knowledge are all combined in the concept of AI literacy, which interacts with AI thinking.

The technological, pedagogical, and content knowledge framework should be taken into account to help educators educate by providing a road map for knowing how to integrate AI literacy into classrooms successfully. K–12 students' conceptual understandings of AI need to be scaffolded, and age-appropriate learning artifacts and curricula need to be developed to boost their motivation and interest in learning AI. Teachers should update their understanding of AI to address issues in the classroom, such as knowing how to use appropriate AI-enhanced tools like adaptive learning systems to manage their daily teaching practice and encourage customized learning to better understand students' learning needs.

In the framework of AI literacy, future researchers and educators will create pedagogical tools (such as collaborative project-based learning, gamification), encourage interaction and cooperation, improve motivation and attitudes, and build a variety of learning abilities. Instead of only boosting students' AI skills and interests, human-centered concerns are crucial to draw attention to the need to educate people to become socially and ethically responsible users. These issues include inclusivity, justice, accountability, transparency, and ethics.

ANNEX 2 - NATIONAL REPORTS

Bulgaria

Plovdivski Universitet Paisiy Hilendarski and Prof. Ivan Apostolov Private English Language School

PART A:	**Level of Integration of AI in Secondary Schools** (for Students)
Formal Education	The National Programme "Information and Communication Technologies (ICT) in the SYSTEM OF Pre-School and School Education" 2021 comprises a set of activities to provide modern means of access to educational resources and training in the school education system, as well as sustainable development of the supporting educational network infrastructure with possibility of future expansion and phased coverage of each educational institution. Formal training in profiled classes in AI is conducted from the academic year 2019-2020 at the Mathematical High School in Plovdiv. In 2021, experimental training began in vocational classes in the specialty "AI Programming" in vocational high schools in Varna and Burgas. For the new 2022-23 school year, admission has been announced in the specialty "AI Programming" in 7 high schools with admission after 7th grade. In addition, the Ministry of Education and Science of the Republic of Bulgaria sets the following main goals in the education system by 2025: ● Stimulating the development of knowledge and skills from an early age with focus on the exact sciences and competencies for the use of information systems and technologies. ● Development of a network of vocational schools with a focus on high technology (high-tech vocational schools) in close cooperation with business and higher education within the regional education ecosystem to create a critical mass of professionals and trained candidate students; ● Building an Augmented and Virtual Reality Center in support of the development of new forms of human-machine interface through public-private partnership; ● Creating curricula related to artificial intelligence and digital transformation in higher and high-tech schools vocational high schools in cooperation with business; ● Accelerate the digital transformation in the education system through integration of information systems of educational institutions, introduction of online content and expanded use of educational analytics, as well as creating online platforms for providing digital learning resources and for individualized training.
Non Formal Education	In several schools it was introduced as an elective profiled discipline "Artificial Intelligence" for students in profiled classes "Software and Hardware Sciences". Students study these courses for several years after 7th grade. The main topics are: Solving problems through search, Logic rules and logic programming, Machine learning and Robotics.
Other	In the last two years, interest clubs in the field of Artificial Intelligence have been experimentally established, as well as robotics clubs in many secondary schools in Bulgaria.

	Development of a network of vocational schools with a focus on high technology (high-tech vocational schools) in close cooperation with business and higher education within the regional education ecosystem to create a critical mass of professionals and trained candidate students.

PART B:	**Elements facilitating an AI Integration in the near Future** (for Teachers)
Courses, Curriculum	**Training course for AI teachers, organized by Plovdiv University:** Link: https://u4ili6teto.bg/brezovo/course/view.php?id=297
Educational Material	Two textbooks for secondary school on the first two topics of the curriculum of the Ministry of Education and Science have been developed and published. Three more textbooks related to "modern AI" are to be published. 0. Artificial Intelligence. Solve problems through search: https://goodboox.bg/index.php?route=product/product&product_id=704 **0.** Artificial Intelligence. Presentation of knowledge through logic. Logical programming: https://bguchebnik.com/izkustven-intelekt-predstavyane-na-znaniyata-chrez-logika-logichesko-programirane.html
Tools, Platforms	**AI Cluster Bulgaria:** Link: https://aicluster.bg/
Conferences, Publications	1. Stanimir Stoyanov, Todorka Glushkova, Ĭordan Todorov, Izkustven intelekt. Reshavane na problemi posredstvom tŭrsene, izd. Izkustva, http://www.izkustva.net/intelekt.html, 2019 2. Glushkova, T., Stoyanov, S., Tabakova-Komsalova, V., Grancharova-Hristova, M., Krasteva, I., An Approach to Teaching Artificial Intelligence in School, Innovative Educational Technologies, Tools and Methods for E-learning Scientific Editor Eugenia Smyrnova-Trybulska "E-learning", 12, Katowice–Cieszyn 2020, pp. 257–267 DOI: 10.34916/el.2020.12.22 3. Stoyanov, S., Glushkova, T., Papancheva, R., LEARNING IN SCHOOL OF LOGIC AND LOGICAL PROGRAMMING FOR PRESENTATION AND PROCESSING OF KNOWLEDGE, Educations and Technologies, VOL. 11/2020, ISSUE 1, ISSN 1314-1791 (PRINT), ISSN 2535-1214, pp. 15-22,2020, http://www.edutechjournal.org/wp-content/uploads/2020/12/1_2020_15-22.pdf, DOI: http://doi.org/10.26883/2010.201.2151 4. Tabakova-Komsalova, V., Glushkova, T., Grancharova-Hristova, M., Krasteva, I., LEARNING TASKS IN ARTIFICIAL INTELLIGENCE EDUCATION, Educations and Technologies, VOL. 11/2020, ISSUE 1, ISSN 1314-1791 (PRINT), ISSN 2535-1214 (ONLINE), pp. 15-22,2020, pp.233-240, DOI: http://doi.org/10.26883/2010.201.2292, http://www.edutechjournal.org/?page_id=2292&lang=en 5. Glushkova, T., Stoyanov, S., Malinova, A., A., STUDY OF ARTIFICIAL INTELLIGENCE AND LOGICAL PROGRAMMING IN SECONDARY SCHOOL, in Proceedings of International conference SREM'2020, pp. 245-251, Pamporovo, 16-18 October 2020, ISBN: 978-619-202-595-3, http://srem2020.fmi-plovdiv.org/wp-content/uploads/2020/10/6_5_Glushkova_Stoyanov_Malinova.pdf 6. Stoyanov, S. Glushkova T., IZKUSTVEN INTELEKT V UCHILISHTE – PREDIZVIKATELSTVO, NEOBKHODIMOST, ILYUZIYA ILI REALNOST, Matematika Plyus, br. 4, 2020, str. 25-38, ISSN 2603-4964

	7. Stoyanov, S., Glushkova, T., Papancheva, R., Izkustven intelekt. Predstavyane na znaniyata chrez logika. Logichesko programirane, Izkustva, 2021, 96 str. ISBN: 978-619-7243-97-0, http://www.izkustva.net/intelekt_2.html 8. Todorka Glushkova, Veneta Tabakova-Komsalova. Some aspects of the application of artificial intelligence in school education, MATHEMATICS AND MATHEMATICAL EDUCATION, Reports of the Fiftieth Jubilee Spring Conference of the Union of Mathematicians in Bulgaria, 245-251, ISSN 1313-3330, http://www.math.bas.bg/ smb / 2021_PK / tom_2021 / pdf / 245-251.pdf 9. Tabakova-Komsalova, V., Glushkova, T., Krasteva, I., Stoyanov, S. AI training – approaches, results, analyses and conclusions, E-learning in the Time of COVID-19 Scientific Editor Eugenia Smyrnova-Trybulska "E-learning", 13, Katowice–Cieszyn 2021, pp. 176–186 https://doi.org/10.34916/el.2021.13.15, ISSN: 0094243X, 15517616 10. Stoyanov, S., Glushkova, T., Grancharova-Hristova, M., Tabakova-Komsalova, V., Guidelines, ideas and approaches for AI education in school. Knowledge structuring and semantic modeling, Education and Technologies, vol.12, issue 1, 100-102, ISSN 1314-1791, 2021 11. Tabakova-Komsalova, V., Glushkova, T., Krasteva, I., Some results and analyzes from the teaching of artificial intelligence in high school, Education and Technologies, vol.12, issue 1, 100-102, ISSN 1314-1791, 2021 12. Kabaivanov, S., AI in management, New Knowledge Journal of Science / Novo Znanie . 2020, Vol. 9 Issue 1, p11-22. 12p. 13. Ivanova K., Nisheva M., Eskenazi A., Angelova G., Maneva N., Artificial Intelligence in and for Education in Bulgaria – Measures for Achievement Reliable Intelligent Growth, Proceedings of the National Conference on "Education and Research in the Information Society", Plovdiv, November, 2020, 007p-020p. 14. Strategy for the development of the Artificial intelligence in Bulgaria until 2030 (Стратегия за развитието на изкуствения интелект в България до 2030 г.), https://www.strategy.bg/StrategicDocuments/View.aspx?lang=bg-BG&Id=1338
	The strategy for the development of artificial intelligence in Bulgaria until 2030, developed by the Bulgarian Academy of Sciences states: "Europe needs to overcome the shortage of qualified staff through adaptation of educational systems and raising the qualification of workforce. This is even more important for Bulgaria with the registered low level of digital skills of a large part of the Bulgarian population. In addition to the activity of the Ministry of Education and Science for introduction of disciplines related to acquisition of digital competencies in school education, and planned measures to increase the role of the so-called STEM disciplines, the following specific measures will contribute to the development of knowledge and skills needed to work in the field of AI: • Increasing the competencies of students in the field of ethical issues, related to the use of information technology and their rights in the conditions of the digital world in which they live.

	• Application of AI tools in education in order to improve quality, the attractiveness and effectiveness of the learning process.

PART C:	AI in Education Practices
Practice 1:	During the last two school years in Plovdiv district at the High School "St. St. Cyril and Methodius"- Asenovgrad introduced the study of Artificial Intelligence as an optional module in the specialized training of XI and XII class, profile" Software and Hardware Sciences ". The training is conducted according to the curriculum approved by the Ministry of Education and Science, using the developed textbooks on the first topic "Solving problems through search", for XI grade, and on the second topic "Presentation of knowledge through logic". Logical programming ", for XII class. In the High School "St. St. Cyril and Methodius"- Asenovgrad, there is a stability of knowledge (about a very good 5), which is due to the study of a sufficient number of hours (3 hours per week). Teachers working with these AI students are confident in their work. They share that the studied AI search algorithms are realized in the hours of the obligatory profiled preparation of the studied programming language. In this way, students acquire lasting knowledge and skills and motivation to continue studying the next course on the topic "Presentation of knowledge through logic. Logical programming. Link: https://susskm.com/
Practice 2:	During the last two school years in Plovdiv district at the **High School "Prof. Dr. Asen Zlatarov"**- Parvomay introduced the study of Artificial Intelligence as an elective module in the specialized training of XI and XII class, profile" Software and Hardware Sciences ". The training is conducted according to the curriculum approved by the Ministry of Education and Science, using the developed textbooks on the first topic "Solving problems through search", for XI grade, and on the second topic "Presentation of knowledge through logic". Logical programming ", for XII class. The training in artificial intelligence in this school is carried out for 2 hours a week. Sustainability is observed in knowledge, but teachers working with these AI students are not confident enough in their work. During the training, teachers regularly shared their difficulties, sought additional information and shared their experiences. From this we can conclude that due to its specifics, training in this subject requires more time for preparation and more joint meetings and discussions with the participation of the authors of textbooks and manuals. According to the teachers for the second school year, continuing the training with the second part of the textbook, including logical programming, teachers will need additional training and additional materials to use in class. Link: sou-zlatarov.org
Practice 3:	Formal training in profiled classes in AI is conducted from the academic year 2019-2020 at the **Mathematical High School in Plovdiv**. In 2021, experimental training began in vocational classes in the specialty "AI Programming" in vocational high schools in Varna and Burgas. **Link 1**: Four innovative classes in Mathematical High School Plovdiv, 2019-2020 school year - https://www.omg-bg.com/ **Link 2**: One vocational class in "AI Programming" in Vocational School of Computer Programming and Innovation, Burgas: https://www.codingburgas.bg/ **Link 3**: One vocational class in "AI Programming" in Vocational School of Computer Modeling and Computer Systems, Varna, https://itpg-varna.bg.

Practice 4:	Over the next 10 years, the Bulgarian state will invest BGN 170 million in the first of its kind in Eastern Europe **Institute of Computer Science, Artificial Intelligence and Technology INSAIT**. It is established in partnership between Sofia University "St. Kliment Ohridski" and two of the leading technological universities in the world - the Swiss ETH Zurich and EPFL. INSAIT was officially started in 2022 in Sofia. One of the goals of the Institute is to support the education system in the process of learning with AI and the implementation of curricula and AI study methodologies at all levels of education. Source:
Practice 5:	**IWD Hackathon 2022 -** Teens in AI runs annual Global Hackathons. The objectives of the event are: Strengthen young people's understanding of/ exposure to AI, critical thinking, ethics and team collaboration; Use AI as a tool for social impact; Encourage young people to use AI for social good - all challenges are aligned with UN Sustainable Development Goals; NextGen upskilling and potential development of talent pipeline; Incubate new AI products, business, and project ideas (all ideas can be used as inspiration to understand the new arising passions and concerns of the younger generations); Diversity & inclusion focus at scale.
Practice 6:	**Digital National Alliance (DNA)** is a EC-led multi-stakeholder partnership created to tackle the lack of digital skills in Bulgaria. DNA was created in June 2014. During strict pandemic restrictions due to COVID-19, DNA managed to successfully conduct two consecutive Teens in AI hackathons in an online format. This allowed the engaging a wider range of children from all over Bulgaria, including representatives of minority groups. As a result of the events, over 100 children from different backgrounds, with zero technical skills and with extensive experience in programming as well, developed nearly 20 innovative AI-based projects, the best of which were evaluated by the international jury of Tees in AI.

PART D:	Other AI Elements/Initiatives/Practices at National and/or European Level
OFFICIAL GOVERNMENTAL PROGRAMS	**links to document / website:** https://www.mtc.government.bg/bg/category/157/koncepciya-za-razvitieto-na-izkustveniya-intelekt-v-bulgariya-do-2030-g
NATIONAL REPORTS	**links to document / website** https://www.strategy.bg/StrategicDocuments/View.aspx?lang=bg-BG&Id=1338 https://www.bas.bg/wp-content/uploads/2020/07/Proposal-National-Strategy-AI-2030-24June2020.pdf
PRIVATE SECTOR PROGRAMS	**links to document / website:** https://www.uni-sofia.bg/index.php/bul/novini/novini_i_s_bitiya/otkrivane_na_instituta_za_kompyut_rni_nauki_izkustven_intelekt_i_tehnologii_insait_k_m_sofijskiya_universitet https://aicluster.bg/events/teens-in-ai-bulgaria-international-womens-day-hackathon-2022/
EU Alliances and initiatives in Bulgaria	**Digital National Alliance (DNA)** is a EC-led multi-stakeholder partnership created to tackle the lack of digital skills in Bulgaria. DNA was created in June 2014. The mission is to attract more people to the world of new technology and support the development of the ICT sector in Bulgaria. They provide educational and training programs for improving children, young people and adults' technical skills, required for the new ICT age as well as for the current and future labour market. https://www.digitalalliance.bg/ **Teens in AI** is a multi-award-winning social impact initiative launched at the UN AI for Good Summit 2018. It exists to increase diversity and inclusion in Artificial Intelligence. The initiative aims to democratise AI and create opportunities for underrepresented talent through a combination of mentoring, workshops, hackathons and networking opportunities

	to give young people aged 12-29 early exposure to AI for social good. Since 2015 Teens in AI reached over 9000 young people in over 140 cities worldwide. https://www.teensinai.com
TEACHER TRAINING	0. In the last two years with the assistance of the Minyo Balkanski Foundation (https://www.balkanski-foundation.org/education/), Prof. Sava Grozdev, Prof. Stanimir Stoyanov, Assoc. Prof. Todorka Glushkova and Assist. Prof. Veneta Tabakova organizes one-week courses in AI for training with outstanding students and teachers at the base of the foundation in the village of Oryahovitsa. **0.** Training of AI teachers under the national program "Motivated Teachers" (http://www.sbubg.info/sbubg.php?page=11&lang=bg&id=5242) in 2020-2021. year, organized by PU "P. Hilendarski "- https://u4ili6teto.bg/brezovo/course/view.php?id=297 (Guest entrance)
TEXTBOOKS AND TEACHING MATERIALS	**Textbooks on the first two topics of the curriculum of the Ministry of Education and Science:** 1. Artificial Intelligence. Solve problems through search: https://goodboox.bg/index.php?route=product/product&product_id=704 **2.** Artificial Intelligence. Presentation of knowledge through logic. Logical programming: https://bguchebnik.com/izkustven-intelekt-predstavyane-na-znaniyata-chrez-logika-logichesko-programirane.html
OTHERS	For the next school year more schools have announced admission to professional classes for the profession "Programmer of AI" with mandatory professional training in AI from 7th to 12th grade. For example: 1. Professional High School of Informatics and Computer Science "Academician Blagovest Sendov" Plovdiv: https://gikn.eu/bg/programirane-na-izkustven-intelekt/ 2. Vocational High School of Computer Modelling and Computer Systems, Varna: https://itpg-varna.bg/%D0%BF%D1%80%D0%B8%D0%B5%D0%BC/%D1%81%D0%BF%D0%B5%D1%86%D0%B8%D0%B0%D0%BB%D0%BD%D0%BE%D1%81%D1%82%D0%B8-%D0%B7%D0%B0-%D1%83%D1%87%D0%B5%D0%B1%D0%BD%D0%B0%D1%82%D0%B0-2022-2023-%D0%B3%D0%BE%D0%B4%D0%B8%D0%BD%D0%B0/%D0%BF%D1%80%D0%BE%D0%B3%D1%80%D0%B0%D0%BC%D0%B8%D1%80%D0%B0%D0%BD%D0%B5-%D0%BD%D0%B0-%D0%B8%D0%B7%D0%BA%D1%83%D1%81%D1%82%D0%B2%D0%B5%D0%BD-%D0%B8%D0%BD%D1%82%D0%B5%D0%BB%D0%B5%D0%BA%D1%82/ 1. Paisii Hilendarski Secondary School, Plovdiv: https://paisii.info/%d0%bf%d1%80%d0%b8%d0%b5%d0%bc-%d0%be%d1%81%d0%bc%d0%b8-%d0%ba%d0%bb%d0%b0%d1%81/

Cyprus

Cyprus Mathematical Society (Cy.M.S.)

PART A:	**Level of Integration of AI in Secondary Schools** (for Students)
Formal Education	In the Cypriot schools (primary and secondary), presently, there are very few elements in the area of AI. But, in line with the decisions of the European Council, the following actions are in the planning of the Education system: Promotion of policies that will release resources in order to upgrade school equipment for the development of digital education. This means hardware, infrastructure, connectivity and software improvements, and the connection of Public Schools of all levels with high-speed networks. Promotion of academic and/or research projects at transnational level aimed at promoting research and innovation in the field of AI. Organization of Competitions at European level that will aim at the development of the interest and the involvement of the European Student Community with AI issues
Nonformal Education	Various organisations and schools are promoting activities in the area of robotics in the form of projects and other activities. Among these the Cyprus Computer Society has announced a competition on robotics (https://ccs.org.cy/en/competitions/robotex-cyprus-1)
Other	There is only reference to the area on occasional cases e.g. in the context of projects in such areas as robotics and so on. Also depending on the initiative of the teacher there are suggestions for consideration of some areas of AI, through references or projects.

PART B:	**Elements facilitating an AI Integration in the near Future** (for Teachers)
Courses, Curriculum	Link: Master's degree in AI by the University of Cyprus Master in Artificial Intelligence (ucy.ac.cy)
Tools, Platforms	Link: https://ccs.org.cy/en/

PART C:	**AI in Education Practices** (for all)
Practice 1:	Link: https://ccs.org.cy/en/competitions/robotex-cyprus-1
Practice 2:	Link: https://ccs.org.cy/en/competitions/wro-cyprus-5

PART D:	Other AI Elements/Initiatives/Practices at National and/or European level
	1. The policy recommendations of the EU on the topic as expressed in the 13297/19 Note of Council of EU in Oct 2019, under the title: Artificial intelligence in education and training - Policy debate (Public debate in accordance with Article 8(2) of the Council's Rules of Procedure) [proposed by the Presidency) 2. The Handbook of the Council of Europe: Digital Citizenship Education Handbook 3. The Unesco publication on AI in Education Policy.
	Link: Artificial intelligence (AI) | European Commission (europa.eu)
	Link: https://rm.coe.int/16809382f9. https://book.coe.int/en/human-rights-democratic-citizenship-and-interculturalism/7851-digital-citizenship-education-handbook.html
	Link: Artificial intelligence in education (unesco.org)

ADDENDUM

Remarks on Policy recommendations in the context of the plans of the Cyprus Educational System

By considering the Cyprus Educational System it can be seen that up to this point there are no concrete elements in the curriculum concerning or indulging with AI at the school level. In a report prepared by two inspectors of the Ministry of Education (APPENDIX 1) it is stated that:

. The object of development of Digital Skills and related knowledge is already in the school curriculum mainly in the range of ages 9-18 years old

. This is achieved either through topics in the area or though applications supporting the learning process or other subjects of the curriculum.

Furthermore, in this report there is reference to what is proposed by the technokrats of the Ministry concerning the field of AI at the school level. In this context it is mentioned the need to systematically address the social, ethical and legal issues raised by the development, implementation and use of AI, such as transparency and accountability of algorithms, non-discrimination, equal opportunities, freedom of expression and pluralism, media pluralism, as well as ownership, collection, the use and dissemination of data and content; recommending the establishment of common European guidelines and standards for the protection of privacy, while making effective use of available data; calls for transparency in the development of algorithms and in accountability for their use.

Going further to this report it is well mentioning what the technokrats suggest as answers to two questions on the AI in school that were to be discussed in the meeting of the EU ministers of Education on the area of AI at school level during November 2019.

Q1. What kind of education and training policies and measures at EU and Member State level should be developed to guide the design and use of AI? How can we ensure that AI benefits society as a whole and that Europe can compete successfully globally?

Proposed Answer:

It is considered necessary to proceed with the upgrading of school equipment for the development of digital education. This means hardware, infrastructure, connectivity and software improvements. The connection of Public Schools of all levels with high-speed networks needs to be upgraded, so that students and teachers have the ability to access broadband infrastructure with high quality, speed and safety, with the ultimate goal of achieving a quality digital learning process.
At the same time, it is important to cultivate and promote digital skills through education and the use of Information and Communication Technologies (ICT) in order to empower and shape the digital citizen.
Another policy that needs to be incorporated, is the integration of Digital Technologies as an independent subject in Primary Education in order to teach programming from the first grades of Primary School is also considered as an important policy. Strengthening of the subject of Informatics and its application as mandatory in all grades both in the Gymnasium and Lyceum Training cycle.
Importance is also given to the expansion of the institution of the STEM program in Primary Education, which offers the opportunity for an interdisciplinary approach to problem-solving skills. The aim is also to create STEM Schools at all levels in order to cultivate talent in the field of AI and develop human resources that will be able in the future to meet the needs for digital jobs.
Two equally important policies are (a) ensuring AI expertise and leveraging experts to reform the education system, promoting AI through Education Curricula. The use of these experts for staff training in the educational applications resulting from the use of AI is considered as something necessary. (b) The second policy is the development and exchange of AI-themed material through networks of Schools.
Q2. What actions could be taken by the EU together with the Member States to enable and promote the use of AI in education and training now and within the next 10 years?

Proposed Answer:
The main actions we recommend are the following:
Promotion of policies that will release resources in order to upgrade school equipment for the development of digital education. This means hardware, infrastructure, connectivity and software improvements, and the connection of Public Schools of all levels with high-speed networks.
Promotion of academic and/or research projects at transnational level aimed at promoting research and innovation in the field of AI.
Organization of Competitions at European level that will aim at the development of the interest and the involvement of the European Student Community with AI issues.
Introduction of postgraduate programs in EU Universities in the field of AI. With the introduction and promotion of such programmes, European citizens will acquire the necessary knowledge for their subsequent admission to a competitive working environment but will also attract third-country nationals to study at universities within the European Union area.
It is worth noting that decision-making and policy making on the issue of AI necessarily needs the assistance of the various bodies of Education. As a tool and/or as a program, AI has a clearly technical structure that offers at the same time the possibility of character and ethics development. If this character and morality are not imbued with the values that the humanism of modern European education carries, then we turn AI into a well-sharpened knife in the hands of a murderer, rather than into a well-made scalpel in the hands of an experienced surgeon.

Further to the above comments it is well mentioning the following actions that are in the process of support of the Cyprus Education System in the area of promoting activities in the field of AI at the school level:

1. The planning of offering a series of presentations on AI at the Pancyprian Gymnasium, a historic secondary school in the country. The lectures will be offered by prof. Antonis Kakas of the University of Cyprus,
2. The policy recommendations of the EU on the topic as expressed in the 13297/19 Note of Council of EU in Oct 2019, under the title: Artificial intelligence in education and training - Policy debate (Public debate in accordance with Article 8(2) of the Council's Rules of Procedure) [proposed by the Presidency)
3. The Handbook of the Council of Europe: Digital Citizenship Education Handbook
4. The Unesco publication on AI in Education Policy.

Greece

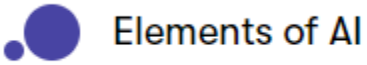
Doukas School

PART A:	Level of Integration of AI in Secondary Schools (for Students)
Formal Education	**Teaching Artificial Intelligence in Primary, Secondary and Post-Secondary Public Education in Greece** Link: https://www.alfavita.gr/sites/default/files/2021-05/TN.pdf “According to CEDEFOP's European Skills Index, Greece ranks last with 17% (with an EU average of 66%) in terms of skills matching, lagging significantly behind in terms of skills development. So, the proposals refer to digital skills development, always in line with AI as well as training activities at every level of Primary and Secondary Education.”
Other	**Artificial intelligence in the field of education** Link: Παιδεία και Τεχνητή Νοημοσύνη In the field of education, the use of TN has not yet reached the level of widespread use, but the choice of its adoption by large companies in the field and the research that is done, give the certainty that soon (and perhaps much earlier than we would expect) teachers and trainees will see applications in their daily practice. Closer to implementation seems to be the automatic production of exam material, where, by providing a "body" of books, notes, presentations and giving some guidelines, a number of questions / exercises for practice / examination can be produced. Similarly, control systems of the work produced by the trainees. Apart from plagiarism detection systems, which are partly based on TN techniques, but mainly on fast data processing systems, the control will consist of detecting "abrupt" changes in the structure of the texts, the way of approaching issues, etc.

PART B:	Elements facilitating an AI Integration in the near Future (for Teachers)
Courses, Curriculum	**Artificial Intelligence in Secondary Education - Seminar of PEKES Western Macedonia** Link: https://dide-new.flo.sch.gr/techniti-noimosyni-sti-defterovathmia-ekpaidefsi-seminario-tou-pekes-dytikis-makedonias/ The Regional Directorate of Primary and Secondary Education of Western Macedonia and the Regional Center for Educational Planning (PEKES) of Western Macedonia are organizing a seminar which aims to present a comprehensive course through which teachers will be educated to manage successfully , at educational and learning level, new technologies and innovation in the classroom with emphasis on the utilization of Artificial Intelligence in Education (Artificial Intelligence in Education). The teachers of all specialties who teach in Upper Secondary Education

	during the school year 2021-2022 are the target group. General Objectives are teachers to know the basic theoretical framework of the subject of Artificial Intelligence in Education, to acquire knowledge about the principles, goals and directions of Artificial Intelligence in Education and to utilize tools and / or software related to the teaching of Artificial Intelligence in Education. **Artificial Intelligence Open Course (includes videos pdfs etc)** Link: https://opencourses.gr/opencourse.xhtml;jsessionid=7C8BEB6F7975248CB777A30D757C03E4?id=15603&ln=el The course deals with the fundamental concepts and algorithms of traditional, otherwise symbolic, Artificial Intelligence. In particular, it delves into problem solving with search algorithms, competitive games, constraint satisfaction problems, propositional logic and first order logic. It thus prepares the student to proceed to more modern subjects of Artificial Intelligence, such as probabilistic reasoning and machine learning. **Seminar "Artificial Intelligence in Primary Education"** Link:https://dmaked.pde.sch.gr/anakoinoseis/anakoinoseis/1661-seminario-texniti-noimosyni-stin-protovathmia-ekpaidefsi The Regional Directorate of Primary and Secondary Education of Western Macedonia and the Regional Center for Educational Planning (PEKES) of Western Macedonia are organizing a seminar which aims to present a comprehensive course through which teachers will be able to more successfully manage, at educational and learning level, new technologies and innovation in the classroom with emphasis on the utilization of Artificial Intelligence in Education (Artificial Intelligence in Education). Teachers of all specialties who teach in Primary Schools during the school year 2021-22 are the target group. **Webinar - NTUA in the Age of Artificial Intelligence and Big Data - Actions and Challenges in Research and Education** Link: https://www.ntua.gr/el/ntuai https://www.europeanschoolnetacademy.eu/courses/course-v1:CodeWeek+AI+2021/course/
Tools, Platforms	Integration of AI technologies in the classroom to enhance learning and improve teaching. Although AI tools and technologies are being developed primarily for businesses and industries, there is already a range of AI tools for teachers wishing to use AI to enhance student learning. Some examples of tools that can be used in STEM courses are PhotoMath, a free AI math application, and Seek by iNaturalist, an application that helps identify items from photos. Verse by Verse can be used for language lessons, with which students can write a poem with the help of AI and learn about American poets and Duolingo, for learning foreign languages. Newspaper Navigator, a tool for searching millions of historical photographs from newspapers and MuseNet, can be used for social science, art and music lessons, to

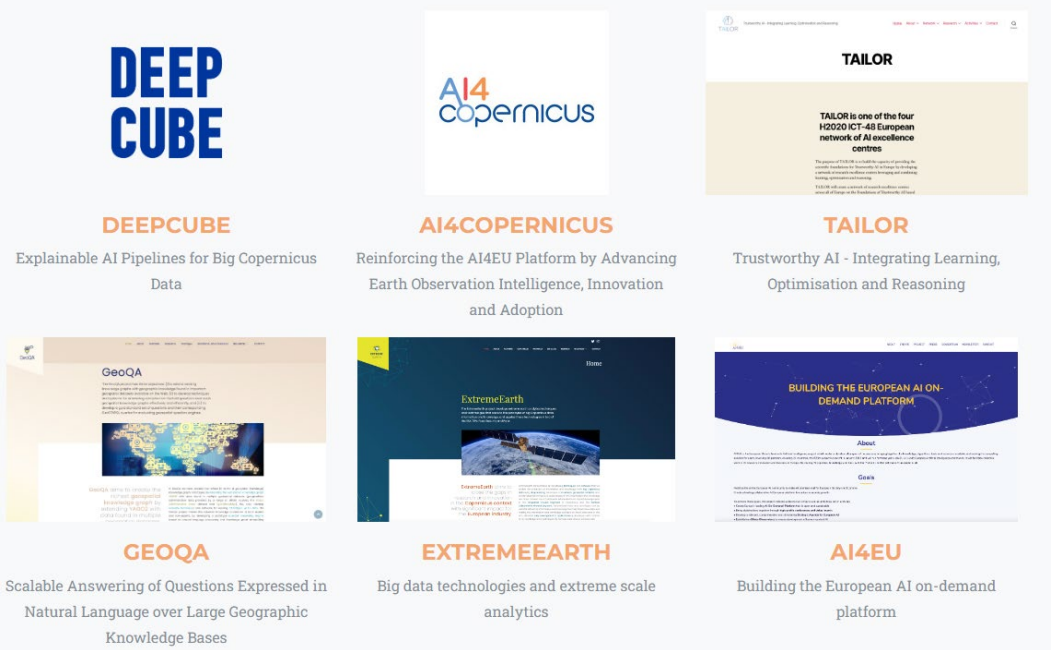
	explore and create music. Tools such as Socratic and Brainly can be used for all subjects. ● PhotoMath, ● Seek by iNaturalist, ● Verse by Verse, ● Duolingo, ● Newspaper, Navigator, ● MuseNet, ● Socratic, ● Brainly (Not national ones were found)
Conferences, Publications	**"The implementation of the requirements of Education 4.0 in Secondary Education in Greece with emphasis on teacher training"** Link: https://apothesis.eap.gr/bitstream/repo/47004/1/104697_Aravantinou_Fatorou_Aikaterini.pdf “The results of the research show that the existence of a variety of training programs is recorded, which are addressed to teachers in Greece and negotiate issues, most of which are outdated, while they are not carried out based on the principles of adult education and the requirements of Education 4.0. Most educators show particular interest and intrinsic motivation for lifelong learning, however, express frustration with the majority of the programs they have participated in, and there were a small number of notable training programs that followed modern methodology and themes. With regard to Education 4.0, we have seen that it has not yet been included in the training programs, despite the clear instructions of the European Commission in its reports on education in the Member States.” **30-06-20 Vassilis Digalakis: "The integration of digital skills and Artificial Intelligence in Education is an indisputable necessity"** Link: https://www.minedu.gov.gr/news/45586-30-06-20-vasilis-digalakis-adiamfisvititi-anagkaiotita-i-ensomatosi-ton-psifiakon-deksiotiton-kai-tis-texnitis-noimosynis-stin-ekpaidefsi

PART C:	AI in Education Practices
Practice 1:	 Link: http://learnml.eu/ Searching multiple libraries and search engines such as Google and scientific papers yielded a PD/Training Programme that comprises a collection of diverse games and software tools that may be used to promote AI and ML in elementary, secondary, and postsecondary education (e.g., Google Search, ACM Digital Library, IEEE Xplore, Science Direct, Google Scholar). During the search, three key words were used: topic ("AI Education," "ML Education," "CS Education"), and medium ("Game-Based Learning," "Games for Learning"). The LearnML project intends to teach students the essential principles of AI and machine learning using a specially created game-based instructional toolset, bringing AI literacy to primary and secondary schools.
Practice 2:	 Link: https://www.elementsofai.com/ Adults from many backgrounds can take online (free) courses. The Elements of AI is a free online course that combines theory with practical tasks and can be taken at your own speed with no difficult math or programming. The purpose of Elements of AI is to demystify AI. The project's goal is to educate as many people as possible about AI, including what it is, what it can (and can't) accomplish, and how to begin developing AI approaches.
Practice 3:	 Link: https://ai-in-greece.scify.org/en/ A unique SciFY effort that brings together all of the country's forces to learn: what Artificial Intelligence (AI) is and is not, what opportunities and problems it presents, and how it influences our present and future. How can we collaborate to co-create AI and make the future a better place for everyone? Learn how to comprehend Artificial

	Intelligence, identify partners to help you build new projects, and share your expertise and best practices.
Practice 4:	Link: https://www.citylab.gr/en/blog.html Creating mini games in arduino and C ++ and playing against the CPU, which uses an artificial intelligence algorithm. The CPU will never lose, while at the same time showing us (changing the color of the track as it successively thinks about what it will play) whether it is going to win or not even if it happens after many moves. The A.I. algorithm is implemented in 40 lines of code with dynamic decision trees, without ready-made scripts or standard game / strategy moves. The project is taught from the beginning, to children from sixth grade and above, who after understanding 100% all the techniques (creation and connection of arduino circuit, led matrix programming, game theory, artificial intelligence algorithm and its implementation in C ++) proceed to implementation. It is emphasized that no prior knowledge is required in the above fields.

PART D:	**Other AI Elements/Initiatives/Practices at National and/or European Level**
	Link: http://www.aris-project.eu/ An online poll was done, and 194 people with experience in AI technology and computer advancements completed the questionnaire. The online poll focuses on the most necessary field knowledge and abilities for working as an AI specialist. The project's major goal is to provide a complete and up-to-date training course in AI technologies and practical applications, with the goal of equipping ICT workers with initiative, entrepreneurship, and the latest digital skills needed in the workplace. The project also seeks to provide current training delivery methods and creative open-access pedagogical materials, allowing learners to acquire and self-assess relevant skills, as well as VET providers tools and strategies to include into their training programs. Another objective of the project is to make it easier for AI skills to be included into EU certification and standards processes.
	Link: https://dsai-project.eu/site/en/index

	Curriculum Development in Data Science and Artificial Intelligence (DS & AI) is a Capacity Building in Higher Education Erasmus + KA2 Project. The Data Science and Artificial Intelligence (DS&AI) initiative intends to establish a new MSc program in Data Science and Artificial Intelligence in Asia. The DS&AI initiative focuses on MSc-level training, offering advanced courses and help in the development of research skills required to create breakthrough new data-driven technologies. The goal of DS&AI is to produce highly competent Data Scientists and other related expertise to help the region's ICT economy, which is in desperate need of them.
	 Link: https://greece-italy.eu/rlb-funded-projects/ai-smart/ The AI SMART Project intends to create a shared port network in the Adriatic-Ionian region based on the idea of "intelligent, green, and integrated ports," allowing for the creation of new green routes connecting regional minor ports in the cross-border nations involved. The project promotes the potential of short sea routes as an integral and complementary part of intermodal TEN-T corridors for sustainable and inclusive transport services, in line with the European 2030 Strategy's objectives for intelligent growth based on the valorization of natural and landscape resources on both coasts and in the hinterland.
	Link: https://www.businessdaily.gr/english-edition/54860_artificial-intelligence-centre-will-gather-greeces-best-minds-greece The initiative of the 'Archimedes' centre started as a thought and today is a real project which has guaranteed funding from the recovery fund in order to gather in Greece brilliant minds who work on this subject. I am also looking forward to this", Prime Minister Kyriakos Mitsotakis said on Wednesday speaking at an event for the establishment of the research centre 'Archimedes' organized by 'Greece 2021' on the subject of artificial intelligence, data science and algorithms. The prime minister stated, among others, that many of the issues that arise from the application of artificial intelligence already have direct implications in the field of philosophy and especially ethics. "Artificial intelligence allows us to see connections where the mind cannot easily see and process. I will give three examples. Last summer we used an artificial intelligence algorithm so that we could do an entrance test in Greece with greater accuracy than if we had done it randomly. Consider the possibilities that exist in the field of tax revenue collection in order to make targeted audits. I imagine that there are tools of artificial intelligence to regulate the operation of traffic lights on the streets and to deal with traffic in Athens. There are too many fields", underlined Mitsotakis. The prime minister also said that he is looking forward to a dialogue with the leading scientists in the field on data issues related to the issues of democracy. "The possibility of having an artificial intelligence centre that will gather the best minds in Greece, with secured funding, is an important asset for the country, a vision that is

	being put into practice and I can only be very satisfied and excited with the prospects that the new effort opens," he added. "In Greece we have an ecosystem of companies that develop products and applications for the global market. Greek jobs, Greek prospects for Greek graduates from our excellent universities", Mitsotakis stated noting, among other things, that artificial intelligence can provide a solution to a problem that cannot be solved with classic tools. The prime minister also referred to the possibility of such a centre to make its judgments in an objective and meritocratic way without interventions. "We want the quality of the work to be judged and your presence is a huge guarantee of meritocracy," he stressed.
	 Link: http://ai.di.uoa.gr/ “The team belongs to the Management of Data, Information and Knowledge Group (MaDgIK) of the Department of Informatics and Telecommunications of the National and Kapodistrian University of Athens. The work focuses on various topics of Artificial Intelligence, and it is done under the supervision of Professor Manolis Koubarakis. The recent research and development activities are in the following areas: Artificial Intelligence Technologies for Earth Observation, Question Answering for Knowledge Graphs, Artificial Intelligence for the Public Sector.”

Italy

ITC Pacle Morante Limbiate

PART A:	**Level of Integration of AI in Secondary Schools** (for Students)
Formal Education	Italy has adopted, with the passage to the Council of Ministers, the Strategic Program for Artificial Intelligence (AI) 2022-2024, the result of the joint work of the Ministry of University and Research, the Ministry of Economic Development and the Minister for technological innovation and digital transition and thanks to the support of the working group on the National Strategy for Artificial Intelligence. In line with the European Strategy, the Program outlines twenty-four policies to be implemented over the next three years to enhance the AI system in Italy, through the creation and enhancement of skills, research, development programs and AI applications. Within the initiatives dedicated to talents and skills, interventions are planned to increase the number of doctorates and attract the best researchers to Italy, both in the fields of fundamental and applied research. At the same time, the program includes policies both to promote courses and careers in STEM subjects Integrate activities, methodologies and contents aimed at the development of STEM subjects in the curricula of all school cycles and to expand AI in ITS ("Higher Technical Institutes") Expand programming courses and include applied AI courses and internships across all ITSi curricula
Non Formal Education	At the Piersanti Mattarella school in Modena, at lower secondary school level, artificial intelligence enters the curriculum. The agreement between the Institute 3 of Modena and the local Ammagamma company - called "Syllabus" - has already provided theory and laboratory for two years "through a path of several disciplines". Right from the start, the mathematical models that are the basis of AI are studied in depth and a first programming attempt is developed, then Informatics.
Other	Blakeley H. Payne, who developed his own curriculum proposal to teach artificial intelligence at school involved more than two hundred students between the ages of nine and fourteen, to experiment with his teaching plan, which is public and welcomes suggestions and proposals. Link: https://www.agendadigitale.eu/scuola-digitale/insegnare-lintelligenza-artificiale-a-scuola-ecco-come-fare/

PART B:	**Elements facilitating an AI Integration in the near Future** (for Teachers)
Courses, Curriculum	DeA School offers a course for teachers at the Secondary School of First degree, Secondary School of II degree. The course will focus on how to introduce Artificial Intelligence in secondary school. Project-based Learning will be the basis of the path. Teachers will be able to experience firsthand the training of Machine Learning algorithms and the construction of smartphone apps based on Artificial Intelligence.

	Link: https://formazione.deascuola.it/offerta-formativa/evento/intelligenza-artificiale-e-machine-learning/ Mathematics and data science with digital technologies # 4 lower and upper secondary school Link: https://scuolafutura.pubblica.istruzione.it/matematica-e-scienza-dei-dati-con-le-tecnologie-digitali-4-scuola-secondaria-di-primo-e-secondo-grado
Educational Material	It is possible to find educational material online. Link: https://www.arci.it/app/uploads/2019/11/eMedia_Robotic_final_IT.pdf Link: https://learning-corner.learning.europa.eu/learning-materials/coding_it Link: https://oppi.it/wp-content/uploads/2021/01/101-111_gabbari-2.pdf Link:Https://www.researchgate.net/publication/357578645_Intelligenza_artificiale_e_educazione_un_incontro_tra_due_mondi_Rischi_e_opportunita Link: https://www.youtube.com/watch?v=D9F4A5ItRnU Link: https://www.youtube.com/watch?v=RtZ9gJ7CyFE Link: https://www.youtube.com/watch?v=4JN_Dr1vPhk
Tools, Platforms	● There are software and apps to capture the level of concentration of the students. ● Carnegie Learning was born as a startup app of the University of Pittsburgh. It offers schools digital platforms that use "AI" to provide students with learning material. Test and feedback, from kindergarten to university level. In addition, the platform creates tests / challenges for the various levels of education that identify gaps in knowledge. So, you know where and how students can catch up, before moving on to new topics. ● Artificial intelligence tools can help make classrooms global and open to the active participation of all. Including those who speak different languages or who may have vision or hearing problems. ● Another example: Presentation Translator is a free plug-in for PowerPoint that creates subtitles in real time while the teacher is explaining something. Link: https://www.digitaleducationlab.it/blog/intelligenza-artificiale-e-apprendimento/
Conferences Publications	Link: https://www.esero.it/webinar-su-intelligenza-artificiale-e-robotica-educativa/ **https://cordis.europa.eu/event/id/145623-the-32nd-aaai-conference-on-artificial-intelligence/it**

PART C:	AI in Education Practices
Practice 1:	Artificial intelligence in education (AIEd) opens new opportunities, potentials, and challenges in educational practices. The research questions are what the different roles of AI in education are, how AI is connected to the existing educational and learning theories, and to what extent the use of AI technologies influence learning and instruction. Link: Artificial intelligence in education: The three paradigms - ScienceDirect
Practice 2:	Link: https://en.unesco.org/artificial-intelligence/education
Practice 3:	Link: https://emerj.com/ai-sector-overviews/examples-of-artificial-intelligence-in-education/
Practice 4:	Link: https://bernardmarr.com/how-is-ai-used-in-education-real-world-examples-of-today-and-a-peek-into-the-future/
Practice 5:	Link: https://news.elearninginside.com/the-role-of-artificial-intelligence-in-improving-education/

PART D:	Other AI Elements/Initiatives/Practices at National and/or European Level
	The first artificial intelligence school in Europe, which allows a completely free but very high-level course, Picampus, in Rome. It is a venture capital and start-up district, which started with the first school in the villa in 2007 and has now reached the sixth villa. The school is totally free for students, and a new business model has been invented in which companies - when they have an artificial intelligence problem - sponsor students. The advantage for the latter is that they will work on real and interesting problems, given by the best corporations in the world. Link: https://www.youtube.com/watch?v=Uvl0IPUIn_U

Portugal

Instituto Politécnico Do Porto

PART A:	**Level of Integration of AI in Secondary Schools** (for Students)
Formal Education	In Portugal there is no specific focus on Artificial Intelligence, but on Digital Skills in which it is indirectly included. National Initiative for Digital Skills e.2030 (INCoDe.2030) had its public launch in early 2017 and has already had many results. INCoDe.2030, in its current format, is not exactly a program in the conventional sense. It is yet another agenda (or a mission) that seeks to stimulate a wide range of public and private partners, build or activate networks, with a view to improving the country's situation in relation to Digital, namely by promoting skills and access and working conditions. as well as specialized training and research in advanced areas. Given the considerable breadth of the domains involved, INCoDe.2030 is organized into 5 axes: inclusion, education, qualification, specialization and research. Each of those axes has a coordination responsible for both the promotion of actions that fall within its scope, and the reporting of what has been achieved. Thus, what is described below is a succinct presentation separated by axis, referring, however, to other documents the descriptive expansion of these same activities. Here, particular emphasis will be given to education.
Non Formal Education	1. Extension of ICT in basic education curricula • The ICT subject was integrated into the curriculum of the schools participating in the Curricular Autonomy and Flexibility Project. 223 schools participated in this project. • Following the above-mentioned project, the ICT subject was integrated into the curriculum for all grades of basic education, applying to all schools. • The corresponding Essential Apprenticeships were prepared, by school year, from the 5th to the 9th grade. • In the case of the 1st cycle, as it is an area of transversal curricular integration, boosted by the globalizing dimension of teaching in this cycle, Curricular Guidelines were produced.
Other	2. Development of digital educational resources • They are in the initial phase of preparation, for the entire 1st Cycle, in the subject areas of mathematics, Portuguese and science; • Also in an initial phase, diversified educational resources on digital citizenship are being developed. 3. Promotion and dissemination of programming, robotics and digital literacy • Promotion and promotion of Programming and Robotics Clubs in schools – 191 this school year, covering 10,993 students; • Project “Programming and Robotics in Basic Education”. In 2017/18, 260 School Groups from Mainland Portugal, 74 Private Education Institutions, 13 schools from the Autonomous Region of Madeira and 3 schools from the Autonomous Region of the Azores, the Portuguese

	School of Macau and the Portuguese School of São Tomé and Príncipe were involved. , involving 1155 professors and 64692 students; • The UAC pilot project! - Using Arduino in the Classroom, developed in partnership with the ICT Competence Center Entre Mar e Serra; • DGE joined the European Programming Week (Code Week) initiative promoted by the European Commission, through the event entitled "Programming and Robotics 2018", which took place on the 19th and 20th of October, involving around 90 teachers.

PART B:	**Elements facilitating an AI Integration in the near Future** (for Teachers)
Courses, Curriculum	1. In-service teacher training (in primary and secondary education) a) Short-term Training Actions • Collaborative work and digital citizenship, among other topics – more than 1000 teachers participated; • Learning Laboratories: 84 training actions, which involved 1796 teachers; • Regional events of the "Programming and Robotics in Basic Education" initiative: 5 events were held on the Continent and Islands, involving around 500 teachers b) MOOC (Massive Open Online Course) in the following areas: • Collaborative work on eTwinning: two editions, with a total of 1690 teachers, having completed 428; • Learning scenarios and stories: three editions, in a total of 2671 teachers, having completed 616; • Curricular Autonomy and Flexibility Project: two editions, with a total of 6426 trainees, having completed 1510. Under development: • Curriculum Guidelines for ICT in the 1st CEB, aimed at teachers of this cycle; • Bullying and cyberbullying, aimed at all educational agents; • Cybersecurity, involving security forces. c) Training workshops: • "Introduction to Basic Education Programming – train trainers" – 3 classes involving 60 teachers. • "Learning laboratories: learning scenarios and stories" – 7 classes involving 108 teachers from the Mainland and Islands; • "Active Learning Strategies using ICT" – 6 classes involving 80 teachers; • "Collaborative work in eTwinning" - 3 classes involving 220 teachers. d) Others: • The "Programming and Robotics in Basic Education" initiative in the 2017/2018 school year developed a set of training activities (training of trainers and training of teachers): o regional events on the mainland and islands, involving around 500 teachers o 8 follow-up national online conferences (webcasts) the Final Event of the Project This initiative was supported by the following partners: Microsoft, ANPRI, CCTIC from the University of Évora, CCTIC from the ESE of Setúbal and CCTIC from the Institute of Education of the University of Lisbon. • 12 webinars were held on topics related to the Curricular Autonomy and Flexibility project; Link: https://www.incode2030.gov.pt

PART C:	AI in Education Practices
Practice 1:	3. Pilot experiences and joint work around the integration of ICT in teaching and learning processes, with schools, municipalities, the Ministry of Education, higher education institutions and companies • 10 ICT Competence Centers - CCTIC under protocols established between the Ministry of Education carried out, in 2018, more than 200 training and awareness actions, which involved more than 8000 teachers; • "Safer Internet Day" campaign - around 60 municipalities and more than 400 groups involved; • Cybersecurity Month Campaign - around 300 groups involved; • eTwinning – collaborative projects between European schools using digital technologies: 1757 schools, 15907 teachers and 8314 registered projects in Portugal; • Training of teachers in Digital Citizenship, in partnership with CPCJ, Sintra Ocidental covering 11 groups; • Apps for Good Project - 217 schools involved; • Mathematics Project and Khan Academy – partnership with the PT Foundation to translate educational resources into mathematics; • Milage Learn+ - teaching and learning mathematics with mobile devices: covers more than 4000 students; • Teachers Try Science – project in the area of science and ICT, in partnership with IBM: students and teachers from 10 groups participate; • Tell us a Story (digital stories produced by children): 512 classes from JI to 4th grade have already participated; • Seguranet Challenges – 30,000 participants, including students, parents and teachers; • Digital Leaders – 700 students and around 100 teachers, influenced more than 12,000 people on issues of safe Internet use; • Digital Security Seal – currently around 300 groups participate and more than 250 seals have been awarded; • National Defense Day – more than 100,000 young adults were trained on issues of safe Internet use; • Partnership between the Union of Journalists and the Directorate-General for Education, on Media Education – "Media Literacy" Pilot – 30 schools participate, involving around 90 teachers; • Portugal Code Movement – in 2017 it involved 813 schools on the mainland and islands. Link: https://www.incode2030.gov.pt
Practice 2:	2. Digital inclusion for special needs in in-service education and training • There are 25 resource centers in mainland Portugal. The autonomous regions operate within the scope of their respective Regional Education Departments. • In mainland Portugal, 981 students were evaluated and, of these, 719 were supported. • 1109 hours of training were given to a diverse audience made up of 162 parents, 956 students, 129 assistants, 255 technicians/therapists and 2547 teachers. • MOOC for teachers on Inclusive Education - in testing phase, to start in January 2019. Link: https://www.incode2030.gov.pt

Romania

Universitatea Spiru Haret

PART A:	Level of Integration of AI in Secondary Schools (for Students)
Formal Education	https://upb.ro/en/faculties/ In Romania there are universities that are in the top 200 in terms of artificial intelligence, but we obtained a better ranking because we have neither financial power nor human expertise. Countries that are in the top 10, have invented artificial intelligence, said Traian Rebedea, associate professor at the Faculty of Automatic Control and Computers at the University Politehnica of Bucharest, All the faculties of informatics profile in Romania have at least one course of artificial intelligence. But there are also majors with four artificial intelligence courses at bachelor's or master's degrees UPB has developed a group of laboratories of "Product Development" and 3D Printing, reunited under the 3D Labs logo, in which over 70 additive manufacturing machines are available to students. Most of our students have the opportunity to actually make these machines' products that shortly before they only imagined, and then modeled them in 3D, so that they could finally hold them in their own hands and take pride in them. As an example, the bachelor's studies, with a duration of 4 years, are generously represented in the offer of the Faculty of Industrial Engineering and Robotics, which includes 10 bachelor's degree programs: ● Computer science applied in industrial engineering ● Robotics ● Industrial logistics ● Machine building technology ● Engineering and quality management ● Industrial Economic Engineering ● Digital production systems ● Engineering and security in the industry ● Welding engineering ● Industrial engineering ● Industrial informatics. In Romania there is market demand (in Bucharest there are 100 positions that cannot be filled), but not the offer. It aims to bring to Romania the experts in the field, Romanians from Diaspora, but also from other countries. The International Center of Excellence in Artificial Intelligence, of UPB in partnership with the University of Medicine and Pharmacy "Carol Davila" of Bucharest, the National University of Theatrical and Cinematographic Art "I.L. Caragiale" and the Technical University of the Republic of Moldova opened at the Polytechnic University of Bucharest. The Center aims to establish partnerships and develop joint research and development projects with national and multinational companies in Romania and to implement AI solutions in commercial applications. AI technologies can help promote inclusive economic growth, solve global challenges - such as climate change and improved healthcare - and also in the fight against pandemics. The areas addressed within the center will range from the use of AI in medical, educational applications, robotics, cyber security, to supporting industrial areas of interest in Romania - including by formulating policies to support the industry. Through the center of excellence, the consortium also aims to attract young talents interested in developing the field.

	https://train.uvt.ro/ The West University of Timisoara (UVT) launched in 2021 an Artificial Intelligence (AI) HUB: "Timisoara Research in Artificial Intelligence Network (TRAIN)" - the new UVT platform for research, innovation and development, which will have the role of knowledge and education ecosystem based on artificial intelligence networks and algorithms. The platform facilitates the development of Artificial Intelligence (AI) applications will be piloted, through which UVT will become a HUB for stimulating research and educational development in this field, in the Banat region, with a national and European perspective. **XAI.Doc:**: A considerable resource of up to date and curated information on all facets of explainable artificial intelligence. **AI.Education:**: Support for AI education in the region, with internationally trained professors and experienced practitioners. We offer machine learning, intelligent systems, biostatistics and bioinformatics courses. **AI.Hub:**: the collaborative AI forum with no boundaries between academia and industry, offering to inter-share the knowledge existenting in the region and eventually to become a national pole in explainable artificial intelligence (XAI) that can attract AI specialists and industry R&D in the region. https://train.uvt.ro/ The Department of Engineering and Computer Science of Spiru Haret University is based on a large team having expertise in Mathematics, Computer Science, and Computer Engineering, being engaged in theoretical and applied research in scientific fields like: Bio-mechanics and dynamic systems, Advanced computing (numerical, data science, big data), Special topics in Geometry and Mathematical Analysis including Fractals, Scalable distributed systems, Formal methods, algorithms, and data structures, Advanced WEB technologies and databases, Cybersecurity, Blockchain, Optimization methods for mobile networks, Machine learning and special topics of Artificial intelligence and computer vision including image/video processing and analysis, Smart ICT, Data analytics, IoT, and Software engineering for desktop, mobile and real time applications. The graduates received training in programming (Python/Tensorflow, C++/C#, Java), developing databases in Oracle, developing games and artificial intelligence applications (fuzzy models, genetic models, deep learning artificial neural networks, nature-inspired techniques, biometric models etc). If working as teachers in secondary education or high schools, the graduates are able to teach artificial intelligence due to their strong background in using artificial intelligence models, reasoning systems, and AI/ML tools.
Non Formal Education	https://train.uvt.ro/ **AI.Education:**: Support for AI education in the region, with internationally trained professors and experienced practitioners. We offer machine learning, intelligent systems, biostatistics and bioinformatics courses. **AI.Europa:**: Scientific collaboration with ELLIS (European Lab for Learning and Intelligent Systems) and institutional collaboration with UNITA, an alliance of six European comprehensive research universities (http://univ-unita.eu).

Spiru Haret, a national leader in connecting digitalization and AI to the businesses is coordinator of European Digital Innovation Hub Walachi EHub

Spiru Haret University (USH), founded in 1991, is the largest private university of Romania. USH through its USH Pro Business centre is the main founder and coordinator of 2 national consortia of clusters - Inter-Bio (agro-ecology) and Wallachia Hub (organic product, engineering, manufacturing, heritage). In 2018, USH co-founded and manages DIH Smart eHub. In 2019, USH was involved in the creation of WEH, as an extended consortium of regional clusters, hence its capacity to deliver DIH type of services. USH created the USH Pro Business as a dedicated university-led centre for entrepreneurial support activities, in 2015. USH Pro Business was aimed to assist companies and groups of companies or business associations in achieving competitiveness, innovation and internationalisation throughout the business life cycle. It also offers cluster development services, being active in 8 clusters (manufacturing, engineering, food, IT&C, creative industries, constructions).

USH Pro Business is the Project Coordinator and leader of Wallachia eHub (www.wallachiaehub.ro) WEH as a mature and well-connected centre having in composition clusters, technology transfer centres, universities and companies will develop and improve high quality services aligned with EDIH call and best practises in the main area – test before investing, skills and training, innovation ecosystem and networking, support to find investment. In this respect, WEH will develop a range of high technology services in AI, Cybersecurity, digital solutions, interoperability supported by GIS applications, logistics engineering, precision agriculture engineering, Smart City, dual use services, urban planning, project management, BIM, blockchain and training programs on digitalization concepts. a. Support to find investment: This service will entail informing and collaborating to attract national and European funds with an emphasis on financing innovation, digitalization, and internationalisation of companies at regional and national level. The partners of the WEH have successfully used workshops, training courses, matchmaking in writing projects with international or national consultants for access to projects in Horizon Europe, Erasmus+, European Structural and Investment Funds, Financial Instruments. At the same time, universities developed special programs to support innovative start-ups through training, coaching or business acceleration with venture capital. Examples of services to find investment: Business acceleration; Market fit and growth hacking solutions; Start-ups and scale-ups Mentorship; Consultancy for funding and internationalisation; Project management for EDIH; Grant advisory for supporting ICT development. b. Skills and training: WEH project will focus on developing specific curriculum adapted to the needs and digital gaps of each sector. Our network will provide competent trainers, professors and practitioners in the following key enabling technologies: AI, Cybersecurity, robotics, blockchain, Big Data, systems modelling, location-based technologies, interoperability, and digital solutions. These training programmes will be divided in specific training for sectors (virtual digital managers, skills for managers to develop strategic tools of digitalisation and digital innovation, skills for professionals to use the technologies – cybersecurity, artificial intelligence). The outcomes and results of these services will be integrated into a knowledge platform for our clients. The main focus is to strengthen the capacity for adopting advanced technologies. The curriculum will be divided strategically for each type of technology,tailor-made including study-cases and best practices. Our DIH actively contributes in the digital upskilling of labour in the RSM where we operate so that our client SMEs/organisations can make the most of digital innovations technologies. DIH's services include advertising, hosting and/or providing training, boot-camps, traineeships, as well as supporting the implementation of short-term advanced digital skills training courses. WEH project partners will also be actively involved in DTA actions such as train-the-trainers programmes. Examples of skills and training services: training sessions delivered after segmenting types of clients (managers, employees, tailor-made programmes responding to specific needs of SMEs and small mid-caps in the region); adapted training formats (secondment, technology and sectorial specific sessions – digital engineering, green IT, BIM, strategic digital

	transformation, ethics in AI, IoT technology development, basics of cybersecurity for non-IT specialists; optimisation of workflows, Big Data, cloud computing, low-code BPM, chatbots, robotics for agriculture, entrepreneurial digitalisation, etc.) c. Test before investing: The consortium has in place research infrastructure in universities (USH, UPG), in their technological transfer centres, clusters (APT, DEH) and also within some SMEs members premises (OME, BEI, CER). It has also trained human resources practitioners for digital assessment, innovation and technological brokerage. WEH provides services and facilities to raise awareness and provide access to digital transformation expertise and testing and experimentation facilities so that potential beneficiaries can make better decisions for investments that will help them develop improved new products and services. The testing services include the provision of facilities for experimentation of hardware and software, where companies and public actors can come and try out new digital technologies that they may want to start utilising in their processes or incorporate in their services and products. They can also serve as environments where suppliers can showcase technologies for future users, as well as facilities where pilot scale solutions can be tested for development purposes. Examples of test before invest services provided by WEH partners: smart city and urban planning engineering solutions, develop BIM pilot projects (ENC), provision of green building solutions, production monitoring with specialised platforms (KFA), AI algorithms, cybersecurity pen-testing and reports in real-environment simulations (OME); access to open blockchain infrastructure; decision support systems and digital twins (BEI). All these activities will be up for testing, validation, support to scale-up and public demonstrations for showcasing marketable digitally innovative solutions. d. Innovation ecosystem and Networking: WEH´s consortium will use its expertise and network membership in European corridors and international networks to stimulate and promote success stories regarding the digitalization of organisations, member companies; participate in national and international digital events (fairs, exhibitions, conferences, seminars, etc.) as well as annual regional events dedicated to digital transformation where attendees include policy-makers, ICT innovative solutions providers, business management representatives, venture capital, investors; maintain structured long-term relationships with the relevant local actors like regional authorities, industrial clusters, SME associations, business development, agencies, incubators; offer a seamless service with EEN and Start-up Europe by offering joint investor-related events, organising common trainings, workshops or info days; ensure the recognition of DIH both locally and internationally; develop a regional network of universities and research centres with competencies in the field of digitalization; actively contribute to the legislative agenda through public policy proposals or evaluations, ex-ante or ex-post on the impact of public policies related to South Muntenia´s digital transformation implemented at national or regional / local level. Networking and community building activities will generate easy access to leading edge technologies and skills/ expertise at European level; facilitate exchange of good practices to support digital transformation between regional stakeholders, support and initiate new business opportunities to broaden and reinforce innovative markets in other regions, enable cross-border synergies in technology and knowledge.

PART B:	**Elements facilitating an AI Integration in the near Future** (for Teachers)
Courses, Curriculum	Primary school – International Premium School of Bucharest Link: https://isb.ro/Primary/Our-Curriculum.aspx
Educational Material	Link: http://turing.cs.pub.ro/ia_10/
Tools, Platforms	Link: Kahoot, MsScratch, mBlock, OpenRoberta, codeBlock MBot robot https://www.makeblock.com/steam-kits/mbot VR glasses: https://thinklab.salford.ac.uk/2018/10/18/thinklab-show-the-value-of-vr-collaboration-at-gamelab-2018/

Conferences, Publications	Link: https://www.mdpi.com/2071-1050/14/10/5842
Context description	Our education system in the pre-university system did not identify in the curricula AI as a distinctive teaching field. The system has limited abilities in our schools and colleges to offer support to students in this area and even less to personalize it to their needs. Classroom teachers may use computers and the Internet, but they lack abilities for adaptive learning platforms in order to provide the opportunity to the students to add value and take creative benefits of learning with a class group. Personalized instruction is rare in spite of the fact that we assess a range of abilities in our school systems through informal tests and more formal exams. The „passing exams'' mentality, combined with the lack of good practices and exchange of knowledge among colleges is acting as a barrier. Educators are skeptical that the focused curriculum is allowing powerful AI to encroach on their traditional role. Many of them distrust or do not understand AI properly. Therefore, skills and knowledge learnt by students is very limited and out of date or less relevant to a fast-changing workplace. Even more, besides teaching AI to the students, the teachers do not know how they can use AI for pedagogical purposes. In many other countries, digital transformation has brought about positive benefits through a network effect resulting from a larger and more connected system or good practice sharing but not too much in our case. In spite of the rigidity of the public schools, there are alternative teaching opportunities in the private educational institutions which invest more in this area. Schools that are part of larger 360% educational integrated system like USH or chains of schools and colleges better interconnected at regional level do manage to benefit from those close relationships, while the majority do not.
Student perspective	The demands placed on teachers in the classroom have undergone significant shifts (beyond things like the increasing paperwork burden). Teachers' expectations have shifted dramatically due to dramatic transformations in numerous national education policy frameworks and an increasingly diverse student body. As a result of these developments, Romania tends to introduce newer, more demanding national content standards, which require students to demonstrate mastery in the disciplinary practices that require them to use their knowledge rather than just understanding the concepts. In addition, the use of technology by teachers as a vehicle for learning, a means of communicating with parents, and a means of exchanging ideas with other educators has grown in importance. Romanian students and the younger generation seem to be more interested in AI, ML (machine learning) and XR (eXtended Reality) than some teachers. In a survey Romanian students declared that they think that ● AI and ML can enhance customized learning, developing skills among students and providing a collaborative learning environment in the HEI. ● AI and ML can enhance customized learning, keeping lifelong connectivity with alumni, improving the institution's security and efficiency, and offering to researchers an adequate and accessible research environment. AI and ML facilitate the utilization/implementation of XR in teaching and learning processes ● XR facilitates increased motivation, engagement, and learning-by-doing activities between students, offering a realistic environment for learning. ● AI and ML are improving the security and efficiency of the institution, providing a peaceful, flexible, and accessible computing environment for research and developing skills among students, and a collaborative learning environment in the HEI reinforces the importance of AI and ML to enhance customized learning

	● ML is one of the most critical areas that can be used to detect cyber-attacks on the Internet of Things, and it is becoming increasingly important. ML is also capable of identifying sophisticated attacks because of the use of in-depth, knowledge-based techniques ● A machine's ability to learn from experience, adapt to new inputs, and perform specific tasks without human intervention is enabled by AI built into the machine. For example, face recognition, speech recognition, chess game victory, and other similar functions are possible. https://www.mdpi.com/2071-1050/14/10/5842

PART C:	AI in Education Practices
Practice 1:	The Pepper robot, this year completes the endowment with robotics for university activities in UVT by purchasing two SCOUT Mini Pro robots equipped with Nvidia AGX Xavier processor, with an Intel RealSense D435 camera and a VLP-16 lidar. They will play an important role in testing and developing algorithms and software solutions in the field of Computer Vision and Machine Learning, of great interest for both research and the IT production sector. Link: https://sursadevest.ro/inteligenta-artificiala-vine-in-ajutorul-studentilor-de-la-uvt-care-aduce-doi-roboti-noi/

PART D:	Other AI Elements/Initiatives/Practices at National and/or European Level
	XAION:: one of the first platforms for Explainable Artificial Intelligence (XAI) competitions, created to meet the industry needs for outsourcing their AI challenges. Instead of hiring an intern to experiment with an AI prototype, why not create a competition and select the best possible solution from a large pool of participants. **XAIBOT::** A trilingual chatbot (English, Romanian, Serbian) offering guidance related to the XAI concepts, dedicated to meet the needs of the users in the region. **XAI.Pro::** A complete implementation and deployment of an XAI project with an intuitive visual interface, to understand the power of the explainable AI technology (in Romanian). Link:
	Link: https://www.globema.ro/artificial-intelligence-machine-learning/
	Link: https://www.edupedu.ro/viata-intre-roboti-si-inteligenta-artificiala-p/

ANNEX 3 - FOCUS GROUP

Focus Group with AI Experts

Tuesday 26 July 2022

The scope of this Focus Group is to discuss and validate with the invited AI experts the "why", "what", "how" on facilitating the introduction of AI in schools, based on the project developed Framework.

Suggested topics and questions for the discussion with the AI experts

(Each question links to the related page)

Version 2: 19 August 2022

0. INTRODUCTION: Erasmus+ Project "FACILITATE-AI"

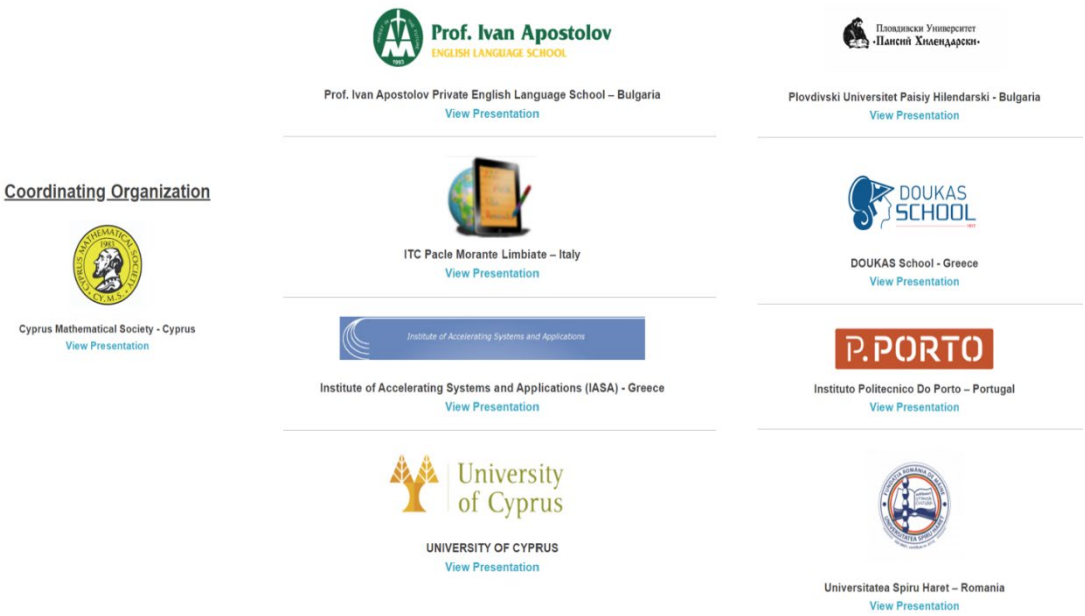
Guidelines for facilitating the learning of Artificial Intelligence (AI) by School Students of Grades 7-12

The aim of the FACILITATE-AI project is to support school teachers (the facilitators of learning) in developing an inquiry base and evidence-based understanding of the complexities and principles of AI, the algorithmic creative thinking, and how these can be integrated in the school students' learning process for promoting creative problem solving, adaptability to change, and progressive design through a STEAME interdisciplinary approach. The three results of the project will be:

Result 1: AI Teaching Guide for teachers facilitating the learning of students in grades 7-12

Result 2: Training Course for Facilitators of learning in AI-STEAME education

Result 3: Dynamic Online Learning Environment with OER on AI in interdisciplinary STEAME school subjects with a set of Blueprint Policy Recommendations



The focus group was based on semi-structured interview questions that investigated key issues in the field of AI integration in education through an inquiry based and evidence-based approach. The focus Group was held on Tuesday, July 26, 2022, with thirteen participants from different countries. Participants included engaged instructors, persons with extensive educational background, and AI experts. Their areas of competence varied, encompassing a wide range of school-taught disciplines and AI knowledge.

The procedure went smoothly, and the conversation brought up some interesting points. Instead of signing consent forms, participants were told about the meeting's recording and agreed to the GDPR alignment in regard to the keeping of the data, the research purpose of its use, the ability to ask to erase any information relating to them, etc. As a result, we have documentation that the participants agreed to be recorded for transcribing reasons and were informed that following the development of this report the recorded video would be deleted.

List of* 11 AI Experts *and Partners' Participants:

Moderators

- Eleni Adamidi - PhD in Electrical and Computer Engineering, NTUA Member of the ATLAS Experimental Physics Department (EP-UAT), CERN, IASA Researcher
- Yannis Kotsanis - PhD in Electrical and Computer Engineering, NTUA, Head of the R&D Dept at Doukas School

Portugal

- Luís Ferreira - Researcher at 2Ai – Artificial Intelligence Laboratory, head of the Master's Degree in Computer Engineering at IPCA (Polytechnic of Cávado and Ave)
- José Cerqueira - He is a high school teacher with a master degree on game development, uses VR/AR on teaching and currently has a project on fighting phobia of speaking in public.

Bulgaria

- Stanimir Stoyanov - AI academic expertise
- Sava Grozdev - AI academic and education expertise

- Veneta Tabakova-Komsalova - AI academic and education expertise
- Momchil Benov

Romania

- Anatol Oprea - Banking financial AI company, environment processing purposes
- Alina Luchian - SAS România, coordonează programul educațional SAS
- Și Florin Grosu - Traderion Inc, Academic
- Costin Lianu - Associate Professor, Prorector & General Manager USH Pro Business, Spiru Haret University
- Rocsana B. Manea Tonis - Associate Prof. PhD.

Netherlands

- Dagmar Heeg - MSc degree in Science Education and Communication, PhD Student at ISEC at the University of Groningen

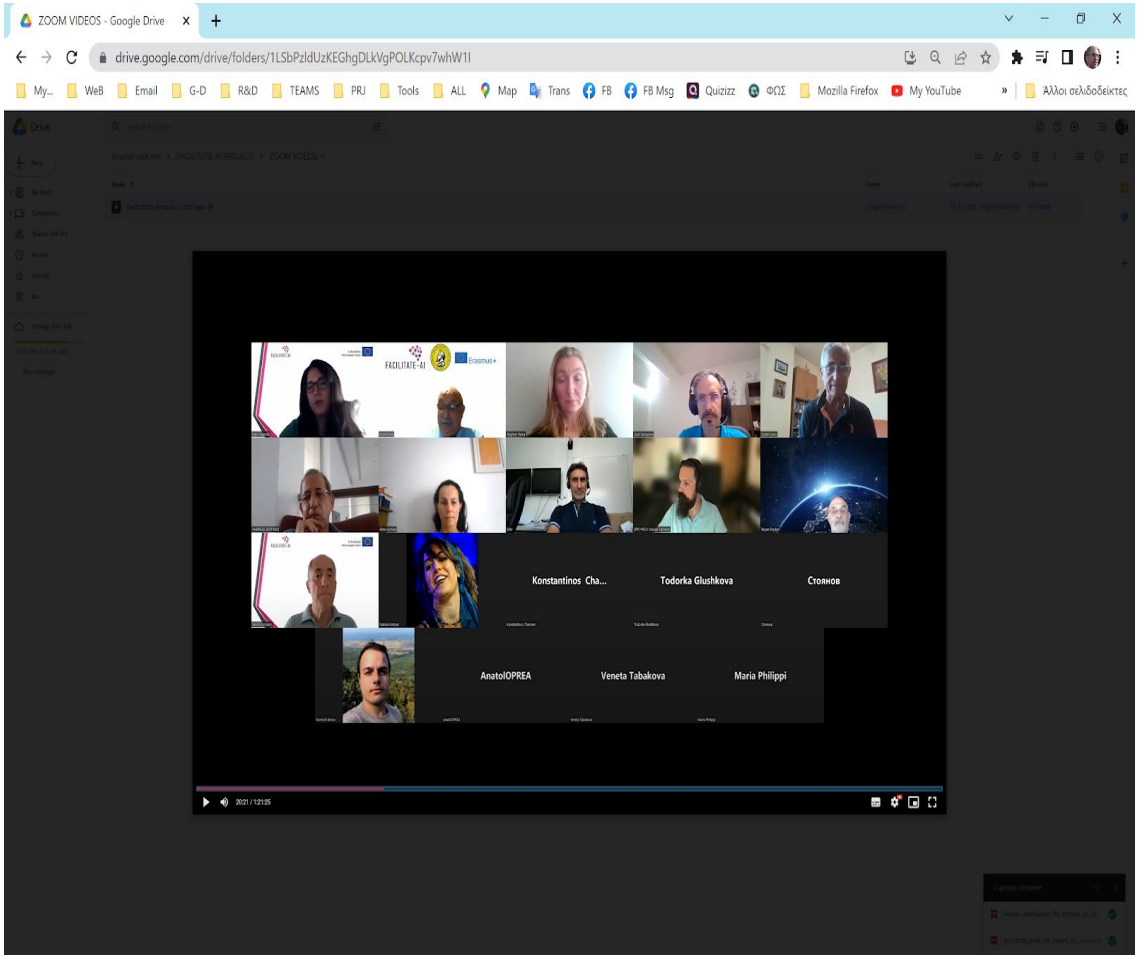
Greece

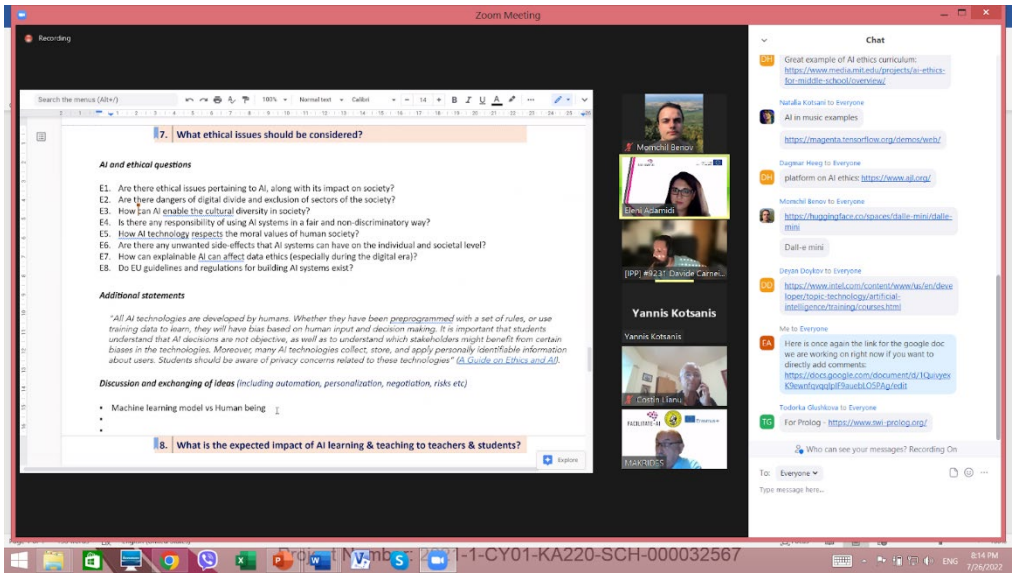
- Natalia Kotsani - AI and Music Researcher at NTUA/EKPA - Machine Learning, Music Information Retrieval, Computational Ethno-musicology
- Maria Philippi - Head the Informatics and Digital Education at Doukas School
- Konstantinos Charonis - Researcher and Robotics & Coding Instructor at Doukas School

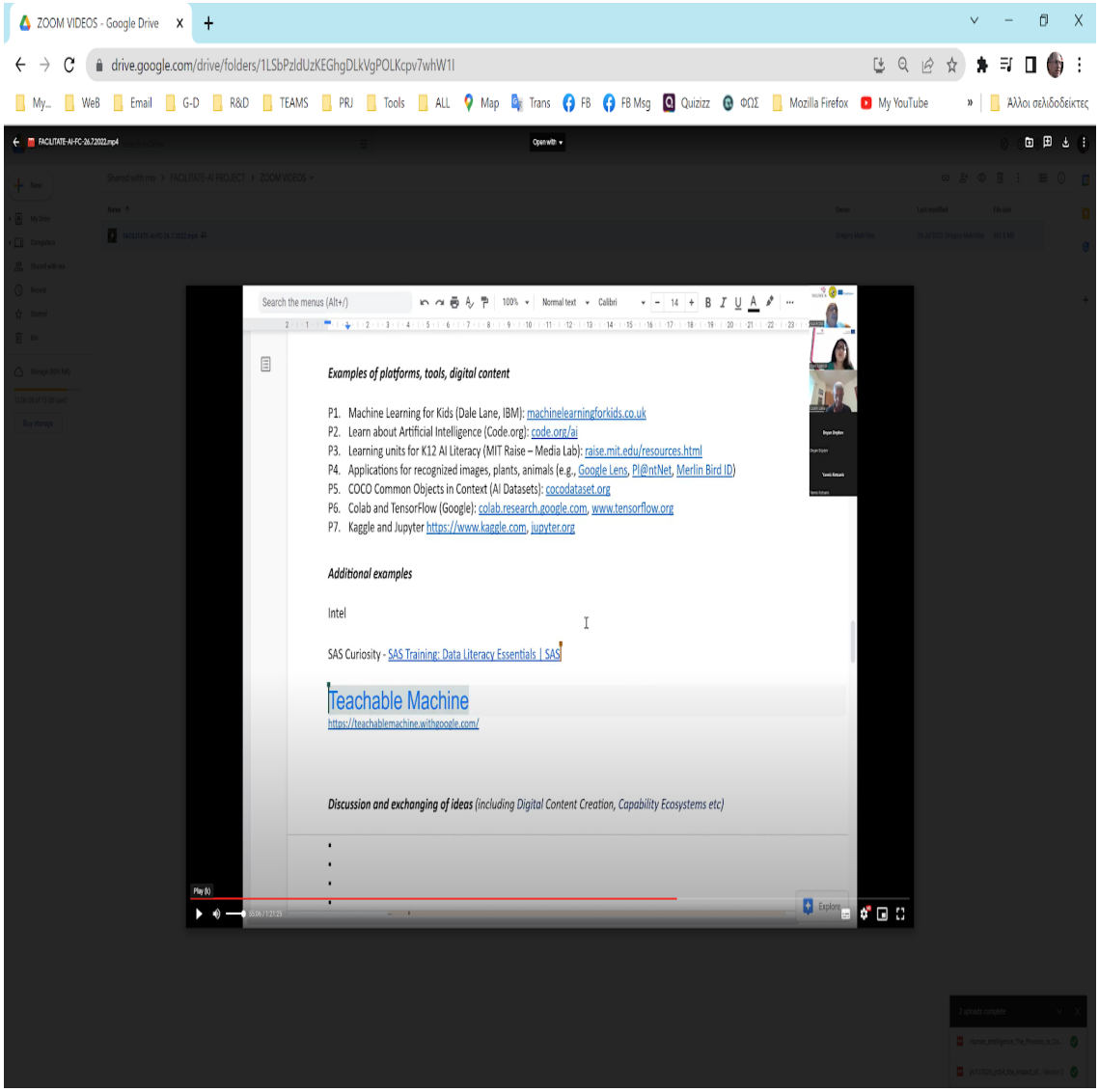
Cyprus

- Gregory Makrides - President European Association of ERASMUS Coordinator, President THALES Foundation, Professor at Pedagogical University of Krakow
- Antonis Kakas – Professor at University of Cyprus
- Andreas Skotinos - Cyprus Mathematical Society

Screenshots from the Focus Group







1. Why introduce AI in Secondary Education, with what objectives?

The objectives of the "FACILITATE AI" Project

1. Support school "facilitators for learning" in their understanding of ***AI use in everyday life***.
2. Prepare school teachers to develop competences in line with an ***AI Digital Competence Framework.***
3. Prepare schoolteachers to become ***good facilitators of teaching AI*** to students and to develop methodologies while taking into account AI applications along with their strengths and weaknesses.
4. Enhance digital competences required at a young age, such as good understanding of what AI is, to achieve the ***digital transformation***.
5. Support teachers and students in developing problem-solving skills, computational thinking and design thinking ***involving AI tools and methods.***
6. Recognize the ***value of the use of AI technology*** in/on our society, its numerous applications and as well as the green economy.

Additional objectives of the "FACILITATE AI" Project

O7. Relation with Project Based Learning
O8. What is intelligence and what are the characteristics that portray it in the human condition? (See Annex - email discussion)

Discussion and exchanging of ideas

An important addition to the project's objectives would be to teach students about the ethical issues around AI, for example the AI bias, which can have a big impact in students' life in general. One of the main reasons we should teach young students about AI ethics is to become critical consumers of this new technology that they will be unable to "avoid" in the future. We should prepare them for the "AI future" because AI is everywhere in our life already. It would be also important, another participant mentioned, to relate the AI with project-based learning such as STEAME activities which includes the entrepreneur element too. This could be done not only by IT teachers but also from physics, mathematics, or management teachers too.

Another objective that was mentioned in the after the FG email communication is "What is intelligence and what are the characteristics that portray it in the human condition?". It can be a momentum for the understanding of the whole topic of AI and provide the context in which we are expecting digital means to develop and be applied in the future. Thus, it provides the basis for the need to indulge in AI not only from the point of view of pure applications, that have as origin the technological developments in the field of AI, but also from the consideration of the prospects of extending it as a tool in broader areas that the humans might need support and conceptions. In this consideration of intelligence - not only the psychological and philosophical determinants of the term - but also the ingredients that lead to critical thinking, problem solving, innovation and creativity and thus providing a foundation for further expansion of AI. This requirement from the school students is fundamental because they must be prepared as future citizens to be innovative and not just users of the existing creations.

2. What elements/topics/modules for an AI Training can we include??

The 8 Modules of introducing AI to Teachers *(designed by FACILITATE AI for the LTTA)*

AI STEAME models of Learning
1. AI in our life…
2. Basics of AI
3. Teaching through games competitions - cooperation
4. Digital Skills & Data Literacy
5. Building an AI model
6. Innovation - Creativity - Entrepreneurship
7. Ethics…

Additional topics/modules of introducing AI to Teachers

M9. Collecting/analysing the correct data

M10. The importance of AI in our everyday life and business

M11. AI for life

Discussion and exchanging of ideas

Some participants proposed to emphasise on some statistics subjects such as linear concepts because AI involves a lot of data manipulation, and everything is about collecting the right data and analyzing them in the right way with the right tools. These can be included in the "basics of AI" module with maybe the addition of some logical programming topics too. A proposal was the first module be the "basics of AI" and the renaming of "AI in our life" to "AI for life". It should be concerned with the level of the modules not to be too sophisticated but be presented in an attractive and popular way e.g., through practical games and game competition. Additionally, it was proposed for a module to focus on machine learning, but the problem is that linear algebra background knowledge is needed. Perhaps some activities including basic data sets scenarios would be the key to address this matter.

3. What competences can we develop (for teachers and their students)?

*The suggested FACILITATE COMPETENCE FRAMEWORK has **5 Competences Areas and 43 Competences***

Framew. No	AI Framework Areas	*Including:*
C1-T&L	Teaching & Learning	*Strategies, Empowering Learners, Assessment*
C2-I&D	Information & Digital Literacy	*Digital Sources, Digital Creation, Coding*
C3-C&C	Communication & Collaboration	*Motivation, Teamwork, Sharing, Promoting*
C4-C&I	Creation & Innovation	*Problem Solving, Creative Thinking, Reasoning*
C5-E&E	Emotion & Ethics	*Attitudes-Values, Social Emotional Skills, Privacy*

*Regarding this matter, during the FG, the five agreed upon categories were simply presented as it would be very difficult to validate the framework online. With this 2-page document AI experts can provide their ideas and comments or/and express their level of agreement for each one of the 43 competences from lowest to highest, or/and suggest a new one! The Framework including Learning Modules is **here**.*

Area A: Teaching & Learning	low	...	...	...	high
1. Acquiring specific transferable achievements	☐	☐	☐	☐	☐
2. Actively engaging learners	☐	☐	☐	☐	☐
3. Adapting accessibility and inclusion	☐	☐	☐	☐	☐
4. Adapting differentiation and personalization	☐	☐	☐	☐	☐
5. Adopting new methods of teaching and learning	☐	☐	☐	☐	☐
6. Creatively using & interacting with digital technology	☐	☐	☐	☐	☐
7. Eliminating disadvantages	☐	☐	☐	☐	☐
8. Enhancing the activities for learning	☐	☐	☐	☐	☐
9. Enhancing the effectiveness of teaching	☐	☐	☐	☐	☐
10. Ensure continuous professional development	☐	☐	☐	☐	☐
11. Identifying needs and technological responses	☐	☐	☐	☐	☐
12. Implementing learning plans	☐	☐	☐	☐	☐
13. Providing feedback to learners	☐	☐	☐	☐	☐
14. Self-regulated learning	☐	☐	☐	☐	☐
15. Using assessment strategies	☐	☐	☐	☐	☐

Area B: Information & Digital Resources	low	...	...	...	high
1. Applying algorithms	☐	☐	☐	☐	☐
2. Critical navigation	☐	☐	☐	☐	☐
3. Developing digital content	☐	☐	☐	☐	☐
4. Exploring & evaluating information and digital content	☐	☐	☐	☐	☐
5. Managing data and digital content	☐	☐	☐	☐	☐
6. Processing data and digital content	☐	☐	☐	☐	☐

Area C: Communication & Collaboration	low	...	...	...	high
1. Actively engaging learners	☐	☐	☐	☐	☐
2. Collaborating through digital technologies	☐	☐	☐	☐	☐
3. Communicating computational thinking	☐	☐	☐	☐	☐
4. Communicating technology responsively	☐	☐	☐	☐	☐
5. Identifying digital gaps	☐	☐	☐	☐	☐
6. Interacting through digital technologies	☐	☐	☐	☐	☐
7. Sharing through digital technologies	☐	☐	☐	☐	☐

Area D: Creation & Innovation	low	...	...	...	high
1. Actively enabling learners	☐	☐	☐	☐	☐
2. Adapting technology to create knowledge	☐	☐	☐	☐	☐
3. Creating content responsively	☐	☐	☐	☐	☐
4. Creatively using digital technology	☐	☐	☐	☐	☐
5. Identifying digital gaps	☐	☐	☐	☐	☐
6. Knowledge of existing innovation ecosystems	☐	☐	☐	☐	☐
7. Knowledge of the strategic framework of innovation	☐	☐	☐	☐	☐
8. Proposing creative solutions to problems	☐	☐	☐	☐	☐
9. Representation and reasoning	☐	☐	☐	☐	☐
10. Using processes for implementing innovation management	☐	☐	☐	☐	☐

Area E: Emotion & Ethics	low	...	...	...	high
1. Awareness of digital division and exlusion	☐	☐	☐	☐	☐
2. Awareness of machine ethics	☐	☐	☐	☐	☐
3. Awareness of guidelines for ethical systems	☐	☐	☐	☐	☐
4. Protecting privacy	☐	☐	☐	☐	☐
5. Respecting safety and well-being	☐	☐	☐	☐	☐

Rubric: Experts' Level of agreement from lowest ☐☐☐☐☐to highest

4. How can we introduce AI, with which methodologies?

The methodologies of introducing AI to Teachers

1. Inquiry-Based Learning
2. Problem-Based Learning
3. Project-Based Learning
4. Game-based Learning
5. Gamification
6. Case studies

Additional topics/modules of an AI Training

L7. Serious games
L8. Design thinking – learning (of products)

Discussion and exchanging of ideas

Some extra educational methodologies could be the serious games and the design learning (of products and projects for example) and thinking a participant added. Furthermore, a relation to huge, real life, technology companies that AI is essential for them - Google, Amazon, etc. - could introduce, engage, and draw student's attention regarding AI. Everyday AI tools can be used too, like face recognition, as practical examples to make AI familiar to students.

5. Which platforms, tools, digital content can you recommend?

Examples of platforms, tools, digital content

1. Machine Learning for Kids (Dale Lane, IBM): machinelearningforkids.co.uk
2. Learn about Artificial Intelligence (Code.org): code.org/ai
3. Learning units for K12 AI Literacy (MIT Raise – Media Lab): raise.mit.edu/resources.html
4. Applications for recognized images, plants, animals (e.g., Google Lens, Pl@ntNet, Merlin Bird ID)
5. COCO Common Objects in Context (AI Datasets): cocodataset.org
6. Colab and TensorFlow (Google): colab.research.google.com, www.tensorflow.org
7. Kaggle and Jupyter https://www.kaggle.com, jupyter.org

Additional examples of platforms and tools that the participants reported

- Courses (intel.com)
  Learn AI concepts and follow hands-on exercises with free self-paced courses and on-demand webinars that cover a wide range of AI topics. The content is designed for software developers, data scientists, and students. It provides a great introduction to the optimized libraries, frameworks, and tools that make up the end-to-end Intel® AI software suite.
- Platform on AI ethics
  The Algorithmic Justice League's mission is to raise awareness about the impacts of AI, equip advocates with empirical research, build the voice and choice of the most impacted communities, and galvanize researchers, policy makers, and industry practitioners to mitigate AI harms/biases. Teachable Machine
  Teachable Machine is a web-based tool that makes creating machine learning models fast, easy, and accessible to everyone. Gather and group your examples into classes, or categories, that you want the computer to learn. Train your model, then instantly test it out to see whether it can correctly classify new examples. Export your model for your projects: sites, apps, and more. You can download your model or host it online.
- Paint with Machine Learning
  This web app allows you to create a landscape painting in the style of Bob Ross using a deep learning model served using a Spell model server. To do so, paint some shapes on the canvas with a set of thematic (trees, mountains, etcetera) brushes provided to you. The shapes you paint are sent to a model server endpoint, which computes an output and presents it on the other screen.

- Great example of AI ethics curriculum
  This project seeks to develop an open source curriculum for middle school students on the topic of artificial intelligence. Through a series of lessons and activities, students learn technical concepts—such as how to train a simple classifier—and the ethical implications those technical concepts entail, such as algorithmic bias.
- AI in music examples
  Browser-based applications, many of which are implemented with TensorFlow.js for WebGL-accelerated inference.
- Dall-e mini: (Craiyon, formerly DALL-E mini)
  AI model generating images from any prompt and AI model drawing images from any prompt.

6. What resources, good practices, activities can you recommend?

Examples of resources, good practices, activities

1. DigComp 2.2 (EU, *with AI tags*): publications.jrc.ec.europa.eu/repository/handle/JRC128415
2. Artificial Intelligence in Education (ISTE): www.iste.org/areas-of-focus/AI-in-education
3. Artificial Intelligence in Education (UNESCO): en.unesco.org/artificial-intelligence/education
4. Hands-On AI Projects for the Classroom, A Guide on Ethics and AI (ISTE): cdn.iste.org/www-root/2021-10/AI_Ethics_Guide_EN.pdf
5. Elements of AI (Reaktor, University of Helsinki): www.elementsofai.com
6. Experiments with Google: experiments.withgoogle.com
7. Best Practices (*collection from "Generation AI" Project*): generation-ai.eu/best-practices

Additional examples

- SAS Training: Data Literacy Essentials | SAS
  Fast-paced course follows the journeys of a concerned parent, a small business owner and a public health expert who rely on data to navigate the COVID-19 pandemic. Access the course to connect skills to strategies for engaging with data in more meaningful ways.

- Courses (intel.com)
  Learn AI concepts and follow hands-on exercises with free self-paced courses and on-demand webinars that cover a wide range of AI topics. The content is designed for software developers, data scientists, and students. It provides a great introduction to the optimized libraries, frameworks, and tools that make up the end-to-end Intel® AI software suite.

- AI textbooks
  Also it was reported that a version of AI textbooks (in Bulgarian language) will be shared and translated by the participants of the project as an extra AI resource.

7. What ethical issues should be considered?

AI and ethical questions

1. Are there ethical issues pertaining to AI, along with its impact on society?
2. Are there dangers of digital divide and exclusion of sectors of the society?
3. How can AI enable cultural diversity in society?
4. Is there any responsibility of using AI systems in a fair and non-discriminatory way?
5. How does AI technology respect the moral values of human society?
6. Are there any unwanted side-effects that AI systems can have on the individual and societal level?
7. How can explainable AI affect data ethics (especially during the digital era)?
8. Do EU guidelines and regulations for building AI systems exist?

Additional statements

> *"All AI technologies are developed by humans. Whether they have been pre programmed with a set of rules, or use training data to learn, they will have bias based on human input and decision making. It is important that students understand that AI decisions are not objective, as well as to understand which stakeholders might benefit from certain biases in the technologies. Moreover, many AI technologies collect, store, and apply personally identifiable information about users. Students should be aware of privacy concerns related to these technologies" (A Guide on Ethics and AI).*

Discussion and exchanging of ideas *(including automation, personalization, negotiation, risks etc)*

- Machine learning model vs Human being
- Background of students on ethics
- Prerequisite on other subjects (e.g., mathematics)

An AI expert reported that a computer does what is told to do and that makes it very reliable. AI models which are very successful in predicting patterns for example, most of the time do what they are made to do in contrast with human beings which are making more mistakes even ethical ones. Any type of model that is created in a technological way is less likely to make ethical mistakes.

Additionally, there was a suggestion that students should have a background on ethics in general and prerequisite on other subjects (e.g., mathematics) to transition smoothly to AI ethics. "Bad" examples of AI, like AI bias, can be presented as practical examples to help students understand the issues. A Harvard paper discussing these subjects: *How Ai Fails Us (harvard.edu)*.

8. What is the expected impact of AI learning and teaching to teachers and students?

The impact of AI learning and teaching

1. Easy access to ***innovative and new learning material*** through easy online sharing systems.
2. More opportunities to ***collaborate and experiment*** on an international scale.
3. Better connection to ***the world of schools***.
4. Flexible access and attention to the ***core business of learning and creativity***
5. Freedom to focus on education to the ***needs of the future***.
6. Better understanding of ***long-term visions*** in education.
7. Considerable ***professional development*** and better skills of educators.

Exchanging of ideas

The impact of AI learning and teaching can originate not only from the point of view of using pure applications, that have as origin the technological developments in the field of AI, but also from the consideration of the prospects of extending it as a tool in broader areas that the humans might need support and conceptions. In this consideration of intelligence, we can also focus on the ingredients that lead to critical thinking, problem solving, innovation and creativity and thus providing a foundation for further expansion of AI. This requirement from the school students is fundamental, because we have to prepare the future citizens to be innovative and not just users of the existing creations.

A mission could also be to raise awareness about the impacts of AI, build the voice and choice of the most impacted communities, and stimulate researchers, policy makers, and industry practitioners to mitigate AI harms/biases. An example is to build a movement to shift the AI ecosystem towards equitable and accountable AI.

9. Do you want to add something else?

Other elements could include:

- The market for A.I. and level of investment (e.g., in new technologies and A.I. start-ups)
- The risks related to A.I.
- Company projects and services/products offered
- Sustainable development projects
- Model standardization
- Quality of IT processes

A topic that was discussed in the email communication after the FG was if the “What is intelligence and what are the characteristics that portray it in the human condition?” should be added in the objectives of the project. A participant reported that this suggestion makes sense since the "genus proximum" of AI is intelligence itself in terms of categories and concepts. However, as one may notice intelligence is a psychological and philosophical term, subject to many interpretations in the theory of knowledge and should be very cautious to choose a definition and features of the concept acceptable to the logical framework of AI development. Making it as an objective implies entering the realm of philosophy and psychology, explaining currents of thoughts and theories at the level of a student. ARTIFICIAL INTELLIGENCE VS. HUMAN INTELLIGENCE – WHICH ONE YOU’D PREFER TO HIRE could possibly help on how to make this topic simpler.

10. ANNEX: Focus Group Chatting and Email Communication

Annex 1 - Focus Group Chatting

From **Alina Luchian** to Everyone 07:30 PM
AI free of charge programs: https://www.sas.com/en_us/learn/academic-programs.html
teaching & learning. alina.luchian@sas.com

From **Alina Luchian** to Everyone 07:39 PM
M5. Data Literacy: https://curiosity.sas.com/en/courses/data-literacy-essentials.html

From **Dagmar Heeg** to Everyone 07:59 PM
Great example of AI ethics curriculum: https://www.media.mit.edu/projects/ai-ethics-for-middle-school/overview/

From **Natalia Kotsani** to Everyone 07:59 PM
AI in music examples
https://magenta.tensorflow.org/demos/web/

From **Dagmar Heeg** to Everyone 08:00 PM
Platform on AI ethics: https://www.ajl.org/

From **Momchil Benov** to Everyone 08:01 PM
https://huggingface.co/spaces/dalle-mini/dalle-mini Dall-e mini

From **Deyan Doykov** to Everyone 08:01 PM
https://www.intel.com/content/www/us/en/developer/topic-technology/artificial-intelligence/training/courses.html

From **Todorka Glushkova** to Everyone 08:08 PM
For Prolog - https://www.swi-prolog.org/

From **Todorka Glushkova** to Everyone 08:14 PM
We will upload a pdf version of AI textbooks (in Bulgarian) in GD.

From **Natalia Kotsani** to Everyone 08:19 PM
https://ethics.harvard.edu/files/center-for-ethics/files/aifailsus.jhdcarr_final_2.pdf?m=1651510742

Annex 2 – Email communication after the Focus Group

Andreas Skotinos

As far as the objectives I would like to add another one, which I believe will be a momentum for the understanding of the whole topic of AI and provide the context in which we are expecting digital means to develop and be applied in the future. My proposal is What is intelligence and what are the characteristics that portray it in the human condition? Thus, we are providing the basis for the need to indulge in AI not only from the point of view of pure applications, that have as origin the technological developments in the field of AI, but also from the consideration of the prospects of extending it as a tool in broader areas that the humans might need support and conceptions. In this consideration of intelligence, I do not mean only the psychological and philosophical determinants of the term but also the ingredients that lead to critical thinking, problem solving, innovation and creativity and thus providing a foundation for further expansion of AI. This requirement from the school students is, in my view, fundamental, because we have to prepare the future citizens to be innovative and not just users of the existing creations. In a sense the consideration of "what is intelligence" provides also a context for the issues that you mention like the ethical questions.

(Certainly, here I do not mean only Aristotle!!!) With this in mind we might need to reconsider the training courses as well.

Sava Grozdev
I find the suggestions of Andreas Skotinos quite interesting and important. In my humble opinion we should support them. The suggestions are connected with expansion of AI leading to problem solving, creativity, etc. Thank you, Andreas!

Costin Lianu
What Andreas is suggesting makes sense since the "genus proximum" of AI is intelligence itself in terms of categories and concepts. However, as one may notice intelligence is a psychological and philosophical term, subject to many interpretations in the theory of knowledge and we should be very cautious to choose a definition and features of the concept acceptable to the logical framework of AI development. Making it as an objective implies entering into the realm of philosophy and psychology, explaining currents of thoughts and theories at the level of a student? Even debates about ingredients of intelligence are not yet based on a scientific consensus.

Antonis Kakas
Costin's comments are legitimate concerns. But the fact remains that AI is concerned with the inner nature of intelligence and would be unwise to ignore this completely. One definition of AI is "The study of (human) intelligence in artifact forms."

Andreas Skotinos
Concerning my suggestion for consideration of the term “Intelligence” I would like to add that what I would expect is not indulging in depth on its concepts, but only the basic ideas that will create the momentum for going into AI concepts and processes. In order to clarify my thoughts and admit that I am very “naïve” I am going to set down a very primitive example or joke which I believe justifies my point.
George received a bill from the waterboard asking him to pay €0,00 for the consumption of water on his premises for the period of June 1980 to July 1980 by the 30/08/1980. Obviously (is that an intelligent thought?) he did not do anything considering that it was a formality by the computer.
In September George received a note from the waterboard saying that he did not fulfill his obligation to pay the amount of €0,00 for the consumption of water on his premises for the period of June 1980 to July 1980 by the 30/08/1980. Furthermore it was stressed that in case he did not pay this amount by the 15 October 1980, the waterboard would proceed to interrupt the water supply to his premises.
In view of that he discussed the issue with his friend Andreas and Andreas suggested to him. Why don’t you send a cheque to the computer of the company writing on it the amount of €0,00, so that you satisfy the computer and fulfill your obligations?
I have the impression that this example indulges in the basic ideas of human intelligence as well as to the need of “proceeding to teach the machines” on how to think and mimic human intelligence. I have to stress again that I am not an expert, and I am very naïve in my way of thinking, but I believe that this is exactly what is needed if we want to provide elements of AI to school students (that are still far away from the university level).

Costin Lianu
Let me be clear. I fully agree it is important as objective and congratulation to Andreas to put it. My concern is how to make it simple using the "Occam razor". Here is a possibility : https://skywell.software/blog/artificial-intelligence-vs-human-intelligence/ As an internal base for debates to reach a consensus among us, here recent research just to see the complexity. The old debate, simple explanations to complex phenomena.

Antonis Kakas

I agree with Costin that the challenge is to find an "economical" way to address the issue. I could come up with some suggestions, but I would need some time as I am so busy, probably till the end of September.

NOTES

This project intends to produce Policy Recommendations that can be adapted by European National Authorities for implementation; therefore, a transnational partnership will help to adapt the results to different European curricula and practices in Education, making the results easier for adaptation throughout Europe. Creating better content that facilitates the learning of AI and collaboration with an international team will apply different experiences and realities in this area. The possibility of creating several programmes that are very oriented towards specific skills is highly motivating when it is done in a multidisciplinary and multilateral cooperation. The project results can have a real impact not only at the level of partner organizations but also at the National, European and International level. In a collaborative way it is easier to find the answer to a problem that at the moment does not have an interesting solution. Cultural and educational differences in countries of origin could give clues to something viable at the international level AI training is of paramount importance in the goals of many partners. Cooperating with transnational partners to achieve the project objectives includes several benefits such as solving barriers beyond borders. AI technology is a great example of providing adaptable and scalable solutions in worldwide challenges such as environmental crisis. Moreover, AI as a technology has a multidisciplinary core that can be addressed by collaborations between different scientists from various countries by exchanging knowledge and new ideas and providing solutions for inclusiveness.

AI thinking and creativity needs to begin from the school education and therefore we consider the proposed Results as a need for the future of humanity for evolving into digital transformation. As AI has to be interdisciplinary, the intersection with STEAME subjects and beyond in embedding AI in the school curricula is considered an innovation, which together with STEAME Guidelines developed by other projects, we expect to complete the puzzle of the evolution of future school education. To the best of our knowledge developing AI in the school curricula for the grades 7-12 is new and is following
the recent goals of the European Commission. The development of the training course for teachers and the development of the BluePrint Policy Recommendation is also considered innovative. Some partners have experience in developing AI applications and research results, which will complement the needs of pedagogy in translating scientific results for the needs of school curriculum.

ANNEX 4 - TRAINING MODULES

#	Training Modules		Source 1	Source 2	Source 3
1	**AI STEAME models of Learning**	IT-School CY-CyMS	Artificial Intelligence And Project-Based Learning - eLearning Industry	Integrating PBL Into Online Learning - eLearning Industry	D4.1-PBL-and-AI-community-document.pdf (projectalien.eu)
2	**AI in our life…** *(understand)*	BG-School GR-IASA	Generation AI: Toolkit	Artificial Intelligence In Education (ISTE)	
3	**Basics of AI** *(know)*	BG Univ RO-univ	Generation AI: Toolkit	Artificial Intelligence In Education (ISTE)	An Integrative Framework for AI
4	**Teaching through games competitions - cooperation** *(apply, analyse)*	PT-UNiv BG-Univ GR-IASA	UNESCO Framework	Microsoft Training and events	Generation AI: Teaching Practices
5	**Digital Skills & Data Literacy** *(analyse)*	GR-Doukas CY-CyMS	DigCompEdu Online Testing Tool	Data Literacy Education Framework	Designing Digital Literacy Activities
6	**Training the AI System** *(use/apply)*	GR-IASA PT-Univ GR-Doukas	Cognimates Studio	Data Collection for Machine Learning	
7	**Innovation - Creativity - Entrepreneurship**	RO-Univ IT-School	Intel Skills for Innovation (SFI)	OECD Conceptual Learning Framework	UNESCO Digital Library Technological Innovation in Education (2022-2025) Childhood Education on AI
8	**Ethics about AI**	CY-Univ BG-School	A Guide on Ethics and AI	Ethics of AI in Education	https://www.elevenjournals.com https://www.buckingham.ac.uk

MODULE 1: AI STEAME models of Learning

#	Area	Competence	Short Description *(related to Module Objectives)*
1.1	Teaching and learning	1.1.1. Teaching	*-To design, plan and implement the use of digital technologies in the different stages of the learning process.*
		1.1.2. Guidance	● To use digital technologies and services to enhance the interaction with learners, individually and collectively, within and outside the learning session ● *To use digital technologies to offer timely and targeted guidance and assistance* ● *To experiment with and develop new forms and formats for offering guidance and support*
		1.1.3. Collaborative learning	● *To use digital technologies to foster and enhance learner collaboration* ● *To enable learners to use digital technologies as part of collaborative assignments, as a means of enhancing communication, collaboration and collaborative knowledge creation*
		1.1.4. Self-regulated learning	● *To use digital technologies to support learners' self-regulated learning i.e. to enable learners to plan, monitor and reflect on their own learning, providing evidence of progress, share insights and come up with creative solutions*
1.2	Digital Assessment	1.2.1. Assessment strategies	● To use digital technologies for formative and summative assessment. To enhance the diversity and suitability of assessment formats and approaches
		1.2.3 Feedback and planning	● To use digital technologies to provide targeted and timely feedback to learners. ● To adapt teaching strategies and to provide targeted support, based on the evidence generated by the digital technologies used. ● To enable learners and parents to understand the evidence provided by digital technologies and use it for decision-making.
1.3	Empowering learners	1.3.1. Accessibility and inclusion	● *To ensure accessibility to learning resources and activities, for all learners, including those with special needs.*
		1.3.2. Differentiation and personalisation	● *To use digital technologies to address learners' diverse learning needs, by allowing learners to advance at different levels and speeds, and to follow individual learning pathways and objectives.*
		1.3.3. Engaging learners	● *To use digital technologies to foster learners' active and creative engagement with a subject matter.* ● *To use digital technologies within pedagogic strategies that foster learners' transversal skills, deep thinking and creative expression.*

			● *To open up learning to new, real-world contexts, which involve learners themselves in hands-on activities, scientific investigation or complex problem solving*

MODULE 2: AI in our life…

#	Area	Competence	Short Description *(related to Module Objectives)*
2.1	Information and Data Literacy	2.1.1 Browsing, searching and filtering data, information and digital content 2.1.2 Digital competence	● to locate and retrieve digital data, information and content ● to cross check the relevance of the source and its content ● to store, manage, and organise digital data, information and content ● the confident and critical use of information society technology (IST) and thus basic skills in information and communication technology (ICT) ● knowledge and application of rules for the use of resources, infrastructures and digital spaces. ● knowledge of the foundations of communication
2.2	Computational Thinking	2.2.1 Representation and Reasoning 2.2.2 Collaborating Around Computing	● to recognize how computing and society interact to create opportunities, inequities, responsibilities and threats for individuals and organisations ● learn to recognize where and how computation can be used to enrich data or content to solve discipline specific problems and be able to connect these opportunities to foundational CT practices and CS concepts.Le
2.3	Safety	2.3.1 Protecting personal data and privacy 2.3.2 Promotion of the construction of an adequate digital identity	● to protect personal data, to apply privacy in digital environments and respect intellectual property ● to protect physical and psychological health, and to be aware of digital technologies for social well-being and social inclusion ● to be aware of the environmental impact of digital technologies and their use

#	Area	Competence	Short Description *(related to Module Objectives)*
3.1	Information and Data Literacy	3.1.1. Evaluation data information and digital content	● To recognize the items related to AI ● to perform the analysis, interpretation, comparison and evaluation of sources of data and the information on the basics of AI and its application ● To understand intelligence: to apply the DIKW model in order to evaluate the level of intelligence of Knowledge Representation and Processing Systems (KRPS) ● to apply searches to obtain quality data and information for applying of main AI technologies
		3.1.2. Managing data information and digital content	● to adapt the information, data and content for the most appropriate organization and management of learning process ● to facilitate the process of integrating knowledge from different STEAME school subjects ● to create and share learning resources, to use open licenses and open educational resources
3.2	Digital content creation	3.2.1. Integrating and re-elaborating digital content	● to apply the different ways to modify, refine, improve and integrate simple items of new content and information to create new and original ones
		3.2.2. Programming	● to apply algorithms to solve a simple problem ● to demonstrate the application of various algorithms for finding and solving problems, logical programming and decision making.
3.3	Problem solving	3.3.1. Creatively using digital technology	● to evaluate, select, and use appropriate digital tools and technologies to represent capabilities and basic AI algorithms for planning, decision making, problem solving and learning ● to apply different digital tools and technologies to define problem and select appropriate way for problem solving

		3.3.2. Using different digital tools and technologies for problem solving	● to evaluate different digital tools and technologies that can be used to create knowledge and to innovate processes and products. ● to adapt appropriately various digital tools and technologies for knowledge formation in the learning process.

MODULE 4: Teaching through games competitions - cooperation

#	Area	Competence	Short Description *(related to Module Objectives)*
4.1	Digital resources and information	4.1.1. Selecting, organizing and sharing of data	● to select, identify and evaluate appropriate learning games for teaching and learning ● to organize and share the learning resources
		4.1.2. Evaluating information and digital content	● to evaluate digital resources, connected with teaching through games. ● to select games developed using various AI-technologies and algorithms
4.2	Communication and Collaboration	4.2.1. Interacting through digital technologies	● to interact through a variety of digital technologies ● to understand appropriate digital communication means for a given context.
		4.2.2. Sharing through digital technologies	● to share data, information and digital content with other participants in the learning process through appropriate digital technologies.
		4.2.3. Collaborating through digital technologies	● to use digital tools and technologies for collaborative learning processes, and for co-creation of new data, resources and knowledge.
		4.2.4. Actively Engaging Learners	● to use game elements to motivate students to participate in the learning process ● to stimulate interpersonal relationships through collaboration and competition
4.3	Digital content creation	4.3.1. Developing digital content	● to change and add content according to the requirements of the AI algorithm using the most appropriate formats.

* Ricardo Jorge: *We added this new competence "**Actively engaging learners**" and removed: "**4.2.4. NETIQUETTE**" and "**4.2.5. Managing digital identity**" for different reasons. In the case of NETIQUETTE we think it should move to a previous module at this stage we are already concerned with other topics. As for the competence "Managing digital identity", we think that it is not part of the objective of our project.*

MODULE 5: Digital Skills & Data Literacy

#	Area	Competence	Short Description *(related to Module Objectives)*
5.1	digital resources	5.1.1 selecting, structuring, sharing	● to identify, evaluate and select digital resources for teaching and learning ● to structure digital content and make it available in different formats to different media ● to share resources to media, use open licenses and use as open licenses and open educational resources
		5.1.2 analysing, modifying, creating	● to analyse and modify existing resources and process it in different formats ● to create or co-create new digital educational resources
5.2	data processing	5.2.1 processing	● to process digital material for retrieving information from trained machine
		5.2.2 creating	● to create and process digital material for training the machine
5.3	digital management	5.3.1 organising, implementing	● to identify technological needs and adapt strategies, educational methodologies, and responses, using documented sources ● to turn ideas into action, designing, planning, implementing and evaluating activities and projects to achieve objectives ● to select and use digital devices and networks, including tools and applications, for any educational and administrative activity
		5.3.2 engagement	● to enhance digital relevant activities and practices ● to ensure continuous professional development
5.4	digital responsibility	5.4.1 responsibility	● to apply privacy in digital environments and respect intellectual properties ● to use digital technologies safely, healthy and responsibly

MODULE 6: Building an AI model

#	Area	Competence	Short Description *(related to Module Objectives)*
6.1.	Teaching using IA facilities	Teaching based on IA	Less study material, with better results in practice Learn from practice (learning by doing) Less formal evaluation, better interiorization of the content Memorize less, experiment and play more!
6.2	Learning using IA facilities	Learning competences in IA environment	Critical thinking Collaboration Communication Creativity Technical skills
6.3	New methods adoption	Acquiring new methods of teaching and learning	Experiential teaching and learning (conducting experiments in natural environments or, at least in virtual environments) The interaction of teaching and learning (the formation of small groups that will solve mini-tasks) Learning based on challenges (students need to find solutions to a current problem/ challenge, such as Covid19) Teaching by asking questions (questions for students to find out the content of the course themselves)?
6.4	Students' achievements	Acquiring specific transferable achievements	Digital competencies rather than content Transferable abilities rather than discipline-specific skills problem solving, systemic thinking rather than STEAM (exact sciences, social sciences, physical education)
6.5	Technology adoption	Using new technologies	MOOCs Virtual and augmented reality Simulation software Digital courses (video, PPT, word, pdf, etc.)
6.5	Mitigate On-line teaching disadvantages	Eliminate disadvantages	Lack of authentic learning Lack of interactivity Lack of social-emotional learning Health problems (too much time spent in front of a computer) Lack of specialized exercises / practice (in medicine, physical education, physiotherapy, informatics, physics, chemistry, etc.) Children need parental involvement Multicultural problems

#	Area	Competence	Short Description *(related to Module Objectives)*
7.1	Empowering learners	7.1.1. Engaging learners	● To use digital technologies to foster learners' active and creative engagement with a subject matter learning in a given learning context or for a specific learning objective. ● To use digital technologies within pedagogic strategies that foster learners' transversal skills, deep thinking and creative expression. ● To open up learning to new, real-world contexts, which involve learners themselves in hands-on activities, scientific investigation or complex problem solving.
		7.1.2 Facilitating Learners' Digital Competence	● To find information and resources in digital environments. ● To organise, process, analyse and interpret information. ● To compare and critically evaluate the credibility and reliability of information and its sources
		7.1.3. Facilitating Digital content creation	● To incorporate learning activities, assignments and assessments which require learners to express themselves through digital means. ● To modify and create digital content in different formats. ● To teach learners how copyright and licenses apply to digital content, how to reference sources and attribute licenses.
		7.1.4. Facilitating digital problem solving	● To incorporate learning activities, assignments and assessments which require learners to identify and solve technical problems. ● To transfer technological knowledge creatively to new situations. ● To formulate and express insightful questions and opinions to generate new ideas.
7.2	Digital resources	7.2.1 Creating and modifying digital resources	● To consider the specific learning objective, context, pedagogical approach, and learner group, when adapting or creating digital learning resources. ● To create new digital educational resources. ● To use digital technologies for collaborative processes, and for co-construction and co-creation of resources and knowledge.
7.3	Self-regulated learning	7.3.1. Enabling learners to come up with creative solutions	● To use digital technologies (e.g. blogs, diaries, planning tools) to allow learners to plan their own learning and to record and showcase their work.

			● To use digital technologies to enable learners to reflect on and self-assess their learning process. ● To contribute unique solutions to complex economic, social and environmental problems involving leadership and independent/unconventional thinking.
		7.3.2. Creating digital content responsively	● To encourage students to express themselves through digital means. ● To modify, refine, improve and integrate information and content into an existing body of knowledge. ● To create new, original and relevant content and knowledge
		7.3.3. Solving problems and transferring knowledge creatively to new situations.	● To encourage learners to use digital technologies in innovative ways to create knowledge. ● To encourage learners to seek opportunities for self-development and to keep up-to-date with the digital evolution. ● To take risks in thinking and creating, discovering through inquiry research, and by hypothesizing and experimenting with new strategies or techniques.
7.4	Digital communication & collaboration	7.4.1 Using digital technology responsively	• To participate in society through the use of public and private digital services. • To seek opportunities for self-empowerment and for participatory citizenship through appropriate digital technologies. • To adapt communication strategies to the specific audience. • To demonstrate leadership, initiative, imagination, creativity, spontaneity and ingenuity in a range of creative processes, and motivate others with an ethical entrepreneurial spirit.

#	Area	Competence	Short Description *(related to Module Objectives)*
7.1	Knowledge regarding innovation	7.1.1. Knowledge, understanding and proper use of concepts, techniques, methods and tools for innovation	Acquiring the main agile management techniques and methods Appropriation of important elements on common processes for innovation management and performance indicators for innovation measurement Interpreting the innovation models and experiences of successful companies Explaining and raising awareness of the need for innovation

			Discussing the problem of dual technologies
		7.1.2. Knowledge of the strategic framework of innovation	Knowledge of the strategic framework of innovation at national and European level and of the methods of stimulation Appropriation of important elements regarding the management of intellectual property and technological transfer
7.2	Knowledge transfer through Entrepreneurial University	7.2.1. Structures of innovation facilitators at national and regional level	Knowledge about the existing networks of facilitators existing in university based innovation ecosystems and their role in guiding young students
		7.2.2. Using the framework for implementing innovation management	- Learning the framework for implementing innovation management at company level: innovation objectives and strategy, innovation culture, innovative programs - Learning the important elements regarding the innovator's dilemma, the life cycle of technology adoption, the risks associated with innovation management
7.3	Identifying digital competence gaps in the field of innovation	7.3.1. Open communication with innovation clusters and business hub to solve stightfoword problems	- recognize and explain where digital competence needs to be improved or updated based on innovative technologies identify and indicate where to seek opportunities for business developments and to keep up-to-date with the digital evolution.
		7.3.2. Solving well-defined and non-routine problems and guiding cluster members	- Indicate illustrate and asses how to support cluster members to develop their digital competence • indicate, propose and guide where to seek opportunities/funds for business developments and to keep up-to-date with the digital evolution
		7.3.3. Proposing creative solutions to complex problems related to technology	create solutions and integrate cluster knowledge to complex problems with limited definition that are related to improving digital competence, and to find opportunities for self-development and to keep up-to-date with new developments.

		7.3.4 Propose new ideas, methods, methodologies, policies	- • create solutions to solve complex problems with many interacting factors that are related to improving digital competence, and to find opportunities for self-development and to keep up-to-date with the digital evolution. - propose new ideas and processes to the field
7.4.	Solving technical problems	-	- Differentiate and create solutions to complex problems with limited definition using digital tools and possible technological responses, and to adapt and customise digital environments to personal needs. - integrate my knowledge to contribute to professional practice and knowledge and guide others in identifying needs and technological responses - create solutions to solve complex problems with many interacting factors that are related to technical problems when operating devices and using digital environments.
7.5.	- Identifying needs and technological responses	-	- apply different digital tools and possible technological responses to solve those needs. - use different ways to adjust and customise digital environments to personal needs. - create solutions to complex problems with limited definition using digital tools and possible technological responses, and to adapt and customise digital environments to personal needs. - integrate cluster knowledge to contribute to professional practice and knowledge and guide others in identifying needs and technological responses

7.6	- Creatively using digital technology	-	- differentiate and apply digital tools and technologies that can be used to create knowledge and to innovate processes and products. - Engage and apply individually and collectively in cognitive processing to understand and resolve conceptual problems and problem situations in digital environments - integrate my knowledge to contribute to professional practice and knowledge and guide others in creatively using digital technologies.

MODULE 8: Ethics about AI

#	Area	Competence	Short Description *(related to Module Objectives)*
7.1	Effect of AI technology on society	7.1.1 Understand the factors that create social cohesion and exclusion in society	● To be aware of the dangers of digital divide and exclusion of sectors of the society ● To understand how AI can enable the cultural diversity in society
7.2	Responsible use of AI	7.2.1 Protection of fundamental rights to personal integrity and privacy in the use of digital technologies 7.2.2 Responsible, safe and healthy use of digital technologies	● To understand the responsibility of using AI systems in a fair and non-discriminatory way. ● To ensure that AI technology respects the moral values of human society. - To be aware of the unwanted side-effects that AI systems can have on the individual and societal level
7.3	Ethical Design of AI systems	7.3.1 Awareness of Guidelines for Ethical systems	● To understand the main guidelines of transparency and accountability of systems needed for their ethical certification. ● To be aware of the EU guidelines and regulations for building AI systems.

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FACILITATE – AI
LEARNING & CREATIVITY PLAN (L&C PLAN):

FUTURE SKILLS IN AI

1. Overview

Title	Future Skills in AI		
Driving Question or Topic	*What I need to know to be skilled in AI? Which are the AI skills?*		
Ages, Grades, …	16-18	8-12	
Duration, Timeline, Activities	4 lessons	4*50 minutes	4 activities
Curriculum Alignment	Skills in AI. Solve problems based on the future skills in AI. AI based product design for life		
Contributors, Partners	*School partners, AI/ML academics/industry*		
Abstract - Synopsis	*AI based product design for life asks for skills in robotics, natural language processing, computer vision, data science, modelling and modern design. The fundamentals AI skills are related to programming languages (Python, R, Julia, C++, C#, Java, JavaScript, Shell, TypeScript, Scala etc.), frameworks (TensorFlow, Pytorch, etc.), data analysis methods and machine learning algorithms (based on linear algebra and statistics), signal processing techniques (required for implementing future extraction in deep learning and computer vision in general), neural networks architectures, service design techniques (like chatbots, expert systems), and cyber security. There are also soft skills to deal with, like: communication and visualization skills, collaboration, critical thinking and problem solving.*		
References, Acknowledgements	*Sumit Raj, Building Chatbots with Python, 2019* *EuniKa Mercier-Laurent, The Future of AI or AI for the Future, 2020* *Bernard Marr, Future skills, Wiley, 2022.* *https://colab.research.google.com/* *https://www.pyml.ro/ (in Romanian)* *https://www.eeml.eu/* *http://aria-romania.org/* *https://www.airomania.eu/* *https://digital-skills-jobs.europa.eu/en/opportunities/training/elements-ai* *https://www.kdnuggets.com/2022/08/indemand-artificial-intelligence-skills-learn-2022.html* *https://www.youtube.com/watch?v=mp3TS_Me3Kw* *https://www.youtube.com/watch?v=5q87K1WaoFI*		

2. FACILITATE AI Framework*

Teachers' Cooperation	*Teacher 1 (computer scientist, the lead teacher) – this teacher will introduce students into the field. Will cover some aspects of programming languages which are necessary for AI. The teacher will present opportunities of AI and will identify the future skills of AI.* *Teacher 2 (mathematics) – this teacher will introduce students to data analysis methods. Depending on age, he/she will move from descriptive statistics to correlation/regression and trend analysis in order to discover patterns in data.* *Teacher 3 (grammar/literature) – this teacher will introduce students to Chomsky grammars, string searching, and introductory nature language processing methods, according to a scenario established with Teacher 1.* *Teacher 4 (biology) – this teacher will introduce students to bioinformatics after discussing with teacher 1.*
FACILITATE-AI in Life (FiL) Organization	*Fil in robotics, Fil in understanding a speaker, Fil in medicine, Fil in business (market analysis, financial portfolio design etc.). Meeting of teachers.*
Action Plan Formulation	*Step 1. Acquisition of fundamental knowledge. Every teacher will provide the specific background. For instance: Teacher 1 will review the basics of Python and show how TensorFlow is used in a classification problem. The Teacher 2 will review some computations on average (mean), median, mode, quartiles, correlation, linear regression. The teacher 3 will give an example of formal grammar to generate statements in natural language. The teacher will emphasis on context-dependency in order to ask for human action when doing NLP. Teacher 4 will introduce some applications of IT in medicine like diagnosing, treatment design etc.* *Step 2. Knowledge application. Teacher 1 will show how some code provide results on a specific problem. Teacher 2 can use visualization tools to explain how data are normal distributed or are completely random. Teacher 3 can use a text to be analyzed according to the grammar rules. Teacher 4 can show how treatments are influenced by diagnosis.* *Step 3. Check for confirmation. Students will present their ideas to answer questions provided by the teachers.* *Step 4. Evaluation step. Both students and teachers should be evaluated according to the internal assessment methodology.*

** under development the final elements of the framework*

3. Objectives and Methodologies

Learning Goals and Objectives	*After completing the program, the students will be able to know about:* ● *Identifying the future skiils for AI.* ● *How to be skilled in NLP* ● *How to be skilled in AI software design* ● *How to interpret medical diagnosis and treatment*
Learning Outcomes and expected Results	*Students will be able to differentiate among skills and will be able to conduct the proper way in AI, if they want. They will be able to build simple products of AI (like establishing some medical treatment, understanding some Q/A dialog or predict some future evolution)*
Prior Knowledge and Prerequisites	This is the big milestone. Students need to be open minded, well prepared in math, grammar, and for life. Some prior knowledge can be mentioned: a programming language, some mathematics including elementary computation, probabilities and statistics, and knowledge on anatomy and hygiene.

Motivation, Methodology, Strategies, Scaffolds	*The interest in AI is high. Both teachers and learners will apply appropriate methodologies to achieve the goal. Both individual and team-based project approach can be used when dealing with language understanding, predicting the future or establish a medical treatment. The students will learn accordingly to their interest for future life. They are encouraged to innovate/discover future sills in AI.*

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	*The classical procedure will be used in a classroom/lab having smart table, computers and other tools. The computer lab can be a standard one but specific software should be installed before by admin.*
Resources, Tools, Material, Attachments, Equipment	*Students will work in lab, in a collaborative environment from Google. The teachers will provide appropriate material and advices.* *https://colab.research.google.com/* *https://www.pyml.ro/ (in Romanian)* *https://www.eeml.eu/* *http://aria-romania.org/* *https://www.airomania.eu/* *https://digital-skills-jobs.europa.eu/en/opportunities/training/elements-ai* *https://www.kdnuggets.com/2022/08/indemand-artificial-intelligence-skills-learn-2022.html* *https://www.youtube.com/watch?v=mp3TS_Me3Kw* *https://www.youtube.com/watch?v=5q87K1WaoFI* *Communication and collaborative platforms: Google Meet, Microsoft Teams, Zoom, Skype etc.* *e-learning platforms: Google classroom, Backboard, Moodle, other*
Health and Safety	*Students and teachers work in a healthy and safe environment.*

5. Implementation

Instructional Activities, Procedures, Reflections	*This plan will cover:* ● *Programming language data structures and control flow methods to implement AI algorithms;* ● *Explanatory Data Analysis methods by mathematics and visualization techniques.* ● *Natural Learning Processing Basics* ● *AI systems for medicine* *Calendar:* ● *The classes will be announced to students and the Calendar (Google) application will be used.* *Timeline:* ● *All 4 lessons can be conducted during one week, or one lesson per week during one month. If possible, the 200 minutes can be used during one day for people of 18 years age.* *Teacher's impact:*

	• *The teacher 1 will conduct the package and will establish by negotiation the content for every class.* • *The main topics covered during the four hours will answer to questions like: Which will be my future skills in AI? What kind of knowledge I need to be an artificial intelligence engineer/developer/operational/security specialist.*
Assessment - Evaluation	At the end of every lesson the students will be evaluated about the learning results, and will appreciate the impact of the lesson on their perception on AI future.
Presentation - Reporting - Sharing	*The students will produce documents in Colab Google environment. The links will be published on the project/school website.*
Extensions - Other Information	The gained experience will be upscaled to new subjects on future skills in AI.

Resources for the development of the FACILITATE AI Learning and Creativity Plan Template
In the case of learning AI by project based activity

FACILITATE AI Prototype/Guide for Learning & Creativity Approach
Action Plan Formulation

Major steps in the FACILITATE AI learning approach:

STAGE I: Preparation by one or more teachers

1. Formulating initial thoughts on the thematic sectors/areas to be covered
2. Engaging the world of the wider environment / work / business / parents / society / environment/ ethics
3. Target Age Group of Students - Associating with the Official Curriculum - Setting Goals and Objectives
4. Organization of the tasks of the parties involved - Designation of Coordinator - Workplaces etc.

STAGE II: Action Plan Formulation (Steps 1-18)

Preparation (by teachers)

1. Relation to the Real World – Reflection
2. Incentive – Motivation
3. Formulation of a problem (possibly in stages or phases) resulting from the above

Development (by students) – Guidance & Evaluation (in 9-11, by teachers)

0. Background Creation - Search / Gather Information
0. Simplify the issue - Configure the problem with a limited number of requirements
0. Case Making - Designing - identifying materials for building / development / creation

0. Construction - Workflow - Implementation of projects
0. Observation-Experimentation - Initial Conclusions
0. Documentation - Searching Thematic Areas (AI fields) related to the subject under study – Explanation based on Existing Theories and / or Empirical Results
0. Gathering of results / information based on points 7, 8, 9
0. First group presentation by students

Configuration & Results (by students) – Guidance & Evaluation (by teachers)

0. Configure AI models to describe / represent / illustrate the results
0. Studying the results in 9 and drawing conclusions, using 12
0. Applications in Everyday Life - Suggestions for Developing 9 (Entrepreneurship - FIL Days)

Review (by teachers)

0. Review the problem and review it under more demanding conditions

Project Completion (by students) – Guidance & Evaluation (by teachers)

0. Repeat steps 5 through 11 with additional or new requirements as formulated in 15
0. Investigation - Case Studies - Expansion - New Theories - Testing New Conclusions
0. Presentation of Conclusions - Communication Tactics.

STAGE III: FACILITATE AI Actions and Cooperation in Creative Projects for school students

Title of Project: _____
Brief Description/Outline of Organizational Arrangements / Responsibilities for Action

STAGE	**Activities/Steps** Teacher 1(T1) Cooperation with T2 and student guidance	**Activities /Steps** **By Students** Age Group: ____	**Activities /Steps** Teacher 2 (T2) Cooperation with T1 and student guidance
A	Preparation of steps 1,2,3		Cooperation in step 3
B	Guidance in step 9	4,5,6,7,8,9,10	Support guidance in step 9
C	Creative Evaluation	11	Creative Evaluation
D	Guidance	12	Guidance
E	Guidance	13 (9+12)	Guidance
F	Organization (FIL) FACILITATE-AI in Life	14 Meeting with Business representatives	Organization (FIL) FACILITATE-AI in Life
G	Preparation of step 15		Cooperation in step 15
H	Guidance	16 (repetition 5-11)	Support Guidance
I	Guidance	17	Support Guidance
K	Creative Evaluation	18	Creative Evaluation

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FACILITATE – AI
LEARNING & CREATIVITY PLAN (L&C PLAN):

Who is in Control?

1. Overview

Title	Who is in Control?		
Driving Question or Topic	How can AI algorithms affect our personal activities, decisions and privacy?		
Ages, Grades, …	15-17	8-10 grade	
Duration, Timeline, Activities	3 lessons	3*40 min	3 activities with 12 steps
Curriculum Alignment			
Contributors, Partners			
Abstract - Synopsis	Recognize that, using personal information gathered online, Artificially Intelligent algorithms and applications create profiles of individuals or groups of people who share characteristics (such as age, grade level, or club membership) in order to predict what online information - in the form of advertisements, search results, videos, or other information - people in these groups will find interesting or hold certain beliefs. The main methods used for this fall under the area of Machine Learning in AI A major problem with this process is that it can trap people in their current interests. It becomes an obstacle in opening up new interests.		
References, Acknowledgements			

2. FACILITATE AI Framework

Teachers' Cooperation	**Teacher 1**: Computer Science Teacher (IT) - Introduces the technical aspects of algorithms and applying AI, and their integration into real life. **Teacher 2**: STE(A)M Teacher – Introduces different issues concerning person's profile, data literacy and trapped into your own interests (the filter bubble).
FACILITATE-AI in Life (FiL) Organization	Meeting with an AI Expert (from University and/or Industry)
Action Plan Formulation	● Preparation (collaborative by the 2 Teachers) ● Development of Activity 1 by Teacher 1 ● Development of Activity 2 & 3 by Teacher 2 ● Guidance (collaborative by the 2 Teachers) ● Review of Activity 1 by Teacher 1

	● Review of Activity 2 & 3 by Teacher 2 ● Evaluation (collaborative by the 2 Teachers)

3. Objectives and Methodologies

Learning Goals and Objectives	● Describe the meaning of "targeted marketing," and explain how it affects people's decisions. ● Recognize that, using personal data gathered online, AI systems create profiles to predict what online information people will find interesting. ● Clarify that individual and group profiles are used by machine learning algorithms to filter the online information that people see. ● Identify the advantages and disadvantages of the decisions people make in response to online information determined by machine learning algorithms.
Learning Outcomes and expected Results	Through these activities, students will have the chance to investigate the various ways that individuals become targeted marketing consumers using their individual and group profiles. The data trails left by their online activities are used by machine learning algorithms to generate these profiles. Should we be concerned about how algorithms affect our lives? This is one of the key ethical questions raised in this research.
Prior Knowledge and Prerequisites	
Motivation, Methodology, Strategies, Scaffolds	● *Motivation*: Examples from the every-day life of students (some well-known) and their participation to common applications and tools (for laptops and smartphones) ● *Methodology*: Brainstorming, Exploration, Inquiry-Based Learning, Role-based Game

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	● Computer(s) or tablet(s) (one per student) with internet connection for accessing web browsers (e.g., Chrome, Safari, or Microsoft Edge), specific search engines (e.g., Google, Bing, or DuckDuckGo), and other online resources ● Writing materials such as paper, pens, pencils ● Chart paper and markers for brainstorming
Resources, Tools, Material, Attachments, Equipment *(for Teachers and for Students)*	● Guide: "Hands-On for the Classroom AI Projects - A Guide on Ethics and AI by ISTE" ● Article: "A simple way to explain the Recommendation Engine in AI" ● Article: "DuckDuckGo vs. Google: An In-Depth Search Engine Comparison" ● Article: "How Google Search Works" ● Article: "Media Literacy Standards to Counter Truth Decay" ● Article: "So Many Choices" ● Activity: "Privacy in the Information Age"

	● Website: "There's No Anonymity" ● Website: "Filter Bubble" ● Video: "What even is an algorithm?" *(for Students)* ● Google Search Engine *(for Students)* ● DuckDuckGo Search Engine *(for Students)* ● Online collaboration tool, e.g. Padlet *(for Students)* ● Additional Lesson: Our AI Code of Ethics (Code.org) *(for Students)*
Health and Safety	Students and teachers work in a healthy and safe environment. No chemicals or hazard situations are involved.

5. Implementation

Instructional Activities, Procedures, Reflections	**Activity 1 Investigating how machine learning algorithms use search engines to predict things about us** Students investigate how predictions produced by search engines utilizing a machine learning algorithm might affect people's views and choices in this activity. Step1: Asking students what they know about how machine learning algorithms can affect the information they view online as a way to introduce this activity and show them this video What even is an algorithm? Step 2: Ask the student pairs to use the Google Search Engine to look up for 3 common topics the class agreed. Request that they and their partner compare their results. Do the lists on each device match one another or not? Step 3: Ask them to open a new browser tab and go to DuckDuckGo. Ask students to look into the same subject again and repeat step 2 Step 4: Ask the student pairs to use the Google Search Engine and the DuckDuckGo to look up for 3 common topics the class agreed and compare the results from the two search engines. *Assessment – Evaluation* After giving students some opportunity to experiment with a few side-by-side searches, facilitate a class discussion in which they can share their thoughts. **Activity 2: Making a person's profile using data trails** Students will build a data profile of themselves based on the types of data trails people frequently leave behind when they are online (for this action you can use "unplugged" approach with papers, or collaborative tool, such as on line editors or boads, e.g. Padlet). Step 1: Give each student the worksheet: "*My profile*" with the following categories (that will write 3 examples for every category), without writing their names, or writing nick names, on the worksheet: 1. *text keywords I have used for online searches* 2. *photos I have searched online (e.g., people, location, things)* 3. *online songs I have listened*

4. *online videos I have watched*
5. *online games I play regularly*
6. *websites I have visited*

Step 2: When students turn in their profiles, the papers will be shuffled, and each student will be given someone else's profile to analyze and specify the type of person he/she believes would have produced this profile

Step 3 Each student suggest a product for that specific profile that has analyzed that believes it would be possible to be interested in.

Step 4 Ask the students who created the profile to verify or not if he would be interested in that product.

Assessment - Evaluation

Before having them write a reflection, have them consider the following questions. After you're done, invite volunteers to express some of their ideas:

- Should we be worried about how machine learning algorithms will affect our lives? If not, why not?
- Whose best interests are served when we succumb to this kind of influence?
- How might these algorithms affect homework or personal activities?
- What tactics can we employ to ensure that whatever influence algorithms may have on our decisions is positive?
- Why should we care about data privacy in relation to this?

Activity 3: AI data collection and applications

Students consider the benefits or conveniences they obtain from the AI-powered technology people use in their daily lives as a trade-off for providing data in this activity. Then they think about the possible dangers and unintended results of sharing that data.

Step 1: Discussion about that fact that AI and machine learning require a lot of data in order to learn, much like a human baby does. An AI system will do jobs more effectively the better the dataset it possesses. As a community or as individuals, we have chosen to trade part of our freedom or privacy for the advantages that AI technologies offer, such as comfort, customization, or automation.

Step 2: There two types of data collected by technologies: footprints and fingerprints. Footprints—sometimes referred to as active data collection—are data you know you are leaving behind and may expect to be seen or used by others. For example, if you create a new account on a website, you might give them your name, email, location, or birthday.
Fingerprints—sometimes referred to passive data collection—are data that you probably don’t think about or expect to leave behind but are being collected or tracked by the application. For example, tracking what links you click on, whose profiles you view, or even a video you didn’t select, but didn’t stop from autoplaying.

Step 3: Students should analyze each of the AI-powered technology products listed below in groups of three to four and identify the types of data being collected as

fingerprints, footprints, and what the user gains from sharing that data. Review the first one as a class, then distribute two or three technologies from the list to each group.

Technology	Footprints/Active	Fingerprints/Passive	User Benefit
Search Engines	Search history	Ads you view on click, links you click, location, type of device	Discovering new things, access to sites you like, personalised search results, targeted ads and recommendation product system
Social Media	Likes, posts, tags, friends etc.		
Music and Video apps			
GPS/Map apps			
Smart home devices			

Step 4: Discuss each technology as a class after the students have had 10-15 minutes to think and write down their ideas in their groups.

Assessment - Evaluation

Extend the students' thinking about the data they share online by considering possible risks or unintended consequences of sharing the data they listed.

Presentation - Reporting - Sharing

Extensions - Other Information

Recommendations for teachers for Activity 1: Investigating How Machine Learning Algorithms Use Search Engines to Predict Things About Us

Asking students what they know about how machine learning algorithms can affect the information they view online as a way to introduce this activity. Remind children that even if they don't sign into an account, there are still ways to track the device they are using online and obtain data on the websites they are visiting, the searches they are doing, and other activities. Inform students that despite the claims made by businesses that machine learning algorithms will make it easier for people to find information that will interest them, these algorithms can actually reduce the options available to people by only including links to the items the algorithm believes the person will find interesting. Also they encourage people to stay within their current interests and thus deter people from opening new horizons of interest.

Inform the class that they will compare the results from two different search engines to observe how they differ from person to person. They will make use of Google and DuckDuckGo as their search engines. Every student needs a partner and a gadget with internet access. For this activity, it is ideal for each student to have a partner and a gadget with internet access. If that isn't possible, the teacher can demonstrate the activity to the entire class using a laptop and a projector, or the students can work in pairs or trios:

- Inquire of the class their knowledge of search engine operation. Let them express their thoughts.
- Describe how search engines are created to assist consumers in locating the internet resources that will be most beneficial to them among the millions of options available. The majority of search engines accomplish this using machine learning algorithms that generate predictions based on the search terms you enter, the location of the computer you're using, the privacy and other settings on the device you're using, and even personal data about you if you're using a search engine inside a web browser you can log into, like Google Chrome.
- Open the web browser that each kid typically uses at school before starting the activity. Which search engine do they always use? (You might need to provide some assistance in figuring out which search engine they are employing; it's probably Google, but it could be something else.)
- Ask the student pairs to use the built-in search engine to look up one of these topics. Alternately, let them each select a subject as long as they agree to utilize the same one. On each of their individual devices, the students should enter the topic they choose after typing it in. Request that they and their partner compare their results. Which resources do they notice? (e.g., images, websites, files, ads). Do the lists on each device match one another or not?
- Ask them to open a new browser tab and go to DuckDuckGo right away. Explain that because DuckDuckGo does not gather tracking data to develop profiles for individuals or groups, it does not employ algorithms to determine which results a given user will receive. Ask students to look into the same subject again. What outcomes do they encounter this time? Are they the same as the outcomes of their partners? Do they match their initial search results? What makes them believe that the results are the way they are?

Source: "Who is in Control?"

Recommendations for teachers for Activity 3: AI Data Collection and Applications

- Say, "When we share data online, we don't always know if, how, or why any of the data that we shared—as footprints or fingerprints—are being used by that computer program or that company—or even if it's being sold to a government or a third party to be used for a different purpose entirely. Sometimes we share what we think is harmless information, but on its own or when combined with other information, it might lead to unintended consequences or uses."
- Project the infographic "What Information Are You Driving Around?" for the class to see. Read through the information that each of the bumper stickers reveals and the potential unintended ways that people might interpret, use, or misuse that data.
- Review the footprints and fingerprints that your students listed about the technologies in the table above, or others that they think of. Ask, "In addition to using data to provide the user benefits you listed before, how else might people, companies, or the government use or misuse the data you said each of these technologies collected? What might they be able to know or do when they aggregate or combine data shared across these apps to create a digital profile of you? What might happen if they give or sell this data to another company or the government?" For example, when students post their photos and a list of their favorite things, someone might use that information to guess their passwords, figure out their security question answers, or impersonate them. Similarly, a company might evaluate the medical or mental health of its users based on their behaviors or the topics of the media they consume.

- Tell students that terms and conditions are one way of knowing how an app or company might use their data, and whether the app or company is saving, deleting, sharing, or even selling their data. Ask students whether they ever read the terms and conditions of apps they download. Discuss why or why not, as well as the benefits of being selective about which applications they use and what data they share.
- Conclude the activity by revealing that trade-offs exist in the design and use of all AI technologies. While you and your students were able to name many pros and user benefits for each of the technologies, there are also potential cons and unintended negative consequences of using these same technologies. When we choose to use an AI technology, we make a decision about the related trade-offs, such as having the convenience of using a map app but giving up our privacy about where we are and where we go.

Technology	Footprints / Active Data Collection	Fingerprints / Passive Data Collection	User Benefit
Social Media Platform (e.g., Facebook, Instagram, or TikTok)	Likes, posts, friends/followers, tagged locations, photos, videos, messages, user tags, hashtags used, which groups you belong to, content of private messages, answers about favorites in personality quizzes	Profiles you view, ads you view, links you click on, amount of time spent in the app, what time of day you use the app, where you use the app.	Connecting with friends, good feelings from people liking your content, discovering new things
Search Engines/ Web Browsing	Search history of websites visited	Ads you view or click, links you click, time spent browsing, your physical location, your language, location where the search was made, type of device used while searching	Discovering new things; access to sites you like; personalized search results; targeted ads or product recommendations based on your predicted age, gender, interests, or location
Music and Video Apps (e.g., Spotify or YouTube)	What you 'like,' which accounts you follow or subscribe to, playlist contents, listening or viewing history	How many times you play a particular artist, song, or video; genres you prefer; topics or tags you prefer; what time of day you listen or watch; how long you listen or watch	Enjoying your favorite songs and videos; discovering new media; easily organizing your entire music library in one place; saving and sharing playlists; sharing media with friends
GPS/Map Apps	Locations you are trying to get to, locations you search, your current location	Where you live, your routine, frequently visited locations, how fast you are driving, location-based interests (food, entertainment, etc.), when you arrive at and leave locations, who you are with (from having location data from you and whomever you're with)	Easily getting to where you are going, getting real-time information about traffic

Source [The Trade-offs of AI Technology]

FACILITATE AI Prototype/Guide for Learning & Creativity Approach
Action Plan Formulation

Major steps in the FACILITATE AI learning approach:

STAGE I: Preparation by one or more teachers

1. Formulating initial thoughts on the thematic sectors/areas to be covered
2. Engaging the world of the wider environment / work / business / parents / society / environment/ ethics
3. Target Age Group of Students - Associating with the Official Curriculum - Setting Goals and Objectives
4. Organization of the tasks of the parties involved - Designation of Coordinator - Workplaces etc.

STAGE II: Action Plan Formulation (Steps 1-18)

Preparation (by teachers)

1. Relation to the Real World – Reflection
2. Incentive – Motivation
3. Formulation of a problem (possibly in stages or phases) resulting from the above

Development (by students) – Guidance & Evaluation (in 9-11, by teachers)

0. Background Creation - Search / Gather Information
0. Simplify the issue - Configure the problem with a limited number of requirements
0. Case Making - Designing - identifying materials for building / development / creation
0. Construction - Workflow - Implementation of projects
0. Observation-Experimentation - Initial Conclusions
0. Documentation - Searching Thematic Areas (AI fields) related to the subject under study – Explanation based on Existing Theories and / or Empirical Results
0. Gathering of results / information based on points 7, 8, 9
0. First group presentation by students

Configuration & Results (by students) – Guidance & Evaluation (by teachers)

0. Configure AI models to describe / represent / illustrate the results
0. Studying the results in 9 and drawing conclusions, using 12
0. Applications in Everyday Life - Suggestions for Developing 9 (Entrepreneurship - FIL Days)

Review (by teachers)

0. Review the problem and review it under more demanding conditions

Project Completion (by students) – Guidance & Evaluation (by teachers)

0. Repeat steps 5 through 11 with additional or new requirements as formulated in 15
0. Investigation - Case Studies - Expansion - New Theories - Testing New Conclusions
0. Presentation of Conclusions - Communication Tactics.

STAGE III: FACILITATE AI Actions and Cooperation in Creative Projects for school students

Title of Project: _____
Brief Description/Outline of Organizational Arrangements / Responsibilities for Action

STAGE	**Activities/Steps** Teacher 1(T1) Cooperation with T2 and student guidance	**Activities /Steps** **By Students** Age Group: ____	**Activities /Steps** Teacher 2 (T2) Cooperation with T1 and student guidance
A	Preparation of steps 1,2,3		Cooperation in step 3
B	Guidance in step 9	4,5,6,7,8,9,10	Support guidance in step 9
C	Creative Evaluation	11	Creative Evaluation
D	Guidance	12	Guidance
E	Guidance	13 (9+12)	Guidance
F	Organization (FIL) FACILITATE-AI in Life	14 Meeting with Business representatives	Organization (FIL) FACILITATE-AI in Life
G	Preparation of step 15		Cooperation in step 15
H	Guidance	16 (repetition 5-11)	Support Guidance
I	Guidance	17	Support Guidance
K	Creative Evaluation	18	Creative Evaluation

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FACILITATE – AI
LEARNING & CREATIVITY PLAN (L&C PLAN):

What is AI Ethics and Trustworthy AI?

1. Overview

Title	What is AI Ethics and Trustworthy AI?
Driving Question or Topic	What is AI ethics? Can you give examples of ethical issues regarding AI systems? Can you match AI techniques with ethical requirements?
Ages, Grades, …	15-17 8-10 grade
Duration, Timeline, Activities	3 lessons 3-4*40 min 3 activities with 9 steps and a poster creation
Curriculum Alignment	
Contributors, Partners	
Abstract - Synopsis	What is AI ethics? It's an umbrella term for many things such as moral agency, existential crisis/superintelligence, adherence (or not) to human moral values and trustworthiness. This learning and activity plan asks students to consider timeless ethical questions, diverse perspectives, and even gray areas as they begin to construct their own ideas about how to determine if an AI system is ethically developed, designed, and used. It makes the fundamental assumption that ethical AI is a shared responsibility. The two main activities are mainly based on the set of 7 key requirements of the "Ethics guidelines for trustworthy AI" presented by the High-Level Expert Group on Artificial Intelligence, set by the European Commission and the resources of the Erasmus+ project "Trustworthy AI".
References, Acknowledgements	

2. FACILITATE AI Framework

Teachers' Cooperation	**Teacher 1**: Social Science/Philosophy/Theory-of-Knowledge Teacher – Introduces the ethical issues in general and the ethics of AI **Teacher 2**: Computer Science Teacher (IT) - Introduces the technical aspects of applying AI (the techniques of AI and their integration into real life).
FACILITATE-AI in Life (FiL) Organization	Meeting with an AI Expert (from University and/or Industry)
Action Plan Formulation	● Preparation (collaborative by the 2 Teachers) ● Development of Activity 1 by Teacher 1 ● Development of Activity 2 by Teacher 2

	● Guidance (collaborative by the 2 Teachers) ● Review of Activity 1 by Teacher 1 ● Review of Activity 2 by Teacher 2 ● Evaluation (collaborative by the 2 Teachers)

3. Objectives and Methodologies

Learning Goals and Objectives	● Recognize that trade-offs are a part of all decisions, including those made by artificial intelligence: can ethical aspects be compromised at the expense of service acquired? ● Identify the benefits and drawbacks of utilizing or applying different AI technologies ● Make wiser choices regarding the data they provide and the AI tools they employ: when can you trust AI systems? ● Describe your personal stance on the application of AI technologies
Learning Outcomes and expected Results	● To be aware of the dangers of digital divide and exclusion of sectors of the society ● To recognize the responsibility of using AI systems in a fair and non-discriminatory way. ● To be aware of the unwanted side-effects that AI systems can have on the individual and societal level ● To determine the main requirements of systems needed for their ethical certification. ● To be aware of the EU guidelines and regulations for building AI systems.
Prior Knowledge and Prerequisites	
Motivation, Methodology, Strategies, Scaffolds	● *Motivation*: Examples from the every-day life of students (some well-known) and their participation to common applications and tools (for laptops and smartphones) ● *Methodology*: Brainstorming, Exploration, Inquiry-Based Learning, Project-Based Learning

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	● Computer(s) or tablet(s) with internet connection for accessing tools and resources online ● Writing materials such as paper, pens, pencils ● Online articles, tools, and resources listed below
Resources, Tools, Material, Attachments, Equipment *(for Teachers and Students)*	● Guide: "Ethics Guidelines for Trustworthy AI - A Definition of AI: Main Capabilities And Disciplines" ● Website: AI-in-education (ISTE)

	● Guide: "Hands-On for the Classroom AI Projects - A Guide on Ethics and AI (ISTE)" ● Resources: "Teaching Trustworthy AI Resources" Erasmus+ Project ● Presentation: "Responsible AI 1-0-1: from Values to Requirements" ● Handout: AI Ethics Research Areas ● Article: "Ethical Concerns of AI" ● Article: "Top 9 ethical issues in Artificial Intelligence" ● Video: "Trustworthy AI: Overview of the 7 requirements for Trustworthy AI" *(for Students)* ● Video: Ethics & AI: Equal Access and Algorithmic Bias *(for Students)* ● Website: DigCitCommit *(for Students)* ● Online collaboration tool, e.g. Padlet *(for Students)* ● Additional Lesson: Our AI Code of Ethics (Code.org) *(for Students)*
Health and Safety	Students and teachers work in a healthy and safe environment. No chemicals or hazard situations are involved

5. Implementation

Instructional Activities, Procedures, Reflections	As you read and teach this lesson plan, you may be surprised to find that that it does not tell students what to believe about what is good or bad, right or wrong, and fair or unfair when it comes to AI technologies. This is by design. Dr. Melvin Kranzberg, a professor of the history of technology at the Georgia Institute of Technology, stated that "technology is neither good nor bad; nor is it neutral." Keeping this statement in mind, this lesson plan asks students to think critically about the impact AI has on society. They will consider the trade-offs (both good and bad) of various AI innovations and will consider ways that biases and negative impacts in AI might be identified and mitigated. Students will understand that while they might use AI to improve efficiency or accuracy of one task, at the same time they may be asked to give away personal data, civil rights, or personal freedoms in return (as mentioned at the "*Hands-On for the Classroom AI Projects - A Guide on Ethics and AI*" by ISTE). ***Activity 1: The 7 Requirements of Trustworthy AI*** Students investigate the benefits and drawbacks of several AI systems in this activity. They take into account the parties impacted by AI technologies, investigate the trade-offs related to AI design and use, and think about how they may individually influence the ethical use of AI technologies in their own lives and the lives of others. **Step 1.1**: The teacher discusses with the students the 7 Requirements of Trustworthy AI which are: 1. *Human agency and oversight*: Including fundamental rights, human agency and human oversight

2. *Technical robustness and safety*: Including resilience to attack and security, fall back plan and general safety, accuracy, reliability and reproducibility
3. *Privacy and data governance*: Including respect for privacy, quality and integrity of data, and access to data
4. *Transparency*: Including traceability, explainability and communication
5. *Diversity, non-discrimination and fairness*: Including the avoidance of unfair bias, accessibility and universal design, and stakeholder participation
6. *Societal and environmental wellbeing*: Including sustainability and environmental friendliness, social impact, society and democracy
7. *Accountability*: Including auditability, minimisation and reporting of negative impact, trade-offs and redress.

Watch the video "Trustworthy AI: Overview of the 7 requirements for Trustworthy AI" with the students, and/or the series of the videos introducing the 7 requirements for Trustworthy AI. Study also the "Top 9 ethical issues in Artificial Intelligence" (by WEF). More information about these requirements can be found in **Extensions - Other Information** below.

Step 1.2: Ask the students, in groups, to find practical examples of ethical issues regarding AI systems.

An indicative list that can be used for reference by the teacher is:

1 Human agency and oversight

- Autonomous/Self-driving vehicle decision making in unavoidable collision
- AI systems for personnel evaluation/recruitment/dismissal
- Accessibility and quality control of collected data

2 Technical robustness and safety

- Cyber attacks
- Wrong decisions of AI systems
- Accidents from AI systems

3 Privacy and data governance

- Data leakage or interception
- Collection and sale of personal data
- Necessity of the personal data we provide to AI applications

4 Transparency

- Chatbots with "human" behavior
- Targeted marketing without consent
- Awareness of what personal data we give to AI systems and how they are being used

5 Diversity, non-discrimination and fairness

- Racial, sexual, ethnic discrimination, etc.
- Stereotypes/ AI bias
- Accessibility for people with disabilities or the elderly

6 Societal and environmental wellbeing

- AI systems on search engines, social media, media applications etc.
- Do system recommendations influence consciences and magnify already existing beliefs?
- What kind of news is suggested to us based on our profile and is it ethical or in the right direction?

7 Accountability

- Can Systems explain their actions?
- Are systems amenable to contesting their decisions?
- Can systems argue with users and can they be convinced to change?

Step 1.3: Ask the students to categorize the examples as above using an online collaboration tool (e.g. Padlet).

Activity 2: Match the examples of AI Techniques with examples of Ethical Requirements

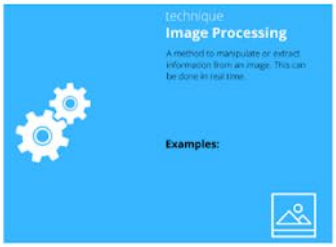
Step 2.1: Watch the video Ethics & AI: Equal Access and Algorithmic Bias with the students.

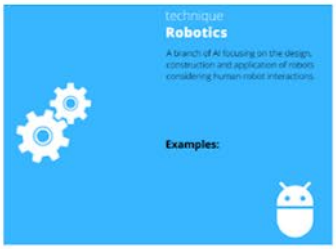
Step 2.2: Discus about the various AI techniques (e.g. Face Recognition, Natural Language Processing, Robotics etc.) as mentioned below in the blue cards. The students are working in groups trying to find examples from of AI technique (e.g. voice recognition, route optimization, monitoring robot) concerning their real life.

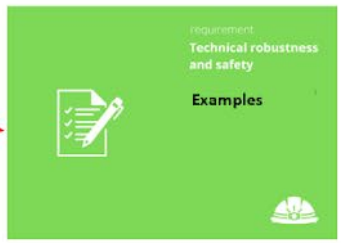
Step 2.3: Match examples of each AI techniques with practical examples of the seven ethical requirements (of activity 1). You can use any kind of tool or the following worksheet (using examples from the Trustworthy AI Card Deck from the project "Trustworthy AI").

Finally, can the students answer at the question: "Does each example of AI technique meet or needs the 7 keys ethical requirements?"

Matching examples of one AI Technique with examples of Ethical Requirements







Activity 3: Create a Poster/Infographic for the Ethical Requirements of AI Applications

Using all the previous information and material, student in small groups can create a poster or infographic using a digital tool including dynamic links (e.g. Canva, Genial.ly, PowerPoint etc.) for the AI Ethics (as a small project in one or two lesson hours).

Step 3.1: Analyse, select and validate the appropriate data/information/links with for the poster, including selected Techniques, the 7 keys Requirements and related examples.

Step 3.2: Design, select and produce the needed graphics and audio-visual elements for representing all the previous selected text and numbers.

Step 3.3: Select the appropriate tool for the poster representation and production, report, present and share the final product of the group.

Presentation - Reporting - Sharing

The completion of this learning and activity plan produces a student artifact as described at the final Step 3.3. of the Final Activity.

Extensions - Other Information

Requirements of Trustworthy AI:

(From EU Guide: "Ethics Guidelines for Trustworthy AI")

1 Human agency and oversight

Including fundamental rights, human agency and human oversight. AI systems should support human autonomy and decision-making, as prescribed by the principle of respect for human autonomy. This requires that AI systems should both act as enablers to a democratic, flourishing and equitable society by supporting the user's agency and foster fundamental rights and allow for human oversight.

2 Technical robustness and safety

Including resilience to attack and security, fall back plan and general safety, accuracy, reliability and reproducibility. A crucial component of achieving Trustworthy AI is technical robustness, which is closely linked to the principle of prevention of harm. Technical robustness requires that AI systems be developed with a preventative approach to risks and in a manner such that they reliably behave as intended while minimising unintentional and unexpected harm and preventing unacceptable harm.

3 Privacy and data governance

Including respect for privacy, quality and integrity of data, and access to data. Closely linked to the principle of prevention of harm is privacy, a fundamental right particularly affected by AI systems. Prevention of harm to privacy also necessitates adequate data governance that covers the quality and integrity of the data used, its relevance in light of the domain in which the AI systems will be deployed, its access protocols and the capability to process data in a manner that protects privacy.

4 Transparency

Including traceability, explainability and communication. This requirement is closely linked with the principle of explicability and encompasses transparency of elements relevant to an AI system: the data, the system and the business models.

5 Diversity, non-discrimination and fairness

Including the avoidance of unfair bias, accessibility and universal design, and stakeholder participation. In order to achieve Trustworthy AI, we must enable inclusion and diversity

throughout the entire AI system's life cycle. Besides the consideration and involvement of all affected stakeholders throughout the process, this also entails ensuring equal access through inclusive design processes as well as equal treatment. This requirement is closely linked with the principle of fairness.

6 Societal and environmental wellbeing

Including sustainability and environmental friendliness, social impact, society and democracy. In line with the principles of fairness and prevention of harm, the broader society, other sentient beings and the environment should be also considered as stakeholders throughout the AI system's life cycle. Sustainability and ecological responsibility of AI systems should be encouraged, and research should be fostered into AI solutions addressing areas of global concern, such as for instance the Sustainable Development Goals. Ideally, AI systems should be used to benefit all human beings, including future generations.

7 Accountability

Including auditability, minimisation and reporting of negative impact, trade-offs and redress. The requirement of accountability complements the above requirements and is closely linked to the principle of fairness. It necessitates that mechanisms be put in place to ensure responsibility and accountability for AI systems and their outcomes, both before and after their development, deployment and use.

Figure: Interrelationship of the seven requirements: all are of equal importance, support each other, and should be implemented and evaluated throughout the AI system's lifecycle

(source: EU Guide: "Ethics Guidelines for Trustworthy AI - A Definition of AI: Main Capabilities And Disciplines")

FACILITATE AI Prototype/Guide for Learning & Creativity Approach
Action Plan Formulation

Major steps in the FACILITATE AI learning approach:

STAGE I: Preparation by one or more teachers

1. Formulating initial thoughts on the thematic sectors/areas to be covered
2. Engaging the world of the wider environment / work / business / parents / society / environment/ ethics
3. Target Age Group of Students - Associating with the Official Curriculum - Setting Goals and Objectives
4. Organization of the tasks of the parties involved - Designation of Coordinator - Workplaces etc.

STAGE II: Action Plan Formulation (Steps 1-18)

Preparation (by teachers)

1. Relation to the Real World – Reflection
2. Incentive – Motivation
3. Formulation of a problem (possibly in stages or phases) resulting from the above

Development (by students) – Guidance & Evaluation (in 9-11, by teachers)

0. Background Creation - Search / Gather Information
0. Simplify the issue - Configure the problem with a limited number of requirements
0. Case Making - Designing - identifying materials for building / development / creation
0. Construction - Workflow - Implementation of projects
0. Observation-Experimentation - Initial Conclusions
0. Documentation - Searching Thematic Areas (AI fields) related to the subject under study – Explanation based on Existing Theories and / or Empirical Results
0. Gathering of results / information based on points 7, 8, 9
0. First group presentation by students

Configuration & Results (by students) – Guidance & Evaluation (by teachers)

0. Configure AI models to describe / represent / illustrate the results
0. Studying the results in 9 and drawing conclusions, using 12
0. Applications in Everyday Life - Suggestions for Developing 9 (Entrepreneurship - FIL Days)

Review (by teachers)

0. Review the problem and review it under more demanding conditions

Project Completion (by students) – Guidance & Evaluation (by teachers)

0. Repeat steps 5 through 11 with additional or new requirements as formulated in 15
0. Investigation - Case Studies - Expansion - New Theories - Testing New Conclusions
0. Presentation of Conclusions - Communication Tactics.

STAGE III: FACILITATE AI Actions and Cooperation in Creative Projects for school students

Title of Project: _____
Brief Description/Outline of Organizational Arrangements / Responsibilities for Action

STAGE	**Activities/Steps** Teacher 1(T1) Cooperation with T2 and student guidance	**Activities /Steps** **By Students** Age Group: ____	**Activities /Steps** Teacher 2 (T2) Cooperation with T1 and student guidance
A	Preparation of steps 1,2,3		Cooperation in step 3
B	Guidance in step 9	4,5,6,7,8,9,10	Support guidance in step 9
C	Creative Evaluation	11	Creative Evaluation
D	Guidance	12	Guidance
E	Guidance	13 (9+12)	Guidance
F	Organization (FIL) FACILITATE-AI in Life	14 Meeting with Business representatives	Organization (FIL) FACILITATE-AI in Life
G	Preparation of step 15		Cooperation in step 15
H	Guidance	16 (repetition 5-11)	Support Guidance
I	Guidance	17	Support Guidance
K	Creative Evaluation	18	Creative Evaluation

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FACILITATE – AI
LEARNING & CREATIVITY PLAN (L&C PLAN):

IMAGE CLASSIFICATION – FIND THE ZOMBIES

1. Overview

Title	Image Classification – Find the zombies		
Driving Question or Topic	How to collect image data and use it to train a Machine Learning model? How to test with unknown images? How to use the model to automate image classification.		
Ages, Grades, …	Ages: 15-18	10th-12th grade	
Duration, Timeline, Activities	3-4 hours	2 mandatory activities + 2 independent optional more advanced activities	4 activities
Curriculum Alignment	Artificial Intelligence, Machine Learning, Computer Programming		
Contributors, Partners			
Abstract - Synopsis	Students will learn about the structure of an image-based dataset, the data collection process and how a Machine Learning model can be trained, evaluated, and used to automatically classify images into categories using neural networks in a competition-based activity.		
References, Acknowledgements	https://www.knime.com/learning https://www.knime.com/community/image-processing https://www.knime.com/deeplearning		

2. FACILITATE AI Framework

Teachers' Cooperation	1st Teacher: Artificial Intelligence/Machine Learning 2nd Teacher: Machine Learning workflow implementation (Two teachers can work together during the whole Project, with a different degree depending on the (sequence of) activities carried out)
FACILITATE-AI in Life (FiL) Organization	Meeting with Data Scientist / Machine Learning Engineer or another similar role, to know how image based ML models are developed and used in real-life
Action Plan Formulation	STAGE I: The 1st Teacher presents the concept of Machine Learning model and presents some examples of real-world applications. The 2nd Teacher presents Knime as a

	machine learning workflow platform, the low code environment based on nodes and workflows and main steps from data preparation to modelling and evaluation. The specific problem of autonomous image classification should be presented (Steps 1-4). STAGE II: The 1st and 2nd teachers prepare an image classification problem that motivates students which may make use of the dataset in the support materials or a new one more tailored to the preferences of the class stating its context and potential applications. It is suggested to use the dataset with Minecraft characters provided (Steps 1-3). The 1st Teacher guides the Students into building and evaluating a ML model using a provided dataset. Students may train different models based on theory presented and critically compare them to select the best one (Steps 4-14) STAGE II: The 2nd Teacher guides the Students into developing a neural net ML model able to process image data inputs and classify them into defined categories for automatic classification. (Steps 10-14) STAGE II: The Teachers challenge the students to revisit the whole process, going back to the data collection or model training phases trying to replicate the concepts learnt with their own datasets (Steps 15-18)

** under development the final elements of the framework*

3. Objectives and Methodologies

Learning Goals and Objectives	By the end of the L&C Plan, Students will be able to know and apply the concepts of image classification, model training, model evaluation and model productionizing.
Learning Outcomes and expected Results	Train ML models based on image datasets into a known category. Critically evaluate and compare multiple ML models according to objective criteria Understand the impact of data collection and model configuration on the quality of ML models
Prior Knowledge and Prerequisites	While not mandatory, it would be useful if students have basic programming knowledge.
Motivation, Methodology, Strategies, Scaffolds	This L&C Plan is built around a project-based and inquiry-based learning. The teachers will provide the structure for the Students' journey, including the different paths that they may take according to their time and/or skills, and then challenge them at certain points in this journey with specific questions such as: "How to build a new neural network?", "How do different layer and parameters affect model performance?", or "What other potential modifications can improve model scoring?". Students will thus have some degrees of freedom and will be able to make their own choices regarding, for example, model configuration, layers selection or neurons count. Teachers shall incite them to explore this search space autonomously, but focusing on understanding the consequences of their choices, namely on model quality, time for computing and model validation. Students will develop critical thinking and communication skills by being challenged by the Teachers to justify the rationale of their decisions, and the quality of their outcomes. Gamification can be used as a complementary methodology, in its simplest form through the use of a Kaggle Competition, as proposed, or through any similar tool. The L&C can be developed with students working individually or in groups. When working in groups, many of the activities can be developed in parallel by multiple Students simultaneously, promoting creativity and group work. In these settings, intra-group competitiveness may also be promoted as a way to motivate Students to stand out. The L&C Plan will be delivered by Teachers as mini-lessons, at least one for each proposed activity. Different journeys can be prepared by the Teachers, depending on the available time, goals and/or skills of the students.

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	The L&C Plan requires a classroom with at least one computer per group (if the activities are carried out in group) or, ideally, one computer per Student. The instructions and materials were prepared for a MS Windows Operating System, although the L&C Plan can be delivered in other environments as well (e.g. macOS, Linux) with some modifications. The following are technical (or other) requirements necessary for delivering the L&C Plan. Additional details for preparing the class and a troubleshooting guide are provided in the attachment "Preparation.pdf". ● Java is required for running ki, preferably a Java Developer Kit (JDK) version 12 to 18 or newer ● An internet connection is only available during the delivery of the L&C plan if a Kaggle competition is being implemented ● An overhead projector, although not mandatory, may be useful for Teachers to share content and resources such as to project Knime workflow demonstrations
Resources, Tools, Material, Attachments, Equipment	Resources: ● https://docs.oracle.com/en/java/javase/13/install/installation-jdk-microsoft-windows-platforms.html ● https://www.knime.com/ ● https://www.kaggle.com/docs Tools: ● Knime – Program to run machine learning workflows ● Kaggle – Web platform to host competitions Materials: ● Dataset.csv – a dataset which contains different game characters which contains zombies and non-zombies samples that can be used as a starting point, to train a model ● Images.zip – a collection of images in different categories to be trained by the deep learning model ● Knime.zip – a folder containing a knime installation with all plugins installed and configured for the lesson plan ● Workflows.zip – collection of knime workflows to demonstrate the application of neural networks, image preparation and classification. ● FACILITATE-AI-Knime-Presentation – supporting presentation with different modules for each task in the learning plan ● Kaggle.pdf – Instruction on how to host a Kaggle competition with the provided dataset to classify images as zombies or non-zombie.
Health and Safety	

5. Implementation

Instructional Activities, Procedures, Reflections	(Prior to the activities, the Teachers should have carried out the preparation activities, as described in document "Preparation.pdf") This L&C Plan is dynamic and can be adapted according to the available time, the learning goals and/or the skills and previous knowledge of the Students. The possible journeys are depicted in the attached document "Preparation.pdf". The teachers should plan ahead and schedule an intended journey for a given class (the activities described below are not meant to be all carried out). Then, during the delivery of the L&C Plan, Teachers may adapt and include additional steps or remove existing ones. This section describes each step individually. Their concatenation into a specific journey must be done according to the process depicted in "Preparation.pdf". A) Context [30 minutes] The 1st Teacher presents the concept of Machine Learning model and presents some examples of real-world applications. The path from data collection to model training and productionizing should be addressed, as well as a first notion of model metrics (e.g. RMSE, Accuracy, …). A brief introduction to neural networks should be presented here describing concepts such as network, layers, neurons, and hidden layers. B) Problem [30 minutes] The 2nd Teacher presents Knime as a machine learning as a software for data science, interoperable with other languages such as python, R and Java. Basic representation of elements presented by the 1st teacher should be demonstrated in this platform in a low code approach, presenting and demonstrating nodes in a workflow. The tools should be presented as a demonstration exemplifying common tasks such as import and export data, partition data, classify problems and data manipulation. C-1) Model Training/Validation with Knime (low-code) [60 minutes] The 1st Teacher shows students how to train and validate an image ML model using Knime. The Teacher and Students can use the **Knime Workflows** attached as starting examples. Students should then be allowed to test with different algorithms/configurations. In this part, the Teacher should not fail to cover important topics such as: image pre-processing, splitting data, model construction, category encoding, comparing different model configurations based on their performance indicators and selecting the best one, or testing the selected models on the test set. C-2) Model Training/Validation with Keras (code-driven) [60 minutes] The 2st Teacher shows students how to train and validate a ML model using python and keras framework. The Teacher and Students can use the Knime workflow attached as a first example. Students should then be allowed to test with different algorithms/configurations. The main difference from C-1 is the use of python scripts integrated inside the Knime platform for a more expert approach in building image ML classification models. D) Submission to Kaggle competition [30 minutes] Independently of the approach followed for training the model (low-code or code-driven), Students will already know by now how to predict images in the dataset provided for them for the Kaggle competition and export their results as a .csv file. In this stage students will submit their classification results to Kaggle and check their position in the Leaderboard in a game based competition to validate learning acquired and image classification skills.

	E) Autonomous Exploration of Competition Dataset in Kaggle [60 minutes] This can be the starting point (after Context and Problem) if a code-driven journey is used, or it can be a revision of the problem under more demanding conditions (i.e. step 15 of STAGE II). The Teacher and the Students can gather custom image categories and build a custom image dataset to classify specific image categories. This approach requires students to manage an end-to-end image processing and classification workflow in a field/problem of their own choosing using the knowledge acquired. F) Presentation/Conclusions [30 minutes] Each Student/Group is given 5-10 minutes to present the results obtained with their best model, and describe/defend the process followed. This should be the key stage for assessment by the Teacher. Important topics to be covered by the Students should include, at least: ● Which features were considered and why? ● What process was followed to train/validate the model? ● What performance metrics were considered to compare between models and what is the performance of the selected model on the test dataset? ● How well did the Students score in the Leaderboard? ● How much time does the workflow require to complete? ● How the network was built, and detail on neural network orchestration?
Assessment - Evaluation	Assessment/evaluation is carried out in two main dimensions: theoretical and practical. The theoretical dimension is assessed through: ● The Students' degree of adherence to the appropriate model building methodologies (e.g. did the Students use the train/test split and/or cross-validation? Did the Students appropriately split the data?) ● The degree of complexity of the task. Since different journeys can be followed, this should be assessed considering the previous knowledge/skills of the student, the degree of complexity of the journey proposed/followed, and the outcomes The practical dimension is assessed through one or both of the following, depending on the implemented journey: ● The overall score and position of the Students' ML model and ML learning issues such as overfit, underfit data, matrix confusion, RSME, etc. ● The position of the Students on the Kaggle Leaderboard after the end of the competition
Presentation - Reporting - Sharing	The presentation of results should be done in activity F described above. Asides from an (informal?) presentation of results, the students can/will (depending on the journey followed) produce as deliverables the following artifacts: ● The Knime workflow developed during the activity ● The ML model(s) trained ● The .csv file submitted for the Kaggle competition

Extensions - Other Information	● Any custom classification ML model built on custom data captured by the students ● Presentation of custom models trained with images collected by the students

Resources for the development of the FACILITATE AI Learning and Creativity Plan Template
In the case of learning AI by project based activity

FACILITATE AI Prototype/Guide for Learning & Creativity Approach
Action Plan Formulation

Major steps in the FACILITATE AI learning approach:

STAGE I: Preparation by one or more teachers

1. Formulating initial thoughts on the thematic sectors/areas to be covered
2. Engaging the world of the wider environment / work / business / parents / society / environment/ ethics
3. Target Age Group of Students - Associating with the Official Curriculum - Setting Goals and Objectives
4. Organization of the tasks of the parties involved - Designation of Coordinator - Workplaces etc.

STAGE II: Action Plan Formulation (Steps 1-18)

Preparation (by teachers)

1. Relation to the Real World – Reflection
2. Incentive – Motivation
3. Formulation of a problem (possibly in stages or phases) resulting from the above

Development (by students) – Guidance & Evaluation (in 9-11, by teachers)

0. Background Creation - Search / Gather Information
0. Simplify the issue - Configure the problem with a limited number of requirements
0. Case Making - Designing - identifying materials for building / development / creation
0. Construction - Workflow - Implementation of projects
0. Observation-Experimentation - Initial Conclusions
0. Documentation - Searching Thematic Areas (AI fields) related to the subject under study – Explanation based on Existing Theories and / or Empirical Results
0. Gathering of results / information based on points 7, 8, 9
0. First group presentation by students

Configuration & Results (by students) – Guidance & Evaluation (by teachers)

0. Configure AI models to describe / represent / illustrate the results
0. Studying the results in 9 and drawing conclusions, using 12
0. Applications in Everyday Life - Suggestions for Developing 9 (Entrepreneurship - FIL Days)

Review (by teachers)

0. Review the problem and review it under more demanding conditions

Project Completion (by students) – Guidance & Evaluation (by teachers)

0. Repeat steps 5 through 11 with additional or new requirements as formulated in 15
0. Investigation - Case Studies - Expansion - New Theories - Testing New Conclusions
0. Presentation of Conclusions - Communication Tactics.

STAGE III: FACILITATE AI Actions and Cooperation in Creative Projects for school students

Title of Project: _____
Brief Description/Outline of Organizational Arrangements / Responsibilities for Action

STAGE	**Activities/Steps** Teacher 1(T1) Cooperation with T2 and student guidance	**Activities /Steps** **By Students** Age Group: ____	**Activities /Steps** Teacher 2 (T2) Cooperation with T1 and student guidance
A	Preparation of steps 1,2,3		Cooperation in step 3
B	Guidance in step 9	4,5,6,7,8,9,10	Support guidance in step 9
C	Creative Evaluation	11	Creative Evaluation
D	Guidance	12	Guidance
E	Guidance	13 (9+12)	Guidance
F	Organization (FIL) FACILITATE-AI in Life	14 Meeting with Business representatives	Organization (FIL) FACILITATE-AI in Life
G	Preparation of step 15		Cooperation in step 15
H	Guidance	16 (repetition 5-11)	Support Guidance
I	Guidance	17	Support Guidance
K	Creative Evaluation	18	Creative Evaluation

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FACILITATE – AI
LEARNING & CREATIVITY PLAN (L&C PLAN):

BUILD THE BEST, DESTROY THE REST!

1. Overview

Title	Build the best, destroy the rest!		
Driving Question or Topic	How to collect data from a (virtual) environment, and use it to train a Machine Learning model? How to test with different features? How to use the model to automate decision-making?		
Ages, Grades, …	Ages: 14-18	9th-12th grade	
Duration, Timeline, Activities	3-5 hours	2 mandatory activities + 2 independent optional more advanced activities	4 activities
Curriculum Alignment	Artificial Intelligence, Machine Learning, Computer Programming		
Contributors, Partners			
Abstract - Synopsis	Students will learn about the structure of a dataset and the data collection process, and how a Machine Learning model can be trained, evaluated, and used in production to automate a decision-making process, while using a programming game.		
References, Acknowledgements	https://docs.h2o.ai/h2o/latest-stable/h2o-docs/index.html https://robowiki.net/wiki/Robocode/Getting_Started		

2. FACILITATE AI Framework

Teachers' Cooperation	1st Teacher: Artificial Intelligence/Machine Learning 2nd Teacher: Programming (the two teachers can work together during the whole Project, with a different degree depending on the (sequence of) activities carried out)
FACILITATE-AI in Life (FiL) Organization	Meeting with Data Scientist / Machine Learning Engineer or another similar role, to know how ML models are developed and used in real-life
Action Plan Formulation	STAGE I: The 1st Teacher presents the concept of Machine Learning model and presents some examples of real-world applications. The 2nd Teacher presents Robocode as a programming game, its rules and physics, and how data can be collected from this

	environment. The specific problem of programming autonomous battle tanks is presented (Steps 1-3) STAGE II: The 1st Teacher guides the Students into building and evaluating a ML model using a provided dataset. Students may train different models and critically compare them to select the best one (Steps 4-14) STAGE II: The 2nd Teacher guides the Students into developing a Robocode robot that uses the trained ML model to decide how to behave in the battlefield (Steps 10-14) STAGE II: The Teachers challenge the students to revisit the whole process, going back to the feature selection / model training phases, or even to the data collection phase (Steps 15-18)

*under development the final elements of the framework

3. Objectives and Methodologies

Learning Goals and Objectives	By the end of the L&C Plan, Students will be able to know and apply the concepts of feature selection, model training, model evaluation and model productionizing.
Learning Outcomes and expected Results	Train ML models based on an existing dataset Critically evaluate and compare multiple ML models according to objective criteria Understand the impact of data collection and feature selection on the quality of ML models Taking a ML model to production
Prior Knowledge and Prerequisites	While not mandatory, it would be useful if students have basic programming knowledge.
Motivation, Methodology, Strategies, Scaffolds	This L&C Plan is built around an inquiry-based learning. The teachers will provide the structure for the Students' journey, including the different paths that they may take according to their time and/or skills, and then challenge them at certain points in this journey with specific questions such as: "What are the most relevant features?", "How do different algorithm parameters affect model performance?", or "What other potentially relevant features could be collected from your robot?". Students will thus have some degrees of freedom and will be able to make their own choices regarding, for example, model configuration, features or model selection. Teachers shall incite them to explore this search space autonomously, but focusing on understanding the consequences of their choices, namely on model quality. Students will develop critical thinking and communication skills by being challenged by the Teachers to justify the rationale of their decisions, and the quality of their outcomes. Gamification can be used as a complementary methodology, in its simplest form through the use of a Kaggle Competition, as proposed, or through any similar tool. The L&C can be developed with students working individually or in groups. When working in groups, many of the activities can be developed in parallel by multiple Students simultaneously, promoting creativity and group work. In these settings, intra-group competitiveness may also be promoted as a way to motivate Students to excel. The L&C Plan will be delivered by Teachers as mini-lessons, at least one for each proposed activity. Different journeys can be prepared by the Teachers, depending on the available time, goals and/or skills of the students. The possible journeys can be planned based on the attached document "Journey.pdf".

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	The L&C Plan requires a classroom with at least one computer per group (if the activities are carried out in group) or, ideally, one computer per Student. The instructions were prepared for a MS Windows Operating System, although the L&C Plan can be delivered in other environments as well (e.g. macOS, Linux). The following are technical (or other) requirements necessary for delivering the L&C Plan. Additional details for preparing the class and a troubleshooting guide are provided in the attachment "Preparation and troubleshooting.pdf". ● Java is required for running Robocode, preferably a Java Developer Kit (JDK) version 12 to 18 or newer ● If the students are going to modify or program their own robot, an IDE is necessary (Netbeans is recommended) ● An internet connection is only available during the delivery of the L&C plan if a Kaggle competition is being implemented ● An overhead projector, although not mandatory, may be useful for Teachers to share content and resources, to project Robocode battles, etc.
Resources, Tools, Material, Attachments, Equipment	Resources: ● Please refer to the document entitled "CreateTheBest_MVP", for an example of an MVP that can be created from this L&C Plan ● https://docs.oracle.com/en/java/javase/13/install/installation-jdk-microsoft-windows-platforms.html ● https://robowiki.net/wiki/Robocode/NetBeans/Configure ● https://robowiki.net/wiki/Robocode/Getting_Started ● https://robowiki.net/wiki/Robocode/Game_Physics ● https://robowiki.net/wiki/Robocode/Robot_Anatomy ● https://robowiki.net/wiki/Robocode/Scoring Tools: ● Robocode – used for running robot battles ● Netbeans – optional, used only if Students are going to develop/modify robots ● H2O – used for training ML models ● Python + scikit-learn – used for training ML models Materials: ● The full list of materials is described in the attachment "Preparation and troubleshooting.pdf"
Health and Safety	

5. Implementation

Instructional Activities, Procedures, Reflections	(Prior to the activities, the Teachers should have carried out the preparation activities, as described in document in the attachment "Preparation and troubleshooting.pdf") This L&C Plan is highly dynamic and can be adapted according to the available time, the learning goals and/or the skills and previous knowledge of the Students. The possible journeys are depicted in the attached document "Journey.pdf". The teachers should plan ahead and program an intended journey for a given class (the activities described below are not meant to be all carried out). Then, during the delivery of the L&C Plan, Teachers may adapt and include additional steps or remove existing ones. This section describes each step individually. Their concatenation into a specific journey must be done according to the process depicted in "Journey.pdf". A) Context [30 minutes] The 1st Teacher presents the concept of Machine Learning model and presents some examples of real-world applications. The path from data collection to model training and productionizing should be addressed, as well as a first notion of model metrics (e.g. RMSE, AUC, Accuracy, …). B) Problem [30 minutes] The 2nd Teacher presents Robocode as a programming game (e.g. how is a robot programmed and run?), its rules and physics, and how data can be collected from this environment. The problem of programming a robot to decide autonomously on how to fire when an enemy is spotted in the radar is presented next. The teacher can use the provided online resources for presenting the Robocode environment, and the **SimpleRobot** provided in attachment as an example of a simple robot. C-1) Model Training/Validation with H2O (low-code) [60 minutes] The 1st Teacher shows students how to train and validate a ML model using H2O. The Teacher and Students can use the **H2O notebook** attached as a first example. Students should then be allowed to test with different algorithms/configurations. In this part, the Teacher should not fail to cover important topics such as: splitting data, feature selection (e.g. do different features result in better/worse models? Analyzing relative feature relevance), comparing different models based on their performance indicators and selecting the best one, or testing the selected models on the test set. C-2) Model Training/Validation with scikit-learn (code-driven) [60 minutes] The 1st Teacher shows students how to train and validate a ML model using scikit-learn. The Teacher and Students can use the script **model_training.py** attached as a first example. Students should then be allowed to test with different algorithms/configurations. In this part, the Teacher should not fail to cover important topics such as: splitting data, feature selection (e.g. do different features result in better/worse models? Analyzing relative feature relevance), comparing different models based on their performance indicators and selecting the best one, or testing the selected models on the test set. D) Submission to Kaggle competition (optional) [10 minutes] Independently of the approach followed for training the model (low-code or code-driven), Students will already know by now how to predict for the Kaggle competition and export their results as a .csv file. If you intend to use Kaggle, in this stage students will submit their results to Kaggle and check their position in the Leaderboard.

	E-1) Productionize H2O model in Robocode [10 minutes] If H2O was used to train the ML model, the Teacher and Students can use the provided **H2ORobot** to test their model in Robocode. While the actual code of the robot may be analyzed/changed, this is not necessary: it is enough to name the exported model appropriately and place it in the corresponding folder. E-2) Productionize scikit-learn model in Robocode [10 minutes] If scikit-learn was used to train the ML model, the Teacher and Students can use the provided **PythonRobot** to test their model in Robocode. While the actual code of the robot may be analyzed/changed, this is not necessary: it is enough to name the exported model appropriately and place it in the corresponding folder. The **PythonServer** should also be run to enable the Robot to communicate with the model. F) Collect data with Robocode [30 minutes] This can be the starting point (after Context and Problem) if a code-driven journey is used, or it can be a revision of the problem under more demanding conditions (i.e. step 15 of STAGE II). The Teacher and the Students can use the provided **DataCollector** robot as a starting point, and either collect additional data or collect additional/different features. The former does not require the editing of the code of the robot, whereas the latter does. Moreover, the latter eventually implies a more thorough description of the Robocode environment (Students must know the available sources of data and their relevance for the firing/hitting problem) and some previous coding experience. G) Presentation/Conclusions [30 minutes] Each Student/Group is given 5-10 minutes to present the results obtained with their best model, and describe/defend the process followed. This should be the key stage for assessment by the Teacher. Important topics to be covered by the Students should include, at least: ● Which features were considered and why? ● What process was followed to train/validate the model? ● What performance metrics were considered to compare between models and what is the performance of the selected model on the test dataset? ● How well did the Students score in the Leaderboard? ● How well did the Students' robot perform in battle?
Assessment - Evaluation	Assessment/evaluation is carried out in two main dimensions: theoretical and practical. The theoretical dimension is assessed through: ● The Students' degree of adherence to the appropriate model building methodologies (e.g. did the Students use the train/test split and/or cross-validation? Did the Students appropriately split the data?) ● The degree of complexity of the task. Since different journeys can be followed, this should be assessed considering the previous knowledge/skills of the student, the degree of complexity of the journey proposed/followed, and the outcomes

	The practical dimension is assessed through one or both of the following, depending on the implemented journey: ● The overall score and position of the Students' robot after the end of a Battle, or the individual scores (e.g. Bullet Damage, Bullet Bonus, first places, …). Please see Robocode/Scoring for more information ● The position of the Students on the Kaggle Leaderboard after the end of the competition
Presentation - Reporting - Sharing	The presentation of results should be done in activity G described above. Asides from an (informal?) presentation of results, the students can/will (depending on the journey followed) produce as deliverables the following artifacts: ● The H2O notebook developed during the activity ● The H2O model(s) trained ● The Python model(s) trained ● The .csv file submitted for the Kaggle competition ● Any robot that has been modified/developed by the Students
Extensions - Other Information	

Resources for the development of the FACILITATE AI Learning and Creativity Plan Template
In the case of learning AI by project based activity

FACILITATE AI Prototype/Guide for Learning & Creativity Approach
Action Plan Formulation

Major steps in the FACILITATE AI learning approach:

STAGE I: Preparation by one or more teachers

1. Formulating initial thoughts on the thematic sectors/areas to be covered
2. Engaging the world of the wider environment / work / business / parents / society / environment/ ethics
3. Target Age Group of Students - Associating with the Official Curriculum - Setting Goals and Objectives
4. Organization of the tasks of the parties involved - Designation of Coordinator - Workplaces etc.

STAGE II: Action Plan Formulation (Steps 1-18)

Preparation (by teachers)

1. Relation to the Real World – Reflection
2. Incentive – Motivation
3. Formulation of a problem (possibly in stages or phases) resulting from the above

Development (by students) – Guidance & Evaluation (in 9-11, by teachers)

0. Background Creation - Search / Gather Information
0. Simplify the issue - Configure the problem with a limited number of requirements
0. Case Making - Designing - identifying materials for building / development / creation
0. Construction - Workflow - Implementation of projects
0. Observation-Experimentation - Initial Conclusions
0. Documentation - Searching Thematic Areas (AI fields) related to the subject under study – Explanation based on Existing Theories and / or Empirical Results
0. Gathering of results / information based on points 7, 8, 9
0. First group presentation by students

Configuration & Results (by students) – Guidance & Evaluation (by teachers)

0. Configure AI models to describe / represent / illustrate the results
0. Studying the results in 9 and drawing conclusions, using 12
0. Applications in Everyday Life - Suggestions for Developing 9 (Entrepreneurship - FIL Days)

Review (by teachers)

0. Review the problem and review it under more demanding conditions

Project Completion (by students) – Guidance & Evaluation (by teachers)

0. Repeat steps 5 through 11 with additional or new requirements as formulated in 15
0. Investigation - Case Studies - Expansion - New Theories - Testing New Conclusions
0. Presentation of Conclusions - Communication Tactics.

STAGE III: FACILITATE AI Actions and Cooperation in Creative Projects for school students

Title of Project: _____
Brief Description/Outline of Organizational Arrangements / Responsibilities for Action

STAGE	**Activities/Steps** Teacher 1(T1) Cooperation with T2 and student guidance	**Activities /Steps** **By Students** Age Group: ____	**Activities /Steps** Teacher 2 (T2) Cooperation with T1 and student guidance
A	Preparation of steps 1,2,3		Cooperation in step 3
B	Guidance in step 9	4,5,6,7,8,9,10	Support guidance in step 9
C	Creative Evaluation	11	Creative Evaluation
D	Guidance	12	Guidance
E	Guidance	13 (9+12)	Guidance
F	Organization (FIL) FACILITATE-AI in Life	14 Meeting with Business representatives	Organization (FIL) FACILITATE-AI in Life

G	Preparation of step 15		Cooperation in step 15
H	Guidance	16 (repetition 5-11)	Support Guidance
I	Guidance	17	Support Guidance
K	Creative Evaluation	18	Creative Evaluation

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FACILITATE – AI
LEARNING & CREATIVITY PLAN (L&C PLAN):

Problem solving scenarios and route finding applications

1. Overview

Title	Problem solving scenarios and route finding applications
Driving Question or Topic	*What I need to know about search and problem solving algorithms and where they are used in my life?*
Ages, Grades, …	*16-18* *9-11 grade*
Duration, Timeline, Activities	*5 lessons* *5*40 min* *5 activities*
Curriculum Alignment	What is a problem in AI. Solve problems by searching. State Space Search Algorithms. Cost optimization. Applications.
Contributors, Partners	*School partners from the tourism business*
Abstract - Synopsis	*Students are initially taught together by the IT teacher, who introduces them to the theoretical frameworks of basic AI concepts and problem solving through search. After that, groups of 5-6 students visit a tourist center and study how a particular tourist site can be visited, in what way and by what means roads. Together with the IT and geography teachers, the groups apply different algorithms to generate different routes.* *In the next stage, the IT teacher presents the A* algorithm to them and the groups of students applying the algorithm by optimizing the previously created routes. They calculate the price of the cost function and suggest the cheapest, fastest, and shortest of the routes. Finally, they present their work.*
References, Acknowledgements	

2. FACILITATE AI Framework

Teachers' Cooperation	***Teacher 1:*** *IT teacher* - this teacher introduces the theoretical aspects of applying AI algorithms to problem solving through search. He helps the students in solving the specific tasks, as well as in the preparation of the results and their presentation ***Teacher 2:*** *Geography teacher* – his/her responsibilities are related to assisting students in defining the problem and presenting additional "heuristic" knowledge about the location of objects and the creation of routes. Its purpose is to realize interdisciplinary connections with the knowledge of geography. ***Teacher 3****: Entrepreneurship teacher* - this teacher will help groups of students calculate the values of the "cost function" in terms of time, distance and cost by finding the optimal solutions. In this way, the theoretical knowledge of entrepreneurship will be applied in solving specific practical problems.

FACILITATE-AI in Life (FiL) Organization	*Meeting with business representatives* *Entrepreneurship - AI in real life*
Action Plan Formulation	***Step 1. Acquisition of theoretical knowledge**: Defining the concept of "Problem" and solving a problem by searching with the IT teacher. The following sample problem "How to create a route to visit a famous tourist site with different means of transport and on different roads" is defined.* ***Step 2**. Receiving the assignment and **applying the knowledge**: Together with the geography teacher, they visit a tourist center in the city and do research on the possibilities of visiting an interesting tourist object in the region - by different roads and with different vehicles.* ***Step 3**. **Confirmation and analysis** of the acquired knowledge: Algorithms for finding a solution to a problem are discussed with the IT teacher. Different routes are generated to solve the example problem by using different algorithms.* ***Step 4. Application of knowledge** to solve the problem and **present the results** Together with IT, Geography and Entrepreneurship teachers, the A* algorithm is considered. Calculate the cost function and generate an optimal route (by cost or time).* ***Step 5**. **Evaluation**. Each teacher follows the leveled assessment methodology, i.e. values teamwork, students' research and knowledge, presentation and communication skills.*

*under development the final elements of the framework

3. Objectives and Methodologies

Learning Goals and Objectives	*After completing the training, students should know:* *- What are the main algorithms for finding a solution to a problem in AI and how are they applied in the modern world.* *- What does it mean to find an optimal solution and what are the algorithms for this.*
Learning Outcomes and expected Results	*Students understand the need to use algorithms in AI when solving specific problems in everyday life - such as searching and generating a route.*
Prior Knowledge and Prerequisites	***They should be able to:*** ● *Solve simple problems by searching with basic AI algorithms* ● *They work in teams* ● *Cooperate with their teachers in solving practical tasks* ● *Conduct research* ● *To plan and organize meetings* ● *To communicate with business partners* ● *To analyze the received information* ● *To prepare presentations and videos* ● *To apply creativity and generate new ideas* ● *Communicate in a team and present to an audience*

	Expected results: ● *Presentations with analysis and results of solving the problem and finding different routes* ● *Final conclusions about the most optimal routes according to various criteria* ● *Real-world application of topics studied in computer science, natural science and entrepreneurship classes* ● *Improvement of teamwork knowledge*
Motivation, Methodology, Strategies, Scaffolds	*A **major task** in the plan is to create and experiment with a **new approach** to studying the very complex topic of search algorithms in AI. Defining specific tasks and applying the most basic algorithms in solving these tasks (such as finding a route to a specific object) reduces abstractness and allows students to understand the meaning of this knowledge.* *The **new role** of all teachers is to guide and support student teams in their work. The plan requires both **individual and collective work** of the students in the team in the initial research and preparation of team presentations.*

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	*The lead teacher is that of Computer Science and IT. He/she presents the new knowledge and helps the teams in their application. The teachers of geography and entrepreneurship support the work of the teams, the visit to the tourist center, the extraction and analysis of the information received from the partners. All teachers (each according to their competencies) collaborate with the students in solving their problem, thus demonstrating the interdisciplinarity of AI.*
Resources, Tools, Material, Attachments, Equipment	*Students work in the classroom or in a computer lab as they acquire new knowledge. They visit a tourist office in the city and work as a team to solve the problem in the STEAME center or other protected environment with their teachers. They prepare the presentation of their solutions in a computer laboratory. Teachers need to have appropriate learning resources such as presentations, video files, practical examples, geographical maps, etc.* ● *Video file for knowledge representation – https://www.youtube.com/watch?v=V-O-RFSRe-E* ● *Video file for basic search AI algorithms – https://www.youtube.com/watch?v=AneIXxdu_g4* ● *Additional info for search AI algorithms- https://www.youtube.com/watch?v=TRAqHQkuo3M* ● *Google maps - https://www.google.com/maps* ● *Presentation for A* algorithm – https://www.youtube.com/watch?v=vP5TkF0xJgI* ● *Additional resources - https://www.youtube.com/watch?v=Mb1srg1ON60 and https://www.youtube.com/watch?v=eyXynZTshP0* ● communication and collaboration platform - Google Meet, Google Classroom, Zoom, Skype, etc. ● e-learning platform – Google classroom, Moodle, other
Health and Safety	*Students and teachers work in a healthy and safe environment.*

5. Implementation

Instructional Activities, Procedures, Reflections	*This Plan was developed with a focus on school hours the subjects Computer Modeling and IT, Geography and Entrepreneurship or in a STEAME club by interest.* *It covers the school subjects:* *- Computer Sciences* *- Entrepreneurship* *- Geography* *- Presentation and communication skills* *- English* *Teachers plan their activities in Google Calendar as part of the curriculum. Teacher 2 and teacher 3 follow their regular plans and include examples and information and activities based on the student teams' area of research. Students are actively engaged through hands-on experience and research conducted as independent work that can be discussed in class.* *It is planned 5 study hours are based on a 40-minute lesson. All classes are held once a week with a curriculum for 5 consecutive weeks, and if it is within the framework of studies STEAME interest club - within 1 week.* *The lead teacher, T1 is involved in conducting all lessons:* *- 1 hour introduction to search algorithms* *- 1 hour – participation in a meeting at a tourist office and setting the tasks* *- 1 hour of training on the use of the A* algorithm* *- 1 hour of work on the development of solutions to the problem and preparation for its presentation* *- 1 hour for final presentations and feedback sessions which are organized during the last lesson on the topic and a presentation before a jury, including T1, T2, T3 and all students from the 9th, 10th and 11th grades. Teachers T2 and T3 align their activities with the implementation, including guidance on interviews with tourism business partners and data analysis, development of charts/graphs and presentations. They support the teams and give feedback on their work and final results.*
Assessment - Evaluation	*The presentation of the final results takes place before: a jury from T1, T2, T3, classmates, external experts, parents. The main ones components of the presentations are: results of the conducted research, the search algorithm used, the results of the assignment and the route found to visit a tourist site.*
Presentation - Reporting - Sharing	*The students' final conclusions and results are a key success factor. Their own opinion and final recommendations are the main focus so that they can analyze and defend their opinion.* *All presentations are uploaded to the school's website and social media posts.*
Extensions - Other Information	*The projects can be further developed into case studies and students and teachers can use them in their classes as teaching materials and/or develop them further as individual projects.*

Resources for the development of the FACILITATE AI Learning and Creativity Plan Template
In the case of learning AI by project based activity

FACILITATE AI Prototype/Guide for Learning & Creativity Approach
Action Plan Formulation

Major steps in the FACILITATE AI learning approach:

STAGE I: Preparation by one or more teachers

1. **Formulating initial thoughts on the thematic sectors/areas to be covered:**
   At the heart of AI lie the theoretical foundations of algorithms for searching for a solution in a state space. Different algorithms exist, some of which quickly lead to a result that is not the best; others - although they seem appropriate, they cannot solve the problem at all; some use prior knowledge of the objects in the state space, while others search "blindly". Through these algorithms, various applications are realized in AI systems: games are created, routes are generated, best solutions to problems are sought, etc. All of this motivates us to demonstrate to students how basic search algorithms work and what problems they can solve. In the course of training, students must solve a specific problem - finding a route using different search algorithms. In the final stage of the work, the students get to know the A algorithm and find the optimal solution to the problem according to various criteria. In this stage, they use not only their knowledge of computer modeling and geography, but also of entrepreneurship.*

0. Engaging the world of the wider environment / work / business / parents / society / environment/ ethics
Not only the 11th and 12th grade students and their computer science, geography and entrepreneurship teachers participate in the training, but also partners from the tourism business, parents and school management.

0. Target Age Group of Students - Associating with the Official Curriculum - Setting Goals and Objectives:
The theme is intended for students in grades 11 and 12 in secondary school. The training can be implemented in a STEAME club based on interests. It can also be organized as part of IT, Geography and Entrepreneurship studies using additional extra-curricular activities and independent study.

0. Organization of the tasks of the parties involved - Designation of Coordinator - Workplaces etc.
The teachers organize the training and support the work of the teams; the partners from the tourist office motivate the students and set a real task to fulfill; the school management supports the organization of meetings with business partners, the extracurricular organization of the work, as well as the presentation of the results to an appropriate audience.

STAGE II: Action Plan Formulation (Steps 1-18)

<u>Preparation (by teachers)</u>

1. **Relation to the Real World – Reflection**
   Presenting a real problem - finding a solution to a problem that involves common sense knowledge and no mathematical algorithm. Students are introduced to some basic search algorithms through examples.

0. Incentive – Motivation
Together with the geography teacher, they visit a tourist office and do real route generation tasks. Posing a real problem motivates students

0. **Formulation of a problem (possibly in stages or phases) resulting from the above**
The students are divided into groups and look for the routes by applying the theoretical knowledge obtained. After that, they learn about the A algorithm and, together with their teachers, generate optimal routes according to various criteria. Finally, they prepare their presentation and present the results to a critical audience.*

Development (by students) – Guidance & Evaluation (in 9-11, by teachers)

0. **Background Creation - Search / Gather Information:**
New knowledge, applications in solving specific tasks, searching for additional information to solve the problem and find the route - settlements, tourist sites, roads, transport, etc.
0. **Simplify the issue - Configure the problem with a limited number of requirements**
The route search task is placed clearly with the necessary information
0. **Case Making - Designing - identifying materials for building / development / creation**
Simple examples are used to understand search algorithms. The task that the individual groups receive is clearly defined
0. **Construction - Workflow - Implementation of projects**
Introductory training with relevant examples - Posing a real problem - Additional training - Finding a solution to the problem - Presenting the results
0. **Observation-Experimentation - Initial Conclusions**
Multiple creation of different routes and their optimization
0. **Documentation - Searching Thematic Areas (AI fields) related to the subject under study – Explanation based on Existing Theories and / or Empirical Results**
Students have the necessary theoretical information and examples.
0. **Gathering of results / information based on points 7, 8, 9**
At each step, the teacher-moderators report the progress of each group in solving the problem
0. **First group presentation by students**
Students present the results of their work after applying different search algorithms and finally after applying the A algorithm*

Configuration & Results (by students) – Guidance & Evaluation (by teachers)

0. Configure AI models to describe / represent / illustrate the results
0. Studying the results in 9 and drawing conclusions, using 12
0. Applications in Everyday Life - Suggestions for Developing 9 (Entrepreneurship - FIL Days)

Review (by teachers)

0. **Review the problem and review it under more demanding conditions**
It is required to find an optimal solution to the given problem - the search for a route. Initially, it may be required to find an optimal solution according to the criterion of least time, and then to set the students the task of finding an optimal route in terms of distance and cost.

Project Completion (by students) – Guidance & Evaluation (by teachers)

0. Repeat steps 5 through 11 with additional or new requirements as formulated in 15
0. Investigation - Case Studies - Expansion - New Theories - Testing New Conclusions
0. Presentation of Conclusions - Communication Tactics.

STAGE III: FACILITATE AI Actions and Cooperation in Creative Projects for school students

Title of Project: Problem solving scenarios and route finding applications
Brief Description/Outline of Organizational Arrangements / Responsibilities for Action

STAGE	**Activities/Steps** Teacher 1(T1) Cooperation with T2, T3 and student guidance	**Activities /Steps By Students** Age Group: 17-18	**Activities /Steps** Teacher 2 (T2) Cooperation with T1, T3 and student guidance	**Activities /Steps** Teacher 3 (T3) Cooperation with T1, T2 and student guidance
A	Preparation of steps 1,2,3,4 and 5		Cooperation in step 2, 3, 4, 5	Cooperation in step 4 and 5
B	Guidance in step 9	4,5,6,7,8,9,10	Support guidance in step 9	Support guidance in step 9
C	Creative Evaluation	11	Creative Evaluation	Creative Evaluation
D	Guidance	12	Guidance	Guidance
E	Guidance	13 (9+12)	Guidance	Guidance
F	Organization (FIL) FACILITATE-AI in Life	14 Meeting with Business representatives	Organization (FIL) FACILITATE-AI in Life	Organization (FIL) FACILITATE-AI in Life
G	Preparation of step 15		Cooperation in step 15	Cooperation in step 15
H	Guidance	16 (repetition 5-11)	Support Guidance	Support Guidance
I	Guidance	17	Support Guidance	Support Guidance
K	Creative Evaluation	18	Creative Evaluation	Creative Evaluation

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FACILITATE – AI
LEARNING & CREATIVITY PLAN (L&C PLAN):

Prolog in the service of AI (Applications, e.g. family relationship)

1. Overview

Title	Prolog in the service of AI (Applications, e.g. family relationship)		
Driving Question or Topic	*What I need to know about search and problem solving algorithms and where they are used in my life?*		
Ages, Grades, …	*16-18*	*8-12 grade*	
Duration, Timeline, Activities	*4 lessons*	*4*40 min*	*4 activities*
Curriculum Alignment	How to process common sense knowledge through rules. How to use the logic programming language Prolog to solve problems and make inferences. Applications in family relationships.		
Contributors, Partners	*School library*		
Abstract - Synopsis	*Students are initially taught by the IT teacher who introduces them to the representation of knowledge through logical rules and the Prolog language. The students then visit the school library with the literature teacher, where they look up information and discuss the family relationships of the Greek gods, according to "ancient Greek legends and myths". In groups of 5-6 students create different branches of the family tree of the gods. The next activity is for each group to program their family tree in Prolog, ask questions and get correct answers. At the last stage of training, each group presents the results of their work to their classmates, teachers, students and parents.*		
References, Acknowledgements	https://www.natgeokids.com/uk/discover/history/greece/greek-gods/		

2. FACILITATE AI Framework

Teachers' Cooperation	***Teacher 1:*** *IT teacher* - the teacher gets acquainted with the theoretical aspects of the representation of knowledge through logical rules and the use of the logical programming language Prolog. He/She facilitates groups of students to program in Prolog family relationships according to their assigned task and to present the results of knowledge processing with common meaning. ***Teacher 2:*** *Literature teacher his responsibilities are related to assisting students in defining the problem and presenting additional knowledge about the kinship relationships between the Greek gods, according to Kun's book "Myths and Legends of Ancient Greece" (studied in literature in grades 5-6) and information available in Internet. Its purpose is to make interdisciplinary connections with the knowledge of literature and history.*

FACILITATE-AI in Life (FiL) Organization	*Meeting with the school librarian*
Action Plan Formulation	***Step 1. Acquisition of theoretical knowledge**: Defining common sense knowledge and solving problems using logical rules with the IT teacher. The Prolog language and its possibilities to infer through logical rules are introduced. The following example task is defined, "Do research on the family relationships of the ancient Greek gods and program them in Prolog.".* ***Step 2**. **Getting the assignment and applying the knowledge:** Together with the literature teacher, they visit the school library and do research on the kinship relationships between the gods in the book "Myths and Legends of Ancient Greece". They are divided into groups and given the task of describing a certain part of the family tree of the ancient Greek gods.* ***Step 3**. **Application of knowledge** to solve the problem - Together with the teachers of IT and literature, the part of the family tree for each group is programmed in Prolog. Various questions are asked of the Prologue (eg Who are the children of Zeus?). The answers received are analyzed**.** The results of the teams' work are being prepared for presentation.* ***Step 4**. **Evaluation**. Each teacher follows the leveled assessment methodology, i.e. values teamwork, students' research and knowledge, presentation and communication skills.*

*under development the final elements of the framework

3. Objectives and Methodologies

Learning Goals and Objectives	*After completing the training, students should know:* *- What is common sense knowledge and how is it represented by logical rules.* *- What is the logic programming language Prolog and what problems can it solve*
Learning Outcomes and expected Results	*Students understand the need to use logic programming in finding solutions and making inferences based on gathered knowledge with common meaning.*
Prior Knowledge and Prerequisites	***They should be able to:*** ● *Find solutions and make inferences based on knowledge with common meaning* ● *Team working* ● *Cooperate with their teachers in solving practical tasks* ● *Conduct research* ● *To plan and organize the common work* ● *To analyze the received information* ● *To prepare presentations and videos* ● *To apply creativity and generate new ideas* ● *Communicate in a team and present to an audience*

	Expected results: ● *Presentations with analysis and results of solving the problem and finding solution by logic programming* ● *Application of AI in the topics studied in computer science and literature classes* ● *Improvement of teamwork knowledge*
Motivation, Methodology, Strategies, Scaffolds	*A **major task** in the plan is to create and experiment with a new approach to studying the subject of knowledge representation through logical rules in AI. Defining specific tasks and applying a logic programming language to solving these tasks (such as the family relationships between the ancient Greek gods) reduces abstractness and allows students to understand the meaning of this knowledge. The new role of all teachers is to lead and support student teams in their work. The plan requires both individual and collective work of students in the team in the initial research and preparation of team presentations.*

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	*The lead teacher is that of Computer Science and IT. He/she presents the new knowledge and helps the teams in their application. The teacher of literature supports the work of the teams, the visit to school library, the extraction and analysis of the information received from the books and internet. All teachers (each according to their competencies) collaborate with the students in solving their problem, thus demonstrating the interdisciplinarity of AI.*
Resources, Tools, Material, Attachments, Equipment	*Students work in the classroom or in a computer lab as they acquire new knowledge. They visit a school library and work as a team to solve the problem in the classroom, in STEAME center or other protected environment with their teachers. They prepare the presentation of their solutions in a computer laboratory. Teachers need to have appropriate learning resources such as presentations, video files, practical examples, books, etc.* ● *Video file for knowledge representation – https://drive.google.com/file/d/1-oTIRapyqa50mMHhxSJLLMQWXYNrcA9m/view?usp=share_link* ● *Additional info for Prolog- https://www.youtube.com/watch?v=gJOZZvYijqk* ● *Info -Family tree Ancient Greek Goods - https://www.google.com/map https://www.natgeokids.com/uk/discover/history/greece/greek-gods/* ● *Additional resources for Greek Goods example - https://drive.google.com/file/d/1xCGjNHPuRAgJKO-iQAY8wCnckMtAkYon/view?usp=share_link* ● communication and collaboration platform - Google Meet, Google Classroom, Zoom, Skype, etc. ● e-learning platform – Google classroom, Moodle, other
Health and Safety	*Students and teachers work in a healthy and safe environment.*

5. Implementation

Instructional Activities, Procedures, Reflections	*This Plan was developed with a focus on school hours the subjects Computer Modeling and IT and Literature or in a STEAME club by interest.* *It covers the school subjects:* *- Computer Sciences* *- Literature(History)* *- Presentation and communication skills* *- English* *Teachers plan their activities in Google Calendar as part of the curriculum. Teacher 2 follows his regular plans and include examples and information and activities based on the student teams' area of research.* *Students are actively engaged through hands-on experience and research conducted as independent work that can be discussed in class.* *It is planned 4 study hours are based on a 40-minute lesson. All classes are held once a week with a curriculum for 4 consecutive weeks, and if it is within the framework of studies STEAME interest club - within 1 week.* *The lead teacher, T1 is involved in conducting all lessons:* *- **Lesson1** - Introduction to Problem Solving Using Logic Rules and Logic Programming in Prolog with the IT Teacher. Useful resources for this lesson can be following:* • *Video file for knowledge representation – https://drive.google.com/file/d/1-oTIRapyqa50mMHhxSJLLMQWXYNrcA9m/view?usp=share_link* • *Additional info for Prolog-https://www.youtube.com/watch?v=gJOZZvYijqk* *Discussion for knowledge representation and logic programming. Open program environment and write simple prolog-programs.* *- **Lesson 2**– participation in activities in the school library and setting the teams' tasks together with the IT, literature teachers and the school librarian. Search information for Greek goods; structuring information; organize team work.* *- **Lesson 3** – programming in Prolog, developing solutions to the task and preparing for its presentation. In computer lab students' groups program family relationships according to created structure in Lesson2. They prepare the presentations.* *- **Lessons 4** - for final presentations and feedback sessions which are organized during the last lesson on the topic and a presentation to a jury, including T1, T2, the school librarian and all students from grades 8-12.* *Teacher T2 aligns his activities with performance, including construction of facts, analysis of decisions and preparation of presentations. They support the teams and give feedback on their work and final results.*
Assessment - Evaluation	*The presentation of the final results takes place in front of: a jury from T1, T2, classmates, external experts, parents. The main ones components of the presentations are: the formulated and correctly structured facts and logical rules, as well as the correct results after the requests made and the questions asked.*
Presentation - Reporting - Sharing	*The students' final conclusions and results are a key success factor. Their own opinion and final recommendations are the main focus so that they can analyze and defend their opinion.*
Extensions - Other Information	*All presentations and source files are published on the educational platform and on the school's website.* *The projects can be further developed into case studies and students and teachers can use them in their classes as teaching materials and/or develop them further as individual projects.*

Resources for the development of the FACILITATE AI Learning and Creativity Plan Template
In the case of learning AI by project based activity

FACILITATE AI Prototype/Guide for Learning & Creativity Approach
Action Plan Formulation

Major steps in the FACILITATE AI learning approach:

STAGE I: Preparation by one or more teachers

1. **Formulating initial thoughts on the thematic sectors/areas to be covered:**
   Processing knowledge with general meaning and drawing conclusions from it is a basic task for classical AI. Using classical logic and logical rules is one of the most used approaches for this. The logic programming language Prolog provides a convenient and easy-to-use environment for processing such knowledge and displaying the results of its processing. All this motivates us to demonstrate to students how Prolog works and how it helps us draw certain conclusions. In the course of training, students must solve a specific problem - forming facts and rules related to the kinship relations between the ancient Greek gods and searching for specific answers and conclusions. In the final stage of the work, the students develop a Prolog program and present the results of their work. In the course of training, they use not only their knowledge of IT and programming, but also of history and literature.

0. Engaging the world of the wider environment / work / business / parents / society / environment/ ethics
Not only students from grades 8-12 and their informatics and literature teachers participate in the training, but also the school librarian, parents and school management.

0. Target Age Group of Students - Associating with the Official Curriculum - Setting Goals and Objectives:
The theme is intended for students in grades 8 to 12 in secondary school. The training can be implemented in a STEAME club based on interests. It can also be organized as part of IT, literature (or History) studies using additional extra-curricular activities and independent study.

0. Organization of the tasks of the parties involved - Designation of Coordinator - Workplaces etc.
The teachers organize the training and support the work of the teams; the partners from school library motivate the students and set a real task to fulfill; the school management supports the organization of an extracurricular organization of the work, as well as the presentation of the results to an appropriate audience.

STAGE II: Action Plan Formulation (Steps 1-18)

Preparation (by teachers)

1. **Relation to the Real World – Reflection**
   Representing a real problem - finding a solution to a problem that involves common sense knowledge for which there is no mathematical algorithm. Students are introduced to the possibilities of drawing conclusions through logical rules and the use of the logical programming language Prolog.

0. Incentive – Motivation
Together with the literature teacher, they visit a school library and solve a real problem. Posing a real problem motivates students

0. Formulation of a problem (possibly in stages or phases) resulting from the above

Students are divided into groups and make inferences by using facts and logical rules by applying the acquired theoretical knowledge. They program in Prolog and finally they prepare their presentation and present the results to a critical audience.

Development (by students) – Guidance & Evaluation (in 9-11, by teachers)

0. Background Creation - Search / Gather Information:
New knowledge, applications in solving specific tasks, searching for additional information to solve the task - family relationships, family tree, facts and logical rules.

0. Simplify the issue - Configure the problem with a limited number of requirements
The task of drawing conclusions using facts and logical rules is clearly stated with the necessary information

0. Case Making - Designing - identifying materials for building / development / creation
Simple examples are used to understand logic programming in Prolog. The task that the individual groups receive is clearly defined

0. Construction - Workflow - Implementation of projects
Introductory training with relevant examples - Posing a real problem - Additional training - Finding a solution to the problem - Presenting the results

0. Observation-Experimentation - Initial Conclusions
Repeatedly adding various facts and rules and analyzing the resulting conclusions

0. Documentation - Searching Thematic Areas (AI fields) related to the subject under study – Explanation based on Existing Theories and / or Empirical Results
Students have the necessary theoretical information and examples.

0. Gathering of results / information based on points 7, 8, 9
At each step, the teacher-moderators report the progress of each group in solving the problem

0. First group presentation by students
Students present the results of their work

Configuration & Results (by students) – Guidance & Evaluation (by teachers)

0. Configure AI models to describe / represent / illustrate the results
0. Studying the results in 9 and drawing conclusions, using 12
0. Applications in Everyday Life - Suggestions for Developing 9 (Entrepreneurship - FIL Days)

Review (by teachers)

0. Review the problem and review it under more demanding conditions
It is required to answer various questions like "Who are the children of...", "Who is the father of...", "Who is the sister/brother of..." etc.

Project Completion (by students) – Guidance & Evaluation (by teachers)

0. Repeat steps 5 through 11 with additional or new requirements as formulated in 15
0. Investigation - Case Studies - Expansion - New Theories - Testing New Conclusions
0. Presentation of Conclusions - Communication Tactics.

STAGE III: FACILITATE AI Actions and Cooperation in Creative Projects for school students

Title of Project: Prolog in the service of AI (Applications, e.g. family relationship)
Brief Description/Outline of Organizational Arrangements / Responsibilities for Action

STAGE	**Activities/Steps** Teacher 1(T1) Cooperation with T2 and student guidance	**Activities /Steps** **By Students** Age Group: 17-18	**Activities /Steps** Teacher 2 (T2) Cooperation with T1, T3 and student guidance
A	Preparation of steps 1,2,3,4 and 5		Cooperation in step 2, 3, 4, 5
B	Guidance in step 9	4,5,6,7,8,9,10	Support guidance in step 9
C	Creative Evaluation	11	Creative Evaluation
D	Guidance	12	Guidance
E	Guidance	13 (9+12)	Guidance
F	Organization (FIL) FACILITATE-AI in Life	14 Meeting with Business representatives	Organization (FIL) FACILITATE-AI in Life
G	Preparation of step 15		Cooperation in step 15
H	Guidance	16 (repetition 5-11)	Support Guidance
I	Guidance	17	Support Guidance
K	Creative Evaluation	18	Creative Evaluation

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FACILITATE – AI
LEARNING & CREATIVITY PLAN (L&C PLAN):

ARTIFICIAL GAMER

1. Overview

Title	**Artificial Gamer**		
Driving Question or Topic	How is it that computers become better and better than people in video games? What does AI in video games have to do with real life problems?		
Ages, Grades, …	**Ages 13-16**	**Grades 7-10**	
Duration, Timeline, Activities	Number of learning hours: 8-10 h.	Timeline/frame, calendar 7 x 40-120 min	Number of activities 7
Curriculum Alignment	Building an understanding of the latest achievements of IT and their role in society. Realizing what the properties of algorithms are. Implementing algorithms in various IT projects Understanding the different types of learning (supervised, unsupervised, semi-supervised, reinforcement learning) and how they are used in games and in real life.		
Contributors, Partners	Schools		
Abstract - Synopsis	The learning activities are meant to illustrate how AI is used in gaming, as computer games are very popular among young adults. Alongside that, students will also understand how the same algorithms are applied in real life, business and the industry.		
References, Acknowledgements	Artificial Gamer Deep Blue vs Gary Kasparov Machine Learning in Video Games Peanut Butter & Jelly: An Algorithm		

2. FACILITATE AI Framework

Teachers' Cooperation	**Teacher 1 – T1** (Computer Science/ICT): Machine learning, computer literacy, problem solving **Teacher 2 – T2** (Mathematics/Physics/Chemistry): Regression, relationships between variables, problem solving **Teacher 3 – T3** (Psychology/Philosophy): Ethics regarding AI applications in real life
FACILITATE-AI in Life (FiL) Organization	All the different types of learning are used to create machines that can beat humans in popular video games. As students learn more and more about machine learning via playing, they will be introduced to different applications of AI in real life – CCTV, risk management in business, etc. A meeting with data scientists and machine learning engineers from different areas of business can be arranged (banks, IT industry, etc.)

Action Plan Formulation	**Stage A – Preparation [Steps 1-3]:** The teachers prepare a workplan for the learning activity, gather proper information and align it according to the curriculum. They also prepare assessment & self-assessment criteria. **Stage B – Development [Steps 4-10]:** All the activities with students are in this stage. They participate in each individual activity: 1. Initial discussion 2. Learning about regression, relationships between variables, classification 3. Playing Atari games 4. Discussion regarding the types of ML, datasets 5. Real-life examples **Stage F – FIL [Step 14]:** Meeting with a data scientist or machine learning engineer **Stage C, D, E – Configuration [Steps 11-13]:** Divided into teams, students need to come up with a simple Atari-like game and make up the rules for it, explaining the simplest way they could be "fed" to a machine learning algorithm. **Stage G, H, I, K – Evaluation [15-18]:** Students assess their own teamwork and the results, as well as those of the other teams. Teachers also evaluate the work of students and their understanding of the subject matter.

*under development the final elements of the framework

3. Objectives and Methodologies

Learning Goals and Objectives	Upon completion of the learning activities, students should **know** and **understand**: 1. How AI is used in video games 2. How AI is used in real life 3. The different types of regression 4. What classification is 5. How different variables could be related; features 6. Why algorithms are important in all areas of life 7. The concept of datasets 8. The basics of the four types of machine learning 9. Reinforcement learning in the context of Atari games The **skills** acquired include: 1. Teamwork 2. Cooperation with teachers/students 3. Generating new ideas 4. Analyzing data 5. Conducting research 6. Producing simple algorithms 7. Providing references 8. Presenting results 9. Self-assessment
Learning Outcomes and expected Results	To **recognize** the different types of machine learning. To **relate** machine learning algorithms from games to real life problems. To **identify** problems that can be solved using AI. To **discuss** different ideas and concepts in AI freely. To **explain** the differences between the different types of machine learning. To **apply** basic machine learning knowledge in the creation of simple algorithms.

Prior Knowledge and Prerequisites	To **understand** datasets, regression. To **analyze** scientific information properly. To **classify** data according to certain features. To **assess** oneself, one's team and other teams. Basic mathematics (algebra) Problem-solving skills Interest in computer science & AI
Motivation, Methodology, Strategies, Scaffolds	The motivation regarding all the learning activities is tightly linked to the applications of AI in real life. Video gaming is very popular among teenagers and for the most part of the activities, they will be **learning by doing**. Playing various games and understanding the underlying algorithms in them paves the way to understanding how AI works and how it can be used for other purposes as well: **inquiry-based learning**. In the end of the activities, students will be tasked with creating a game with their own rules. The rules should be very specific, so that they could be translated to an AI. This directly corresponds to **project-based learning**. Furthermore, **working in teams** is also a great attribute to this approach, as it will develop the soft skills of students as well. This multi-modal approach allows students to base their learning process on their own experience, while still deepening their knowledge of AI.

4. Preparation and Means

Preparation, Space Setting, Troubleshooting Tips	The preparation for the learning activities includes cooperation between T1, T2 and T3. However, the leading teacher is T1 (IT), as they are the most knowledgeable in terms of AI. All students need a personal computer or laptop. Alternatively, they might use the computer lab of their respective school. A classroom is sufficient for teaching regression, classification, relationships between variables. All activities might be performed in a hybrid environment if needs must.
Resources, Tools, Material, Attachments, Equipment	1. The Atari 2600 Games task – presenting models used to beat the algorithm of Atari games 2. A free Atari games platform, such as free80sarcade 3. Google Colab – for presenting ML models easily 4. MS Office/Paint to create mind maps 5. MS Excel and Kaggle to examine different datasets 6. Communication online platform – Google Meet, Discord, etc. 7. E-learning platform
Health and Safety	Understanding that the internet is not a safe space and no information online should be taken for granted.

5. Implementation

Instructional Activities, Procedures, Reflections	All of the learning activities are meant to show that AI surrounds all of us – not just adults, but children as well. This allows each individual activity to be quite adaptable in terms of specific information and/or examples. The current L&C plan accounts for a total of **6 mentored activities** and **1 group activity**, which is to be evaluated by teachers, but carried out entirely by students. **Discussion Alpha [40-60 min]:** T1 presents the basic concepts of AI and its role in everyday life. This is the first building block in the activities, as it might spark further interest in the topic. This is why it is important for T1 to make it very clear that AI is used in something as familiar to students as videogames. Different examples may be presented and the

	Artificial Gamer video might be played, as it is a good depiction of an AI algorithm used in Dota 2. In the very same discussion, awareness needs to be raised about ethics in terms of AI (potentially causing invasion of privacy, other issues as well) by T3. **Science concepts [40-80 min]:** T2 introduces students to concepts like regression and explains how variables could be related. This activity is crucial for the understanding of algorithms used in AI, so T2 also needs to revise certain concepts that might be forgotten by students. Students shall be introduced to the different types of regression, concentrating mainly on linear regression (as it is the simplest and most straightforward one). Inquiry-based learning may be used to present how classifications are used in every field of science, AI being no exception. **Learning by doing [4x40 min]:** This activity focuses on learning by doing – namely, playing games such as **Atari games**, trying to beat "the machine" in them. T1 should ask questions regarding the possible underlying algorithms, while also explaining briefly what they are and how they work. Each of these four sessions will be mostly playing and then in the end (for about 10 minutes) the algorithms are to be explained briefly by T1. Moving on from simple games to more complex ones is important, as it will keep the interest of students and it will provide them with a clearer view of AI uses. **Discussion Beta [40-60 min]:** In this discussion, students are urged to think about their experience playing and to explain how algorithms work using their own words. T1 follows up with a gamification regarding algorithms, then proceeds with information regarding datasets, how they are used and why they are important to get proper results from training AI. Then, students get introduced conceptually to the different types of machine learning (supervised, unsupervised, semi-supervised and reinforcement learning). T1 shows examples in Google colab with proper visualization. **Meeting the Experts [60-120 min]:** Meeting with a field professional, asking questions, learning about different aspects of AI in business. **Teamwork makes the Dreamwork [2x40 min]:** Students are divided into teams and they are tasked with creating a simple made-up game. They need to work on the basics of the game – creating a good set of rules and figuring out how they could put them to work. They are later challenged with thinking about ways of beating their own rules or optimizing them for best results. **Presentation and Evaluation [1/2/3x40 min]:** Depending on the number of teams, this activity might be done in three different days. Each team is given 10 minutes to present their simple games, as well as the rules for them, explaining briefly how these rules translate to AI and how AI could be used to play in their games. Each student evaluates the work of their teammates and each individual team evaluates all the other teams. In this activity, the assessment of the teacher is also done with regard to the presentations of the teams and the shown level of understanding of AI.
Assessment - Evaluation	1. **Self-assessment**: Evaluating the work of each student on the scale from 1 to 10 based on different criteria (understanding, critical thinking, contribution to team, creativity, etc.).

	2. **Team assessment**: Each team member evaluates the work of each other team member on the scale from 1 to 10 based on the same criteria as in the self-assessment. 3. **Teacher assessment**: The teachers take into account the self-assessment and team assessment results, while also evaluating the work of each team by asking questions regarding the work put into the game and the knowledge of AI gained.
Presentation - Reporting - Sharing Extensions - Other Information	The games of the students are to be presented in an appropriate way. Depending on their programming skills, the teams might write a code for their game and execute it. Another option is presenting their game and rules using a PowerPoint presentation or by creating a poster/physical game.

Resources for the development of the FACILITATE AI Learning and Creativity Plan Template
In the case of learning AI by project based activity

FACILITATE AI Prototype/Guide for Learning & Creativity Approach
Action Plan Formulation

Major steps in the FACILITATE AI learning approach:

STAGE I: Preparation by one or more teachers

1. Formulating initial thoughts on the thematic sectors/areas to be covered
2. Engaging the world of the wider environment / work / business / parents / society / environment/ ethics
3. Target Age Group of Students - Associating with the Official Curriculum - Setting Goals and Objectives
4. Organization of the tasks of the parties involved - Designation of Coordinator - Workplaces etc.

STAGE II: Action Plan Formulation (Steps 1-18)

Preparation (by teachers)

1. Relation to the Real World – Reflection
2. Incentive – Motivation
3. Formulation of a problem (possibly in stages or phases) resulting from the above

Development (by students) – Guidance & Evaluation (in 9-11, by teachers)

0. Background Creation - Search / Gather Information
0. Simplify the issue - Configure the problem with a limited number of requirements
0. Case Making - Designing - identifying materials for building / development / creation
0. Construction - Workflow - Implementation of projects
0. Observation-Experimentation - Initial Conclusions

0. Documentation - Searching Thematic Areas (AI fields) related to the subject under study – Explanation based on Existing Theories and / or Empirical Results
0. Gathering of results / information based on points 7, 8, 9
0. First group presentation by students

Configuration & Results (by students) – Guidance & Evaluation (by teachers)

0. Configure AI models to describe / represent / illustrate the results
0. Studying the results in 9 and drawing conclusions, using 12
0. Applications in Everyday Life - Suggestions for Developing 9 (Entrepreneurship - FIL Days)

Review (by teachers)

0. Review the problem and review it under more demanding conditions

Project Completion (by students) – Guidance & Evaluation (by teachers)

0. Repeat steps 5 through 11 with additional or new requirements as formulated in 15
0. Investigation - Case Studies - Expansion - New Theories - Testing New Conclusions
0. Presentation of Conclusions - Communication Tactics.

STAGE III: FACILITATE AI Actions and Cooperation in Creative Projects for school students

Title of Project: _____
Brief Description/Outline of Organizational Arrangements / Responsibilities for Action

STAGE	**Activities/Steps** Teacher 1(T1) Cooperation with T2 and student guidance	**Activities /Steps** **By Students** Age Group: ____	**Activities /Steps** Teacher 2 (T2) Cooperation with T1 and student guidance
A	Preparation of steps 1,2,3		Cooperation in step 3
B	Guidance in step 9	4,5,6,7,8,9,10	Support guidance in step 9
C	Creative Evaluation	11	Creative Evaluation
D	Guidance	12	Guidance
E	Guidance	13 (9+12)	Guidance
F	Organization (FIL) FACILITATE-AI in Life	14 Meeting with Business representatives	Organization (FIL) FACILITATE-AI in Life
G	Preparation of step 15		Cooperation in step 15
H	Guidance	16 (repetition 5-11)	Support Guidance
I	Guidance	17	Support Guidance
K	Creative Evaluation	18	Creative Evaluation

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FACILITATE – AI
LEARNING & CREATIVITY PLAN (L&C PLAN):

AI in STEAME

1. Overview

Title	**AI in STEAME**		
Driving Question or Topic	Can we say the T in STEAME also includes AI? How do we use AI in Science, Engineering and Entrepreneurship? Is AI Art still art and what can we use it for? What is the Mathematics and the Technology behind AI?		
Ages, Grades, …	**Ages 14-19**	**Grades 9-12**	
Duration, Timeline, Activities	Number of learning hours: 11 h.	Timeline/frame, calendar 15 x 30-60 min	Number of activities 9
Curriculum Alignment	Understanding how AI is used in all the aspects of STEAME. Debating on certain aspects of AI in art and figuring out how we can use it to our advantage. Discovering ever newer applications of AI.		
Contributors, Partners	Schools		
Abstract - Synopsis	The learning activities are focused on doing and understanding. Students first understand the concept of AI and then use their tech knowledge to present the applications of AI with code. They are divided into teams and tasked with figuring out different ways to use AI in Science, Business, Engineering and Art.		
References, Acknowledgements	STEAME Learning with STEM		

2. FACILITATE AI Framework

Teachers' Cooperation	**Teacher 1 – T1** (Computer Science/ICT): Technology, Machine learning, computer literacy, problem solving **Teacher 2 – T2** (Mathematics/Physics/Chemistry): Ai in Science, Engineering **Teacher 3 – T3** (Psychology/Philosophy), **Teacher 4 – T4** (Art): Ethics regarding AI applications in Art **Teacher 5 – T5** (Mathematics): Using AI to solve problems in mathematics **Teacher 6 – T6** (Entrepreneurship): Business intelligence, AI and why it is used more and more frequently in business
FACILITATE-AI in Life (FiL) Organization	Meeting with data scientists/machine learning engineers/developers working on business or science projects. Talking about the usage of AI in real life and discussing the ethics around it.

Action Plan Formulation	**Stage A – Preparation [Steps 1-3]:** The teachers prepare a workplan for the learning activity, gather proper information and align it according to the curriculum. They also prepare assessment & self-assessment criteria. **Stage B – Development [Steps 4-11]:** All the activities with students are in this stage. They participate in each individual activity: 1. AI concepts 2. Finding AI tools and learning about them 3. Students teaching students 4. Open discussion and debates 5. Coding **Stage F – FIL [Step 14]:** Meeting with a data scientist or machine learning engineer **Stage C, D, E – Configuration [Steps 12-13]:** Divided into teams, students need to come up with simple machine learning models (in Python) that could be used in Science, Business or Engineering. **Stage G, H, I, K – Evaluation [15-18]:** Students assess their own teamwork and the results, as well as those of the other teams. Teachers also evaluate the work of students and their understanding of the subject matter.

*under development the final elements of the framework

3. Objectives and Methodologies

Learning Goals and Objectives	Upon completion of the learning activities, students should **know** and **understand**: 1. Simple machine learning algorithms 2. AI fundamentals 3. How AI is used in real life 4. The Math behind AI 5. The role of AI in Technology 6. AI in Science, Engineering and Business 7. Ethics in terms of AI 8. How AI changes Art The **skills** acquired include: 1. Teamwork 2. Cooperation with teachers/students 3. Generating new ideas 4. Analyzing data 5. Conducting research 6. Producing simple machine learning models 7. Debating 8. Working with Google Colab 9. Python 10. Python Libraries 11. Providing references 12. Presenting results 13. Self-assessment
Learning Outcomes and expected Results	To **recognize** the different types of machine learning. To **relate** machine learning algorithms from games to real life problems. To **identify** problems that can be solved using AI. To **discuss** different ideas and concepts in AI freely.

	To **explain** the differences between the different types of machine learning. To **apply** basic machine learning knowledge in the creation of simple ML models. To **understand** the mathematics behind AI. To **analyze** scientific information properly. To **classify** data according to certain features. To **assess** oneself and other teams. To **create** simple ML models. To **estimate** whether a model is appropriate for a problem. To **experiment** with different models in solving a problem.
Prior Knowledge and Prerequisites	Linear algebra Problem-solving skills Interest in computer science & AI Basic coding skills in Python
Motivation, Methodology, Strategies, Scaffolds	The motivation regarding all the learning activities is tightly linked to the applications of AI in real life. All the examples provided establish a good environment for **inquiry-based learning**. In the end of the activities, students will be tasked with creating a simple machine learning algorithm which can be used to solve tasks in business/science/engineering. This directly corresponds to **project-based learning**. Furthermore, **working in teams** is also a great attribute to this approach, as it will develop the soft skills of students as well. The **debate** regarding art and ethics in art contributes to critical thinking and public speaking. This multi-modal approach allows students to base their learning process on their own experience, while still deepening their knowledge of AI.

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	The preparation for the learning activities includes cooperation between T1, T2, T3, T4, T5 and T6. However, the leading teacher is T1 (IT), as they are the most knowledgeable in terms of AI. All students need a personal computer or laptop. Alternatively, they might use the computer lab of their respective school. A classroom with an interactive whiteboard is sufficient for the presentations and the debates. All activities might be performed in a hybrid environment if needs must.
Resources, Tools, Material, Attachments, Equipment	1. MS PowerPoint – to create presentations for different STEAME areas. 2. Dall-E 2 – to create images using AI 3. Google Colab – for presenting ML models easily 4. MS Excel and Kaggle to examine different datasets 5. E-learning platform 6. Online communication platform – Google Meet, Discord, etc.
Health and Safety	Spending too much time in front of a screen might lead to nervous system issues and vision problems. Using a computer needs to be in moderation.

5. Implementation

Instructional Activities, Procedures, Reflections	STEAME education is important for interdisciplinary development. AI can enhance that and the main objective of this L&C plan is to help students understand the role of AI in STEAME. Even though the plan is quite flexible, the main 9 engaging activities (in a classroom or a computer lab) are of utmost importance for the understanding of AI:

AI Fundamentals [3x40 min]:

Getting familiar with basic AI concepts. Machine learning, regression and classification problems and how they can be solved. Looking at specific examples, prepared by T1.

AI in STEAME [30-40 min]:

Students are divided into teams. Each team gets assigned a topic from STEAME – Science, Technology, Engineering, Art, Mathematics or Entrepreneurship. The Math team needs to understand the math behind AI – matrices, basic statistics, etc. The Tech team is tasked with linking the math to specific code, using Python and its libraries on Google Colab. The Science, Business and Engineering teams should find AI applications in their respective fields (e.g. drug development, business intelligence, autonomous vehicles). The Art team needs to understand how Dall-E 2 works and create different images that could be shown in class for further discussions.

Information gathering and analysis [3x40 min]

The teams create presentations. The aim is to study the different problems in perspective. With the help and mentorship of their teachers, students conduct research, they analyze the resources they found and they reference them accurately. All topics need to be understood well, with any misconceptions being cleared up by T1.

First presentation [60 min]

Students present their research. Both their classmates and their teachers ask them appropriate questions. This activity may start with the presentations of the more practical topics (AI in real life) and then these applications may be backed up by theoretical knowledge (Math & Tech teams). In both cases, students teach students. If there are any errors in the presentation, T1 corrects them. After the activity, a preliminary assessment is done by the teachers, based on teamwork, understanding the subject matter in depth and presentation skills.

Art debate [40 min]

The Art team divides in two smaller groups and the students debate on topics related to ethics and art in terms of AI. Here, the topics may vary depending on the interests of students, but they might include:

1. AI art is still art.
2. An AI could be called an artist.
3. AI art should be available for everyone to use.
4. Deepfakes should be banned.
5. AI artists are racist.

Students that are not in the Art team are urged to participate in the final round of each debate – where questions are asked and the discussions can be held freely outside the debate frame.

STEAME coding tasks [30-40 min]

New teams are formed. It is compulsory for each new team to consist of at least one member of each previous team, so that the new teams are made up of students engaged in all STEAME areas. This is how homogeneity is achieved in the teams and the collective creativity in terms of solving problems increases. Each team gets assigned a new task – to present how AI can be useful in STEAME areas with code, using a Kaggle dataset for example. The problems may include:

1. Create an ML model that can help medical professionals in their work.
2. Create an ML model that can be used for business intelligence.
3. Create an ML model that can be used in autonomous vehicles.

	STEAME coding in progress [3 x 40 min] Models are created using Python and its libraries in Google Colab. Making up the model using premade code is also allowed, as long as the resources are referenced, the students know what lies behind the code and they can explain what exactly the model does. **Meeting the Experts [60-120 min]:** Meeting with a field professional, asking questions, learning about different aspects of AI in business. **Assessment [40 min]** Presenting results, comments, assessment.
Assessment - Evaluation	1. **Self-assessment**: Evaluating the work of each student on the scale from 1 to 10 based on different criteria (understanding, critical thinking, contribution to team, creativity, etc.). 2. **Team assessment**: Each team member evaluates the work of each other team member on the scale from 1 to 10 based on the same criteria as in the self-assessment. 3. **Teacher assessment**: The teachers take into account the self-assessment and team assessment results, while also evaluating the work of each team by asking questions regarding the work put into the game and the knowledge of AI gained.
Presentation - Reporting - Sharing	The first result from the L&C plan is a PowerPoint presentation for different STEAME areas. The second (and main) result has to do with a code, which can be presented on Google Colab, as it is a user-friendly platform.
Extensions - Other Information	

Resources for the development of the FACILITATE AI Learning and Creativity Plan Template
In the case of learning AI by project based activity

FACILITATE AI Prototype/Guide for Learning & Creativity Approach
Action Plan Formulation

Major steps in the FACILITATE AI learning approach:

STAGE I: Preparation by one or more teachers

1. Formulating initial thoughts on the thematic sectors/areas to be covered
2. Engaging the world of the wider environment / work / business / parents / society / environment/ ethics
3. Target Age Group of Students - Associating with the Official Curriculum - Setting Goals and Objectives
4. Organization of the tasks of the parties involved - Designation of Coordinator - Workplaces etc.

STAGE II: Action Plan Formulation (Steps 1-18)

Preparation (by teachers)

1. Relation to the Real World – Reflection
2. Incentive – Motivation
3. Formulation of a problem (possibly in stages or phases) resulting from the above

Development (by students) – Guidance & Evaluation (in 9-11, by teachers)

0. Background Creation - Search / Gather Information
0. Simplify the issue - Configure the problem with a limited number of requirements
0. Case Making - Designing - identifying materials for building / development / creation
0. Construction - Workflow - Implementation of projects
0. Observation-Experimentation - Initial Conclusions
0. Documentation - Searching Thematic Areas (AI fields) related to the subject under study – Explanation based on Existing Theories and / or Empirical Results
0. Gathering of results / information based on points 7, 8, 9
0. First group presentation by students

Configuration & Results (by students) – Guidance & Evaluation (by teachers)

0. Configure AI models to describe / represent / illustrate the results
0. Studying the results in 9 and drawing conclusions, using 12
0. Applications in Everyday Life - Suggestions for Developing 9 (Entrepreneurship - FIL Days)

Review (by teachers)

0. Review the problem and review it under more demanding conditions

Project Completion (by students) – Guidance & Evaluation (by teachers)

0. Repeat steps 5 through 11 with additional or new requirements as formulated in 15
0. Investigation - Case Studies - Expansion - New Theories - Testing New Conclusions
0. Presentation of Conclusions - Communication Tactics.

STAGE III: FACILITATE AI Actions and Cooperation in Creative Projects for school students

Title of Project: _____
Brief Description/Outline of Organizational Arrangements / Responsibilities for Action

STAGE	**Activities/Steps** Teacher 1(T1) Cooperation with T2 and student guidance	**Activities /Steps** **By Students** Age Group: ____	**Activities /Steps** Teacher 2 (T2) Cooperation with T1 and student guidance

A	Preparation of steps 1,2,3		Cooperation in step 3
B	Guidance in step 9	4,5,6,7,8,9,10	Support guidance in step 9
C	Creative Evaluation	11	Creative Evaluation
D	Guidance	12	Guidance
E	Guidance	13 (9+12)	Guidance
F	Organization (FIL) FACILITATE-AI in Life	14 Meeting with Business representatives	Organization (FIL) FACILITATE-AI in Life
G	Preparation of step 15		Cooperation in step 15
H	Guidance	16 (repetition 5-11)	Support Guidance
I	Guidance	17	Support Guidance
K	Creative Evaluation	18	Creative Evaluation

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FACILITATE – AI
LEARNING & CREATIVITY PLAN (L&C PLAN):

BYOD – Study Method & School Success

1. Overview

Title	BYOD TO IMPROVE YOUR STUDY METHOD & BOOST YOUR SCHOOL SUCCESS		
Driving Question or Topic	*A good study method corresponds to guaranteed academic success.*		
Ages, Grades, …	*Age: 15 - 18*	*10th-12th grades*	
Duration, Timeline, Activities	*Number of learning: 7 learning hours*	*Timeline/frame, calendar 7*55*	*Number of activities: 5 activities*
Curriculum Alignment			
Contributors, Partners			
Abstract - Synopsis	*The five activities allow searching for the right questions, interviewing and uploading data into the system to understand the students' study method and suggest appropriate modifications if necessary.*		
References, Acknowledgements	*https://resilienteducator.com/classroom-resources/what-is-byod-bring-your-own-device-and-why-should-teachers-care* *https://cmap.ihmc.us* *https://learningapps.org* *https://kahoot.com/schools-u* *https://www.lucidchart.com/blog/how-to-make-a-decision-tree-in-excel*		

2. FACILITATE AI Framework*

Teachers' Cooperation	*Teacher 1: Literature/English in cooperation with Teacher 2 computer science*
FACILITATE-AI in Life (FiL) Organization	*Possible meeting with former students*
Action Plan Formulation	*Phase 1: preparation of the Literature or English teacher. He or she must understand, through the proposed activities, the students' strengths and weaknesses so that appropriate action can be taken on the study method.* *Phase2: Creation of the learning plan.*

* *under development the final elements of the framework*

3. Objectives and Methodologies

Learning Goals and Objectives	*The invincible tool to overcome any obstacle in memorisation and comprehension is the study method. Everyone has his own, it's all in:*

	● *knowing how to organise the study* ● *establishing a timeline and a schedule* ● *preparing study material* ● *memorising the material* *The project therefore offers students the opportunity, through group work and computer applications that facilitate supportive learning environments, to:* ● *understand the study method that best matches their abilities.* ● *be able to search for the correct variables to include in a decision-making system.* ● *be able to actively interact on topics of their own interest.* ● *know how to create and manage a decision-making system, also using basic software.* *It will also strengthen the following competences:* ● *A2. Creatively using & interacting with digital technology* ● *A3. Acquiring specific achievements* ● *B3. Processing data and digital content* ● *B4. Developing digital content* ● *B5. Managing data and digital content* ● *D3. Adapting technology to create knowledge*
Learning Outcomes and expected Results	● *Recognize and define different learning ways and their relevance to study method* ● *Promote a metacognitive reflection related to the student's study method and on possible improvement actions to be taken* ● *Use a decision tree to classify the different learning ways and difficulties to predict the most appropriate study method.* *Expected results* ● *To use digital technologies to support learners' self regulated learning i.e. to enable learners to plan, monitor, reflect on their own learning, to design, plan and implement the use of digital technologies in the optimization of the learning process*
Prior Knowledge and Prerequisites	*No prior knowledge is required other than intermediate knowledge of Excel and familiarity with IT tools*
Motivation, Methodology, Strategies, Scaffolds	*At the end of the project, the students will have the basis on which to base their future school work, thus improving their grades and their skills to summarize and memorise. They will have developed critical thinking as they learn from observing their peers and will refine the technical knowledge they have learned the classroom. The research and design based learning will lead them to discover their own path.*

	This type of activity also promotes the knowledge and use of artificial intelligence, as it will be a computer system that will predict the best choices for a good study method.

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	*Students will be online or in presence in their classroom or computer lab. Online students will work with their devices on computer applications that promote learning and will be provided with the right concentration and interaction through video call software.*
Resources, Tools, Material, Attachments, Equipment	*Attendance at school is necessary for the design phase, as each student, supported by the Computer Science teacher, will create and test the prediction system.*
Health and Safety	*IT security management for any sensitive data resulting from the interviews, and in any case for the student's health on a video screen, is ensured by the school and the supervision of the teachers.*

5. Implementation

Instructional Activities, Procedures, Reflections	*The Office package, learning Apps, Cmap and a good Internet connection in general will be the basis for every task.* *Tablets/laptops will be needed for students at every stage, as teachers will conduct their lessons by inviting students to do research; interviews can also be conducted online and finally, the use of PCs will be indispensable for the system design.* *Depending on the activity, groups of 4 to 5 students may be created. Collaboration will be an integral part of the success of the project.* *<u>ACTIVITY 1: Brainstorming</u>* *The students, also in groups, will have a blank sheet of paper or Microsoft Word page (for the online group) in which they will have to enter all the terms that come into their mind when looking at a picture related to studying at school and at home.* *This activity will allow them to impress their ideas and difficulties on paper.* *At the end of the first part of the activity (lasting approximately 30 minutes), they will have found out the first variables that the system must contain.* *Just as an example: if a good number of students enter the term reading on an image of a school backpack, surely the term reading will become part of the variables of the prediction computer system.* *The second part of the activity (about 30 minutes) involves filtering these choices. All student's words can be considered, but only the words repeated in several groups need to be focused on.* *From these words will arise the questions and the guided formative discussion.* *For instance: if the term reading is one of the system's variables, the first questions to be asked by the computer system will arise. For example: How many times do you read a text? Do you repeat aloud after reading?* *Necessarily bringing up questions for the computer system will generate a formative dialogue with the teacher, so that he can better understand his students' problems.*

ACTIVITY 2: The box of life

The Literature or English teacher(s) will ask the students to get a box and put everything inside that describes or characterises them. The important thing is to be able to understand through the objects he/she proposes the student's weaknesses. Each student can therefore describe him/herself (in mother tongue or English), highlighting strengths and weaknesses of his/her being.

Subsequently, the Computer Science teacher will ask the students to report on a digital map, through the use of the Cmap application, what they have expressed verbally.

Cmap allows students to graphically represent concepts and relationships between concepts through the use of circles and rectangles. In the map, each concept consists of a minimum of words needed to represent the object or event and the linking words (usually a verb) are required to be concise.

This tool will make it possible to support especially students with learning difficulties in the context of artificial intelligence. Support is provided by the ability to summarise and discuss a specific topic

For instance: if a student places the book 'The Little Prince' in the box, the link to childhood is obvious. By knowing the book or through the student's explanation, the psychological profile leads to understand the need of the student to find non-obvious solutions to problems (problem-solving). This need necessarily leads him to the need for longer periods of time for success, which does not mean that the student has a deficit.

This activity can be developed entirely online and can last up to 2 hours.

ACTIVITY 3: The digital loop.

The Computer Science teacher will request the creation of an App (crossword puzzle, single quiz, answer race, etc.) through the use of Learning Apps, in which everyone will present their study method to the class or ask questions to the class about the study method they adopt.

The teacher will explain to them how study topics can be repeated through play, then stimulate the students to use the Learning Apps to challenge their peers and learn at the same time.

By example: students can create a quiz based on the "Who Wants To Be a Millionaire?" model offered by Learning Apps in which they submit a set of questions relating to their own study method.

Or a crossword puzzle in which they challenge their peers in understanding a previously proposed text. From the difficulty in finding the solutions, it will be possible to understand how good the individual's study method is.

Or the creation of a matching-image search game, in which visual memory skills can be developed.

This activity can be developed entirely online and can last up to 1 hour.

ACTIVITY 4: Interview

Through the use of Meet (or another video calling application), different groups of students can interview former students of the school or classmates from the same class. The questions will be targeted and contextual to Activity 1.

ACTIVITY 5: Implementation of the artificial intelligence computer system

The answers from activities 3 / 4 are to be entered into a system appropriately designed by the students. This system will return the prediction on the most appropriate study method.

It will also allow the student to enter his or her own answers because the student interviewer must also be able to obtain a prediction about his or her situation.

The system will be designed using the functions provided by Microsoft Excel for decision trees.

	For example, we can think of an Excel file in which several embedded and cascading 'If' functions are exploited. The input of these functions and the difficulty of these functions will be defined by the number of input variables that the system will have to manage on its own. The user will only see the questions that the system submits, but each of his or her choices will be handled by the functions below, like a decision tree *This activity is scheduled to last 2 hours with students in the computer lab.*
Assessment - Evaluation	*Evaluation can vary depending on the activity carried out.* *It may be a process evaluation (based on the student's participation to the activity) or an outcome evaluation (based on the output realised).*
Presentation - Reporting - Sharing	*Documents and outputs foreseen by the different types of activities (a quiz, a crossword puzzle, a matching-image search game, an Excel file, etc).*
Extensions - Other Information	

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FACILITATE-AI

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FACILITATE – AI
LEARNING & CREATIVITY PLAN (L&C PLAN):

GUESS WHO?

1. Overview

Title	Guess who?		
Driving Question or Topic	How can a decision tree algorithm support a classification problem such as identifying an artist from characteristics of his/her art work? What kind of strategies can we adopt to improve our classification?		
Ages, Grades, …	Age 15-19	9-13 grade	
Duration, Timeline, Activities	Number of learning: hours 6-8 h.	Timeline/frame, calendar 6*55 min	Number of activities: 6 activities
Curriculum Alignment	How to analyze a painting, taking in account different parameters, criteria or features.How to approach the world of artificial intelligence. Understanding how AI can impact real life. Understanding the logic of the decision tree as a basic classification algorithm used in the world of artificial intelligence. Develop your own decision tree model and turn it into a playful activity.		
Contributors, Partners	School		
Abstract - Synopsis	The project aims at showing how information is classified in relation to a specific discipline or topic, in this example, Art. When we are in the presence of a large amount of data, the AI can classify it as a support in analyzing the information and be of help in making decisions regarding real problems. Students will come to create a riddle game based on topics from their disciplines.		
References, Acknowledgements	https://cdn.iste.org/www-root/Libraries/Documents%20%26%20Files/Artificial%20Intelligence/AIGDEL_0820-red.pdf http://www.pangeaformazione.com https://it.akinator.mobi/ www.PangeaFormazione.com https://sliceofml.withgoogle.com/#/ https://www.youtube.com/c/SefikIlkinSerengil/featured https://sefiks.com/2018/08/27/a-step-by-step-cart-decision-tree-example/ https://steamygoeshybrid.eu		

2. FACILITATE AI Framework*

Teachers' Cooperation	The teacher of the specific discipline of interest: Art (literature, science, physical education). Her/his task is to assist students in choosing the different objects or specific terms of the discipline (e.g. list of tool bags), after the deep dive, the teachers are helping in identifying classification criteria and dividing the items into groups and then classifying them. The IT teacher guides students through the internet search for examples of web application of the classification. The math teacher: explains the mathematical background of the classification process (e.g. the Gini index and variance). The IT Teacher in cooperation with the math teacher 2 explains how the decision tree works.
FACILITATE-AI in Life (FiL) Organization	Meeting with school teachers
Action Plan Formulation	Several teachers participate in creating the learning plan. The science and Computer Science teachers are the co-leaders of the project. The teachers of Arts, Mathematics and IT or computer science participate in some specific activities. Implementation method: in presence / online or blended using a videoconference format: Google Meet / Zoom or similar. PHASE I: Understanding AI and the Visual grammar of seeing PHASE II: Creation of a Game

** under development the final elements of the framework*

3. Objectives and Methodologies

Learning Goals and Objectives	Classify, recognize and define different styles and artists in art. Use a decision tree to classify study object data. • Understand how AI uses classification algorithms to make decisions and solve real-world problems. • Create a riddle game that simulates an AI classification algorithm applied to the specific discipline chosen: art.
Learning Outcomes and expected Results	• Recognize and define the different styles/materials/palette and artists in art history. Use a decision tree to classify study items. • Understand how AI uses classification algorithms to make decisions and solve real-world problems. • Create a riddle game that simulates an AI classification algorithm applied to the specific discipline chosen: art. ● Be able to generalize the concept of classification to other context in the real life

Prior Knowledge and Prerequisites	Student should be able to ● Be in an active mode since they are establishing their learning objectives, develop social skills and contribute to learning competences ● Open up learning to new, real-world contexts, which involve learners themselves in hands-on activities, scientific investigation or complex problem solving ● Collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making ● Basic math concept ● Basic art history knowledge Expected result ● Use digital tools to analyze data, and represent them in various ways to facilitate problem-solving and decision-making ● Students formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions. ● To design, plan and implement the use of digital technologies in the different stages of the learning process ● to use digital technologies to support learners' self regulated learning i.e. to enable learners to plan, monitor, reflect on their own learning, providing evidence of the progress, share insides and come up with creative solutions
Motivation, Methodology, Strategies, Scaffolds	● Project-based learning activities ● Inquiry based learning activities ● It is possible to better distribute the work by creating groups in which special needs students are supported by other students. In addition, everyone can take action, expressing their skills at their best and reach a level of greater satisfaction with respect to their work. ● Instruction differentiation for students' needs (learning styles, multi-modal representations, roles to students etc.) ● Active students' engagement, individual-team-classroom work

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	The teachers plan together the different activities, times and spaces. They prepare the material to be provided to the students and provide the bibliography for further information.
Resources, Tools, Material,	Students work in groups or alone, both in the classroom and in the laboratory. They must be able to organize their work, choose a representative, explain their reasoning. Teachers must have prepared all the material for the different activities: books, videos, websites, examples.

Attachments, Equipment	With their own device: they can simulate on the platform in a faster and better organized way what is usually done manually.Manually : Sticky notes, chart paper, and/or a magnet board for each group might help them better visualize their classification criteria. AI: Google documents, jambord, MIRO can be useful but not must-have ● https://miro.com/about/ ● https://www.canva.com/it_it/ ● http://flowgorithm.org/ ● https://www.assess.ai/ ● https://assess.com/the-impact-of-artificial-intelligence-in-education/ ● https://www.americanprogress.org/article/future-testing-education-artificial-intelligence/ ● https://blog.eera-ecer.de/artificial-intelligence-in-student-assessment/ ● https://www.getmagicbox.com/ai-in-assessements/ ● https://medium.com/@roybirobot/how-intelligent-tutoring-systems-are-changing-education-d60327e54dfb#:~:text=Intelligent%20Tutoring%20Systems%20(ITSs)%20are,one%2Don%2Done%20curriculum
Health and Safety	Students and teachers work in a healthy and safe environment. No chemicals or hazard situations are involved. Take care of power cords on the floor before starting and outline the nearest escape routes.

5. Implementation

Instructional Activities, Procedures, Reflections	This plan focuses on STEAME methodologies and involves teachers of Art History, Mathematics and IT. Its purpose is to bring students closer to AI, through the study of art and mathematics. It can be developed either at the end of the course of study, before the final exam, including all the historical periods of art carried out in the five years or at the end of the single year, taking into consideration the whole program carried out in the same year. *Activity I* The Art teacher will show 10–20 pictures of paintings to the students asking them to group them based on their own preferred criteria. Each student or group explains to the class how they have grouped the items and what characteristics the elements of a given category have in common. Moment of reflection How did you classify the different characteristics? What is your classification method compared to that of the other groups? How would art experts organize the different characteristics or aspects? • What can be done to teach a computer to classify the different elements of the paintings? Explain the objectives of these activities: understand how AI analyzes and classifies information. Students will think about ways in which AI could be applied to solve problems relevant to their courses. Explain to them that they will create a guessing game that will simulate an AI classification process.

	Activity 2 With the help of the IT teacher the students are encouraged to understand how data, or information, can be represented (graphs, diagrams, models, logic models, Venn diagrams, mind maps or infographics). Encourage students to investigate what artificial intelligence is and how AI is used to support decision making on datasets. Analyze decision trees as a basic tool for classification *Activity 3* The math teacher introduces the math part that underlies the decision trees. Together with the IT teacher he/she will follow the students in the elaboration of different decision trees. *Activity 4* In this activity, students will see real-world problems that can be solved by AI with classification algorithms. Through the use of the Flowgorithm software, the teacher assigns a problem and guides the students to reduce the problem into sub-problems and solve them step by step (problem solving). This activity is the basis of the development of a decision tree *Activity 5* *Students can practice building decision trees with a free online decision tree simulator.* *Activity 6* In this phase, students will develop their own decision trees to classify information in their paintings and will use their decision trees to simulate a question-based game that simulates an artificial intelligence algorithm. In groups they will try to guess an artist. In groups they will try to guess an artist based on specific characteristics.
Assessment - Evaluation	Teachers develop a series of indicators that take into account the different aspects of working in groups and as individuals.
Presentation - Reporting - Sharing	Students, working in small groups, will develop their own decision trees to classify information from their coursework and they will use their decision trees to simulate a Questions game. Each round, one group will pick one decision tree to work with. One student will secretly choose an item that would fall into only one category (leaf) on that tree. Then, another person will act as the AI, using only the questions and branches on the decision tree to try to guess the other player's item. Then, the group will move to the next round and test another tree.
Extensions - Other Information	It could be expanded to classify books, novels, songs or music. If students enjoy working with a classifier, they can actually build one with Python/Excel or any other programming language

Resources for the development of the FACILITATE AI Learning and Creativity Plan Template
In the case of learning AI by project based activity

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Action Plan Formulation

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STAGE II: Action Plan Formulation (Steps 1-18)

Preparation (by teachers)

1. Relation to the Real World – Reflection
2. Incentive – Motivation
3. Formulation of a problem (possibly in stages or phases) resulting from the above

Development (by students) – Guidance & Evaluation (in 9-11, by teachers)

0. Background Creation - Search / Gather Information
0. Simplify the issue - Configure the problem with a limited number of requirements
0. Case Making - Designing - identifying materials for building / development / creation
0. Construction - Workflow - Implementation of projects
0. Observation-Experimentation - Initial Conclusions
0. Documentation - Searching Thematic Areas (AI fields) related to the subject under study – Explanation based on Existing Theories and / or Empirical Results
0. Gathering of results / information based on points 7, 8, 9
0. First group presentation by students

Configuration & Results (by students) – Guidance & Evaluation (by teachers)

0. Configure AI models to describe / represent / illustrate the results
0. Studying the results in 9 and drawing conclusions, using 12
0. Applications in Everyday Life - Suggestions for Developing 9 (Entrepreneurship - FIL Days)

Review (by teachers)

0. Review the problem and review it under more demanding conditions

Project Completion (by students) – Guidance & Evaluation (by teachers)

0. Repeat steps 5 through 11 with additional or new requirements as formulated in 15
0. Investigation - Case Studies - Expansion - New Theories - Testing New Conclusions
0. Presentation of Conclusions - Communication Tactics.

STAGE III: FACILITATE AI Actions and Cooperation in Creative Projects for school students

Title of Project: Guess who?
Brief Description/Outline of Organizational Arrangements / Responsibilities for Action

STAGE	**Activities/Steps** Teacher 1(T1) Cooperation with T2 and student guidance	**Activities /Steps** **By Students** Age Group: 15-19	**Activities /Steps** Teacher 2 (T2) Cooperation with T1 and student guidance
A	Preparation of steps 1,2,3		Cooperation in step 3
B	Guidance in step 9	4,5,6,7,8,9,10	Support guidance in step 9
C	Creative Evaluation	11	Creative Evaluation
D	Guidance	12	Guidance
E	Guidance	13 (9+12)	Guidance
F	Organization (FIL) FACILITATE-AI in Life	14 Meeting with Business representatives	Organization (FIL) FACILITATE-AI in Life
G	Preparation of step 15		Cooperation in step 15
H	Guidance	16 (repetition 5-11)	Support Guidance
I	Guidance	17	Support Guidance
K	Creative Evaluation	18	Creative Evaluation

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FACILITATE – AI
LEARNING & CREATIVITY PLAN (L&C PLAN):

AI Virtual Doctor

1. Overview

Title Driving Question or Topic	AI Virtual Doctor ● Can we predict the disease from given symptoms? ● How do computers and human can interact in natural language? ● Can we create a virtual doctor to give us medical advice when symptoms are presented?		
Ages, Grades, …	Ages: 16-18	10th - 12th grade	
Duration, Timeline, Activities	14 Learning hours	8*60 min	6 activities
Curriculum Alignment Contributors, Partners	*Investigating symptoms and related diseases correlation.* *Understanding the importance of multiple factors for diagnosis.* *Using AI tools such as Natural Language Processing (NLP) to create a virtual doctor (similar to virtual assistants).*		
Abstract - Synopsis	*Understanding data correlation can be a valuable knowledge for students. Such correlations are present between symptom data and disease diagnosis data. Students can learn the input-output concept of informatics though creating a Virtual Doctor. Most importantly they will be able to use NLP tools for developing a first prototype.*		
References, Acknowledgements	https://thestempedia.com/project/virtual-doctor-using-nlp-extension-in-pictoblox/		

2. FACILITATE AI Framework

Teachers' Cooperation	**Teacher 1 (T1)**- Computer Science Teaching basic concepts of NLP **Teacher 2 (T2)**- Biology Teaching symptom-diagnosis correlation Teacher 1 will cooperate with Teacher 2 through all the stages
FACILITATE-AI in Life (FiL) Organization	The ultimate goal is to develop a prototype AI Virtual Doctor that can provide medical advice if given patient symptoms. The importance of application in real life is evident with numerous advantages, such as minimizing diagnosis time and cost, assessing multiple factors and predicting possible disease outputs, etc.

Action Plan Formulation	**STAGE I**: T1 presents basic concepts of Machine Learning and NLP applications and T2 teaches students basic symptomatology of some example diseases to understand data correlation. **STAGE II**: T1 and T2 guide the students through the development of an NLP based virtual doctor with PictoBlox (Scratch) **STAGE II**: The teachers along with the student test the virtual doctor with multiple input symptom data. More questions will arise concerning system possible weaknesses and propositions for optimization can be generated along this final stage.

3. Objectives and Methodologies

Learning Goals and Objectives	Upon completion of this L&C Plan students should be able to: 1. Identify data correlations between diseases examples and given symptoms 2. Understand NLP basics (human-computer interaction) 3. Use NLP tools to develop AI Virtual Doctor 4. Understand the interaction between computers and humans in natural language.
Learning Outcomes and expected Results	Students will learn the basics concepts of Natural Language Processing and its application on virtual assistants such as the virtual doctor. Once completed they will have the opportunity to experiment with the prototype and understand the constraints when developing such applications. Familiarization with AI tools will be one of the most valuable outcomes of this L&C Plan to motivate them and unravel the "black box" of AI applications in our everyday lives.
Prior Knowledge and Prerequisites	Basic scratch SW familiarization.
Motivation, Methodology, Strategies, Scaffolds	Detecting relations of symptoms with specific diseases in the framework of this L&C Plan, apart from consisting an important step towards understanding NLPs, can be an excellent point of starting interest for studying life sciences related majors. When it comes to methodology, once understanding of basics NLP concepts is achieved, training the test classifier will be initiated. Moreover, various roles can be assigned to each student of the developers group. One student may research symptomatology of specific diseases, another can identify data sources for the training phase of the algorithms.

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	Computer Science teachers and IT can assist the teachers and the students to train and test the NLP model.
Resources, Tools, Material, Attachments, Equipment *(for Teachers & Students)*	Pictoblox platform MIT_Machine Learning explained (https://mitsloan.mit.edu/ideas-made-to-matter/machine-learning-explained) pandas library allows you to easily manipulate data, graphing resources (matplotlib, seaborn)
Health and Safety	

5. Implementation

Instructional Activities, Procedures, Reflections	The first 4 hours will consist of setting the theoretical background of NLPs. Six classroom activities will take place. **Activity 1**. Introduction to NLP (Definition, examples, understanding the interaction between computers and humans in natural language. **Activity 2**. PictoBlox Platform exploration **Activity 3**. Data collection from open source databases or custom. **Activity 4**: Training the Text Classifier. Start training the text data for diseases to Pictoblox. Add text data in classes, i.e the symptoms for three diseases, COVID-19, Malaria, and Diabetes. **Activity 5**: Final Script for the Virtual Doctor Using NLP Begin to write the script that to make the virtual doctor say the name of the disease we have after we tell him our symptoms. **Activity 6**: Conclusion. To escalate the project instead of typing your symptoms you can use speech recognition blocks to recognize your voice and then diagnosis the diseases.
Assessment - Evaluation	*Assessment and formative evaluation processes will be continuous with testing.*
Presentation - Reporting - Sharing *Extensions - Other Information*	*Once the 5th activity is completed students can invite teachers and other students to experiment with the virtual doctor tool.*

Resources for the development of the FACILITATE AI Learning and Creativity Plan Template
In the case of learning AI by project based activity

FACILITATE AI Prototype/Guide for Learning & Creativity Approach
Action Plan Formulation

Major steps in the FACILITATE AI learning approach:

STAGE I: Preparation by one or more teachers

1. Formulating initial thoughts on the thematic sectors/areas to be covered
2. Engaging the world of the wider environment / work / business / parents / society / environment/ ethics
3. Target Age Group of Students - Associating with the Official Curriculum - Setting Goals and Objectives
4. Organization of the tasks of the parties involved - Designation of Coordinator - Workplaces etc.

STAGE II: Action Plan Formulation (Steps 1-18)

Preparation (by teachers)

1. Relation to the Real World – Reflection
2. Incentive – Motivation
3. Formulation of a problem (possibly in stages or phases) resulting from the above

Development (by students) – Guidance & Evaluation (in 9-11, by teachers)

0. Background Creation - Search / Gather Information
0. Simplify the issue - Configure the problem with a limited number of requirements
0. Case Making - Designing - identifying materials for building / development / creation
0. Construction - Workflow - Implementation of projects
0. Observation-Experimentation - Initial Conclusions
0. Documentation - Searching Thematic Areas (AI fields) related to the subject under study – Explanation based on Existing Theories and / or Empirical Results
0. Gathering of results / information based on points 7, 8, 9
0. First group presentation by students

Configuration & Results (by students) – Guidance & Evaluation (by teachers)

0. Configure AI models to describe / represent / illustrate the results
0. Studying the results in 9 and drawing conclusions, using 12
0. Applications in Everyday Life - Suggestions for Developing 9 (Entrepreneurship - FIL Days)

Review (by teachers)

0. Review the problem and review it under more demanding conditions

Project Completion (by students) – Guidance & Evaluation (by teachers)

0. Repeat steps 5 through 11 with additional or new requirements as formulated in 15
0. Investigation - Case Studies - Expansion - New Theories - Testing New Conclusions
0. Presentation of Conclusions - Communication Tactics.

STAGE III: FACILITATE AI Actions and Cooperation in Creative Projects for school students

Title of Project: _____
Brief Description/Outline of Organizational Arrangements / Responsibilities for Action

STAGE	**Activities/Steps** Teacher 1(T1) Cooperation with T2 and student guidance	**Activities /Steps** **By Students** Age Group: ____	**Activities /Steps** Teacher 2 (T2) Cooperation with T1 and student guidance

A	Preparation of steps 1,2,3		Cooperation in step 3
B	Guidance in step 9	4,5,6,7,8,9,10	Support guidance in step 9
C	Creative Evaluation	11	Creative Evaluation
D	Guidance	12	Guidance
E	Guidance	13 (9+12)	Guidance
F	Organization (FIL) FACILITATE-AI in Life	14 Meeting with Business representatives	Organization (FIL) FACILITATE-AI in Life
G	Preparation of step 15		Cooperation in step 15
H	Guidance	16 (repetition 5-11)	Support Guidance
I	Guidance	17	Support Guidance
K	Creative Evaluation	18	Creative Evaluation

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FACILITATE – AI
LEARNING & CREATIVITY PLAN (L&C PLAN):

AI PROFESSION ORIENTATION CHATBOT

1. Overview

Title	AI Profession Orientation Chatbot
Driving Question or Topic	Can an AI-based chatbot help students choose the profession they want to follow? How to create an AI-based chatbot? What are the AI fields usually used for the development of such chatbots?
Ages, Grades, …	Ages: 16-18 11-12th grade
Duration, Timeline, Activities	6-7 hours 4*60 min, 1*40 min, 1*120min 6 activities
Curriculum Alignment	Artificial Intelligence (AI), Machine Learning (ML), Deep Learning (DL), Unsupervised Learning
Contributors, Partners	
Abstract - Synopsis	Career guidance in the era of fast changing employment world is crucial for today's young students. So far, only limited research has been conducted on using artificial intelligence to support guidance across primary and secondary education and professions. This L&C Plan will provide a guide to create an AI chatbot that will help students explore professions that they might be interested in, according to their hard and soft skills and their personality. In this way students will value the importance of using artificial intelligence to support career guidance in education and get familiarized with cognitive intelligence.
References, Acknowledgements	[1] https://openai.com/blog/chatgpt/ A new cutting-edge AI chatbot that can be used as motivation for the purposes of this L&C Plan. [2] https://juji.io/ This is Juji Studio that will be used for deploying an AI chatbot for the purposes of this L&C Plan. [3]https://eic.eismea.eu/challenges/solution/jobiri-1degai-based-digital-career-advisor/about This is the first AI based digital career advisor, Jobiri. It can be used as a first reference on what is available for profession orientation.

Teachers' Cooperation	Teacher 1 (T1): Computer Science Teacher 2 (T2): Sociology/ Humanity
FACILITATE-AI in Life (FiL) Organization	Meeting with industry representatives, researchers, or other professionals to discuss the required skills needed in their own professions as real-life examples for career orientation.
Action Plan Formulation	**STAGE I: Preparation by T1 & T2** Steps 1-4: Teacher 1 presents an introduction on artificial intelligence, machine learning, deep learning and provide some current example applications. T1 then explains how AI based chatbots can be developed. Basic concepts of cognitive intelligence and reinforcement learning can be introduced in this step. Once the introduction is completed, teacher 2 provides insights on multiple career choices and on how personality and specific skills can be assessed. Then, teachers discuss with the students, examples of existing AI chatbots and brainstorm on possible applications. AI methods used in these example applications can be further discussed during this step. **STAGE II: Action plan formulation** **Preparation steps 1-3**: T1 demonstrates existing AI-based chatbots to engage students. A strong example will be the recently released **OpenAI's ChatGPT** [1] chatbot. T1 will present thus large language model and elaborate on how this was trained using a machine learning technique known as unsupervised learning. T1 explains that this AI chatbot was trained on a large corpus of text data, without any explicit labels or guidance, in order to learn the patterns and structures of natural language. This allows it to generate text that is coherent and relevant to the input it receives and enables it to assist with a variety of tasks. Students have hands-on experience on the chatbot and experiment with its capabilities and limitations. Towards the scope of creating a career guidance chatbot, T2 discusses the importance of profession orientation for and with the students. **Development steps 4-10**: Students gather additional information on existing AI chatbots used for profession or career orientation. Teachers along with the students explore the basics of machine learning, deep learning, unsupervised learning, natural language processing, reinforcement learning and understand why these are used in the development of these chatbots. T1 then introduces Juji [2] platform for developing a cognitive AI chatbot. Juji Studio provides an intuitive graphical user interface (GUI) for non-IT professionals or anyone to rapidly create, customize, test, deploy, and manage AI chatbots with no code or IT support. Born with advanced human soft skills (cognitive intelligence), such a chatbot can automate human-human interactions at scale and accomplish non-trivial tasks empathetically and responsibly. Students get familiar with Juji Studio, and the steps needed for developing a chatbot on their own. Students develop their own AI chatbot that will provide profession orientation. **Configuration and results steps 11-14**: Students present their initial results to the classroom and to the teachers. T1 can elaborate on the goal of these Juji chatbots to give them advanced human soft skills such as emotional intelligence so that they could connect with users on a more human level than existing systems have. Explore where Juji chatbot is already used to motivate students (for example staff members at the University of Illinois were able using Juji chatbot, to create and manage their custom A.I. chatbot and scale their student recruitment operations).

	Review Step 15: Teachers will review the developed chatbot. **Completion and evaluation steps 16-18**: Students will complete the project and teachers will evaluate the results. Communication tactics of the results will be discussed.

3. Objectives and Methodologies

Learning Goals and Objectives	Upon completion of this L&C Plan, students will get familiarized with the AI methods used for chatbots and will develop their own example for profession orientation.
Learning Outcomes and expected Results	Understand basic AI methods used for chatbot development Develop a cognitive AI based chatbot Explore how specific soft skills are related to specific professions Self-reflect, communication skills enhancement
Prior Knowledge and Prerequisites	Handling basic functionalities of Microsoft Excel would be useful when building their own chatbot in the proposed platform. No programming knowledge is needed.
Motivation, Methodology, Strategies, Scaffolds	One of the most frequent question school students have when reaching the last grades (even sooner than that), is "What profession should I choose?". Many schools provide career orientation to their students through self-assessment tests and other relevant activities. The driving thought for practicing this L&C Plan in schools, is to **explore how AI can help the students towards choosing the optimum profession choice** and more specifically "can an AI chatbot accomplish that"? When it comes to AI chatbots in the latest years, few examples have worked well at specific tasks but with several limitations. To initially motivate students the teachers can demonstrate in the classroom how the best AI chatbots work today. More specifically, teachers can demonstrate OpenAI's latest achievement, the "ChatGPT" [1] chatbot who has proven to be a new cutting-edge A.I. chatbot able to make jokes, write code, explain difficult scientific concepts and much more. This is a project-based learning plan where students will create their own chatbot through the proposed Juji platform. This process will enhance critical thinking. Moreover, to develop communication skills, students can be assigned with roles. One role is research on existing career orientation AI-based applications. Jobiri can be used as a first example for existing AI tools [3]. Another role is designing the questions that will be included in the training of their chatbot. Other roles include testing the limits of their chatbot and propose optimization ideas. Finally, multiple student groups can create their own Juji chatbot and compare their results, which will foster team-classroom work, active engagement, and improvement of their communication skills.

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	The teacher presents and demonstrates the needed resources though a projector. One computer per student group is the minimum requirement.

Resources, Tools, Material, Attachments, Equipment *(for Teachers & Students)*	● The following tool can be used as an initial inspiration to experiment with what is considered the best AI chatbot today: https://openai.com/blog/chatgpt/ ● Juji will be used to create AI chatbot without coding: https://juji.io/

5. Implementation

Instructional Activities, Procedures, Reflections	To use this L&C Plan teachers and students can follow the next activity steps: **Activity 1**: Introduction to AI, ML, DL and their application today, performed by the teachers as described in STAGE I (60 min). **Activity 2**: T1 demonstrates existing AI-based chatbots to engage students and students experiment with OpenAI's new cutting edge ChatGPT chatbot. Teachers and students discuss how this chatbot works (40 min). **Activity 3**: Students perform initial research on existing AI chatbots used for profession or career orientation (60 min). **Activity 4:** Students get familiar with the Juji platform, and the steps needed for developing a chatbot on their own. They form groups and assign roles for the design, development, and testing steps (60 min). **Activity 5:** Students develop their own AI chatbot that will provide profession orientation (120 min). **Activity 6:** Students present their chatbots to everyone (classmates and teachers) (60 min), presentation time may vary depending on the number of student groups.
Assessment - Evaluation	Teachers and students review the developed chatbots and test each group's chatbot. They all provide feedback and reflect on their learning process.
Presentation - Reporting - Sharing *Extensions - Other Information*	Students present their chatbots to everyone (classmates and teachers). They can also publish their chatbot (see Juji publishing options).

Resources for the development of the FACILITATE AI Learning and Creativity Plan Template
In the case of learning AI by project based activity

FACILITATE AI Prototype/Guide for Learning & Creativity Approach
Action Plan Formulation

Major steps in the FACILITATE AI learning approach:

STAGE I: Preparation by one or more teachers

1. Formulating initial thoughts on the thematic sectors/areas to be covered
2. Engaging the world of the wider environment / work / business / parents / society / environment/ ethics

3. Target Age Group of Students - Associating with the Official Curriculum - Setting Goals and Objectives
4. Organization of the tasks of the parties involved - Designation of Coordinator - Workplaces etc.

STAGE II: Action Plan Formulation (Steps 1-18)

Preparation (by teachers)

1. Relation to the Real World – Reflection
2. Incentive – Motivation
3. Formulation of a problem (possibly in stages or phases) resulting from the above

Development (by students) – Guidance & Evaluation (in 9-11, by teachers)

0. Background Creation - Search / Gather Information
0. Simplify the issue - Configure the problem with a limited number of requirements
0. Case Making - Designing - identifying materials for building / development / creation
0. Construction - Workflow - Implementation of projects
0. Observation-Experimentation - Initial Conclusions
0. Documentation - Searching Thematic Areas (AI fields) related to the subject under study – Explanation based on Existing Theories and / or Empirical Results
0. Gathering of results / information based on points 7, 8, 9
0. First group presentation by students

Configuration & Results (by students) – Guidance & Evaluation (by teachers)

0. Configure AI models to describe / represent / illustrate the results
0. Studying the results in 9 and drawing conclusions, using 12
0. Applications in Everyday Life - Suggestions for Developing 9 (Entrepreneurship - FIL Days)

Review (by teachers)

0. Review the problem and review it under more demanding conditions

Project Completion (by students) – Guidance & Evaluation (by teachers)

0. Repeat steps 5 through 11 with additional or new requirements as formulated in 15
0. Investigation - Case Studies - Expansion - New Theories - Testing New Conclusions
0. Presentation of Conclusions - Communication Tactics.

STAGE III: FACILITATE AI Actions and Cooperation in Creative Projects for school students

Title of Project: _____
Brief Description/Outline of Organizational Arrangements / Responsibilities for Action

STAGE	**Activities/Steps** Teacher 1(T1) Cooperation with T2 and student guidance	**Activities /Steps** **By Students** Age Group: ____	**Activities /Steps** Teacher 2 (T2) Cooperation with T1 and student guidance
A	Preparation of steps 1,2,3		Cooperation in step 3
B	Guidance in step 9	4,5,6,7,8,9,10	Support guidance in step 9
C	Creative Evaluation	11	Creative Evaluation
D	Guidance	12	Guidance
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FACILITATE – AI
LEARNING & CREATIVITY PLAN (L&C PLAN):

Image-Sound Recognition and Generation using Datasets

1. Overview

Title	**Image-Sound Recognition and Generation using Datasets**		
Driving Question or Topic	How effective are machines in image-sound recognition and generation?		
Ages, Grades, …	12-15	K-12 grade level selection	
Duration, Timeline, Activities	3 learning hours	3 * 40 min	4 activities
Curriculum Alignment			
Contributors, Partners			
Abstract - Synopsis	How to analyze a dataset. How a computer analyze a picture comparison with human analysis. How computer vision and AI can have an effect in day to day activities. Use face recognition for your own benefits in for of a interactive game in classroom. Use image grouping technology in class to see first hand how it can be a daily useful tool in our hands		
References, Acknowledgements			

2. FACILITATE AI Framework

Teachers' Cooperation	**Teacher 1**: Computer Science Teacher (IT) - Introduces the technical aspects of all AI-based activities. **Teacher 2**: of the specific discipline of interest, e.g. literature, science, physical education, art, with the role to assist students in the activities and help them be separated in teams, guiding them through the internet search for examples and solutions
FACILITATE-AI in Life (FiL) Organization	Meeting with an AI Expert (from University and/or Industry)
Action Plan Formulation	The two teachers formulate the following steps, collaboratively: ● Preparation ● Development of Activities ● Guidance ● Review of Activities ● Evaluation of Activities

3. Objectives and Methodologies

Learning Goals and Objectives	● Image processing ● Create Computer generated images ● Image analysis with computer vision and AI ● Create a game so the students can use and understand better face recognition tools After the conclusion of activities. Students will be more familiar with AI and image processing using a machine. More specifically. <u>Students will be able to:</u> 1. Work with large datasets and find ways to filter those datasets 2. Pick characteristic images inside a picture that make this picture different than others 3. Work as a team to achieve a goal 4. Successfully use an image recognition software 5. Group their pictures based on a face recognition feature 6. Know more about Image recognition and dataset manipulation
Learning Outcomes and expected Results	● Understand different application of image recognition ● Familiarize ourselves with different datasets ● Create games to use existing tools for image clustering and face recognition ● Be able to understand image recognition and face id in real life with day to day examples
Prior Knowledge and Prerequisites	● Open up learning to new, real-world contexts, which involve learners themselves in hands-on activities ● Be active since they are establishing their learning objectives, develop social skills and contribute to learning competences ● Interact and work well with team members ● Cooperate with teacher and classmates ● Work as a team to find out the solution of a problem Expected skills after the completion: ● Collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making ● Improvement of the values of team work ● Better understanding of real work application of Ai technology

Motivation, Methodology, Strategies, Scaffolds	● Branstorming and discussion about face and voice ● Exploration activities ● Team building activities ● Game play for better understanding and familiarize with the tools ● Promote collective work without dismiss individual improvement

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	Activities 1,2 are suggested for class environment Activity 3 can be done nicely outside And activity 4 can take place both outside and in the classroom
Resources, Tools, Material, Attachments, Equipment *(for Teachers & Students)*	Students will work in teams and will have to discuss together to understand and present the results of computer vision today. 1. https://www.whichfaceisreal.com/index.php: An online game showing us two images on photograph and one computer generated image. Goal is to find the photograph 2. https://cocodataset.org/#explore: An online huge image dataset(120.000 + images)that we can narrow down based on preexisting labels 3. https://play.google.com/store/apps/details?id=com.luxand.facerecognition: An app both for android an iOS of the Luxand face apps family used for face recognition if you teach it your name it will remember you! 4. https://experiments.withgoogle.com/bird-sounds: Experiment about the recognition of the bird sounds
Health and Safety	Students and teachers work in a healthy and safe environment. No chemicals or hazard situations are involved.

5. Implementation

Instructional Activities, Procedures, Reflections	This plan focuses on STEAME methodologies and fun activities to help children familiarize themselves with computer vision and AI, datasets and image-sound recognition. The main teacher will be the one of Computer Science or IT, but help and assistance will be provided from STEAME teacher (Art) for Activity 1 and Activity 2 (Photograph and image analysis). Also PA teacher will be able to help with activity 3 maybe during gym class. **Activity 1: Guess Who? Human or Computer?** In this activity our goal is for students to realize the progress of computer generate images. Since computer can create so perfect images that we can say for sure which is real and which is fake, it stands to reason that with similar mechanics it will be able to analyze a face as well. Kids will be guessing between two face images which one is a photograph and which one is generated by computer. ● Step1: Teacher shows the classroom two pictures. (https://www.whichfaceisreal.com/index.php).

- Step 2: Each student must guess which image is a photo taken by a human and which is a picture created by a computer.
- Step 3: After 10 images Students compare scores and discuss.
- Step 4: Students try 10 more times.

Assessment - Evaluation

The correct guesses were as expected? We can see that computer generated face image is almost indistinguishable from real photograph. Stand to reason that computer can recognize human faces.

Activity 2: Coco Explore and Bird Sounds

Coco Explore has a huge data set which the students will dive through and after the activity they will be able to select specifics labels to narrow down their dataset. For example the will be able to find all images that have a car AND a dog.

- Step 1: Students form small teams.
- Step 2: Every team opens coco dataset (https://cocodataset.org/#explore).
- Step 3 There are thousands of images which can be filtered by selecting some labels (e.g. cat, dog, bird, sheep etc.) Student use the labels to narrow down the dataset try different combination to see different results.
- Step 4: Locate the labels in each picture.

Assessment - Evaluation

Discussion can you see daily application of programs like this?
Can we recognize bird sounds? Can we group this data?
(https://experiments.withgoogle.com/bird-sounds)

Activity 3: Face Recognition (Spy Agency)

In this activity will use a face recognition app Luxand. We will create a game for the students where they will be spies with hidden identities. Only way to find who is who is with their specific tablet so everyone will be scanning each other to learn their name and their base. Students will have good time while learning and using a very innovative face id software.

- Step 1: Make teams 3-4 students per team (IMPORTANT: students must not know their team or team members) and create bases for the teams (maybe with some desks).
- Step 2: Have a tablet per team with (https://play.google.com/store/apps/details?id=com.luxand.facerecognition installed).
- Step 3: The teacher or an elected Head Spy scan each team member and gives a code-name with the app. This process must be done in secret.

- Step 4: One member per team must be the security of the agency and the rest are the spies.
- Step 5: Spies try to get into their base. Security team member scans each spy and allow or decline access via the app.

Assessment - Evaluation

After everyone found their team you can run the game again with different roles. Is it possible to trick the security with a picture of another member or with a mask or sunglasses? Where you can find similar technology in daily life

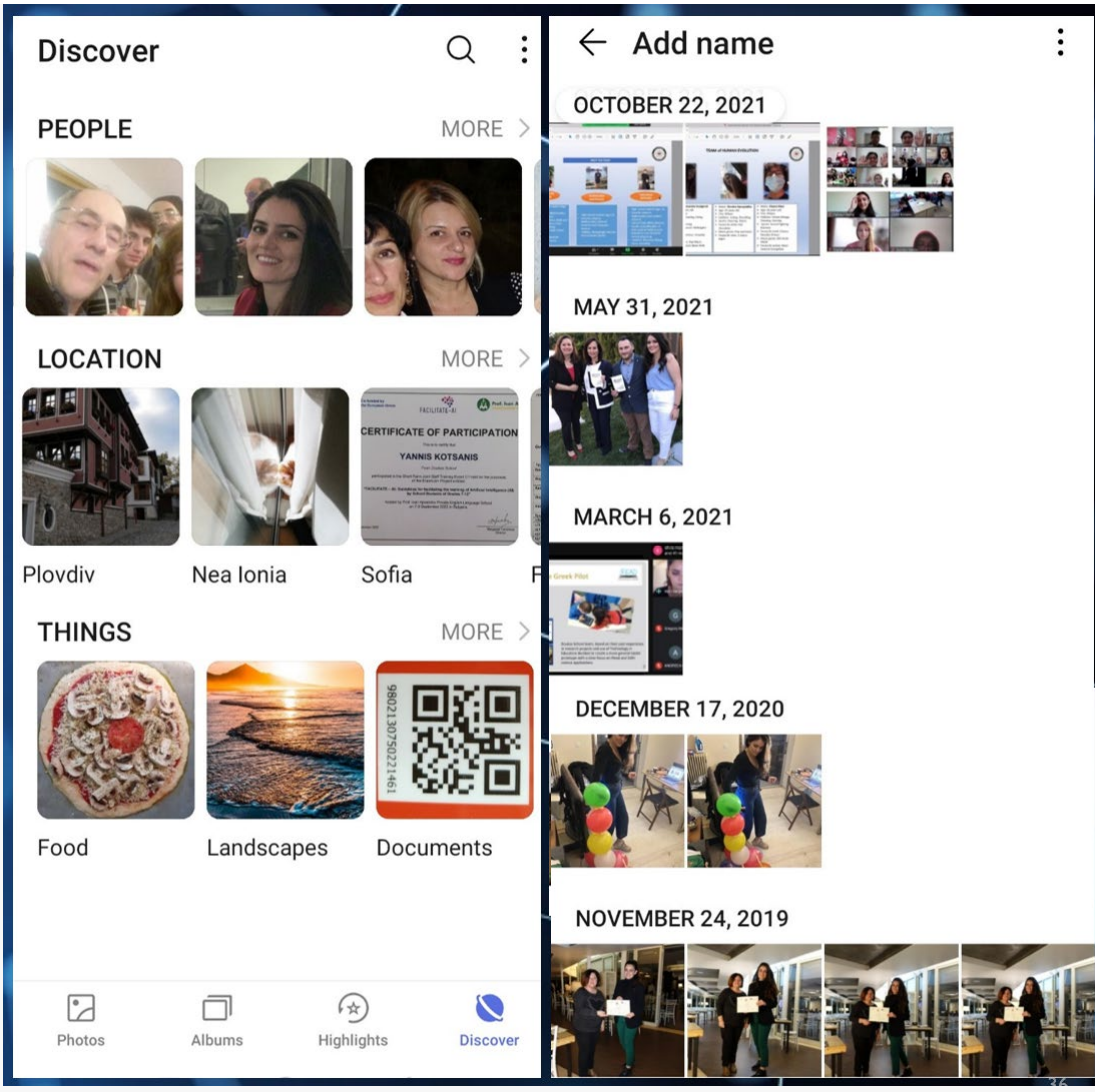
Activity 4: Google photos

One other platform we will use in our activities is google photos. Here the students will take pictures of each other then they will see how google photos pick out the faces inside a photo and then can even group their photo gallery by searching a specific face.

- Step 1: Take pictures of the students in random groups.
- Step 2: After you have taken several photos in different combinations take a photo or two of each student and then a couple group photos.
- Step 3: Open Google photos (e.g. Gallery app, Discover menu), if you select one photo and go to more you can see the faces of the people in the photo, and you can add names.
- Step 4: Select one face it will find all other pictures with the same person.

Assessment - Evaluation

Discussion Some faces might not recognized in the group photo, why is that? Can you think of reasons that grouping can be useful?



Discovering 'Elpi' at the Gallery photos…

Presentation - Reporting - Sharing	Documents, outputs, artifacts, products produced by the students with references, web links etc., for sharing to media
Extensions - Other Information	

Resources for the development of the FACILITATE AI Learning and Creativity Plan Template
In the case of learning AI by project based activity

FACILITATE AI Prototype/Guide for Learning & Creativity Approach
Action Plan Formulation

Major steps in the FACILITATE AI learning approach:

STAGE I: Preparation by one or more teachers

1. Formulating initial thoughts on the thematic sectors/areas to be covered
2. Engaging the world of the wider environment / work / business / parents / society / environment/ ethics
3. Target Age Group of Students - Associating with the Official Curriculum - Setting Goals and Objectives
4. Organization of the tasks of the parties involved - Designation of Coordinator - Workplaces etc.

STAGE II: Action Plan Formulation (Steps 1-18)

Preparation (by teachers)

1. Relation to the Real World – Reflection
2. Incentive – Motivation
3. Formulation of a problem (possibly in stages or phases) resulting from the above

Development (by students) – Guidance & Evaluation (in 9-11, by teachers)

0. Background Creation - Search / Gather Information
0. Simplify the issue - Configure the problem with a limited number of requirements
0. Case Making - Designing - identifying materials for building / development / creation
0. Construction - Workflow - Implementation of projects
0. Observation-Experimentation - Initial Conclusions
0. Documentation - Searching Thematic Areas (AI fields) related to the subject under study – Explanation based on Existing Theories and / or Empirical Results
0. Gathering of results / information based on points 7, 8, 9
0. First group presentation by students

Configuration & Results (by students) – Guidance & Evaluation (by teachers)

0. Configure AI models to describe / represent / illustrate the results
0. Studying the results in 9 and drawing conclusions, using 12
0. Applications in Everyday Life - Suggestions for Developing 9 (Entrepreneurship - FIL Days)

Review (by teachers)

0. Review the problem and review it under more demanding conditions

Project Completion (by students) – Guidance & Evaluation (by teachers)

0. Repeat steps 5 through 11 with additional or new requirements as formulated in 15
0. Investigation - Case Studies - Expansion - New Theories - Testing New Conclusions
0. Presentation of Conclusions - Communication Tactics.

STAGE III: FACILITATE AI Actions and Cooperation in Creative Projects for school students

Title of Project: _____
Brief Description/Outline of Organizational Arrangements / Responsibilities for Action

STAGE	**Activities/Steps** Teacher 1(T1) Cooperation with T2 and student guidance	**Activities /Steps** **By Students** Age Group: ____	**Activities /Steps** Teacher 2 (T2) Cooperation with T1 and student guidance
A	Preparation of steps 1,2,3		Cooperation in step 3
B	Guidance in step 9	4,5,6,7,8,9,10	Support guidance in step 9
C	Creative Evaluation	11	Creative Evaluation
D	Guidance	12	Guidance
E	Guidance	13 (9+12)	Guidance
F	Organization (FIL) FACILITATE-AI in Life	14 Meeting with Business representatives	Organization (FIL) FACILITATE-AI in Life
G	Preparation of step 15		Cooperation in step 15
H	Guidance	16 (repetition 5-11)	Support Guidance
I	Guidance	17	Support Guidance
K	Creative Evaluation	18	Creative Evaluation

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FACILITATE – AI
LEARNING & CREATIVITY PLAN (L&C PLAN):

DIGITAL ASSISTANT IN CLASS

1. Overview

Title	Digital Assistant in Class
Driving Question or Topic	**How can digital assistants be incorporated in Class**
Ages, Grades, Duration, Timeline, Activities	12-15 Grades 7-10 3-4 3-4 * 40 min More than 10 activities
Curriculum Alignment	
Contributors, Partners	
Abstract - Synopsis	Digital Assistants (e.g. ChatGPT, Alexa, Siri, Google Assistant) have already been part of our everyday life so, we need to teach & learn our students the way to use them. Recently a break-through new tool – AI chatbot was presented and it was adopted by Education. Consequently, new educational scenarios were created, while accomplishing the objectives of efficient student learning. The learning plan is based on the collaboration of the Departments of Digital Education & Foreign Languages.
References, Acknowledgements	

2. FACILITATE AI Framework

Teachers' Cooperation	**Teacher 1**: Computer Science Teacher (IT) - Introduces the technical aspects of Digital Assistants (DA) and how different types of them are installed. **Teacher 2**: Language teacher suggests the way DA will be used and has the role of facilitating students with the activities.
FACILITATE-AI in Life (FiL) Organization	Meeting with an AI Expert (from University and/or Industry)
Action Plan Formulation	The two teachers formulate the following steps, collaboratively: ● Preparation ● Development of Activities ● Guidance ● Review of Activities ● Evaluation of Activities

3. Objectives and Methodologies

Learning Goals and Objectives	● Learners understand the way digital assistants operate and process information according to the datasets of this AI environment ● Learners exploit new Vocabulary by getting familiar with AI and geographical features vocabulary ● Learners are introduced to a new grammar point, identifying the need of incorporating digital assistant in the learning process, getting with the specific grammar point: present tenses ● Learners improve knowledge of AI environment features in order to implement it throughout After the conclusion of activities students will be more familiar with DA and the outcomes from collaborating with an AI tool. More specifically students developed: Digital skills 1. Adaptability 2. Critical thinking, 3. Initiative 4. Engagement 5. Motivation 6. Collaboration 7. Learning to learn 8. Digital literacy 9. Grammatical correctness 10. Linguistic competency 11. Communication 12. Writing Competency
Learning Outcomes and expected Results	● Learners should be able to successfully understand and apply the basic principles related to the use and exploitation of this environment ● Learners should be able to properly pronounce relevant vocabulary ● Learners should be able to ask the digital assistant and the get the right answer ● Learners should be able to use targeted grammatical structures meaningfully and appropriately in oral and written production. ● Learners should be able to distinguish between conventional and digital assisted lesson ● Learners should be able to work in teams and apply research methods to evaluate AI environment
Prior Knowledge and Prerequisites	● A2 EFL level ● Use of mobile devices ● Open up learning to new, real-world contexts, which involve learners themselves in hands-on activities ● Interact and work well with team members ● Cooperate with teacher and classmates ● Ready to interact with a digital entity

	Expected skills after the completion: ● Collect data or identify relevant data sets, use digital tools to analyse them, and represent data in various ways to facilitate problem-solving and decision-making ● Improvement of the values of teamwork ● Better understanding of real work application of Ai technology ● Ready to use DAs in their classes
Motivation, Methodology, Strategies, Scaffolds	● Team building activities ● Create game for better understanding and familiarize with the tools ● Create team project goals ● Have students help each other with teacher supervision ● Promote collective work without dismissing individual improvement

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	All activities are suggested for the class environment. Some could be transferred to an outdoor environment with the use of mobile DA.
Resources, Tools, Material, Attachments, Equipment *(for Teachers & Students)*	● ChatGPT: OpenAI ● Alexa: Amazon - What is Alexa? ● Siri: Siri - Apple ● Google Assistant: Google Assistant, your own personal Google Other useful links: ● climate.ec.europa.eu/climate-change/causes-climate-change_en ● climate.ec.europa.eu/climate-change/causes-climate-change_en#causes-for-rising-emissions ● www.un.org/en/climatechange/science/causes-effects-climate-change ● www.epa.gov/climatechange-science/causes-climate-change
Health and Safety	Students and teachers work in a healthy and safe environment. No chemicals or hazard situations are involved.

5. Implementation

Instructional Activities, Procedures, Reflections	This plan focuses on helping children familiarize themselves with the use of DAs. The presence of the IT teacher is necessary for the introduction of technical parts . **Introduction Activity: Who is our new friend in Class today?** In this activity our goal is for students to install the DA and learn how to interact.

Activity 1: Today Alexa (or ChatGPT) will help us with Vocabulary!

The educator and the students ask DA and DA answers providing the suitable information (more details at the Worksheet “Activity 1”)

The teacher starts with a warmup activity by asking the DA: What day is today? The answer <<Today is International day of persons with disabilities>> provides the basis for discussion

Geographical features

We asked Alexa about:
Cave _____
Cliff_____
Coast_____
Glacier_____
Ocean_____
Rainforest_____
Stream_____
Valley_____

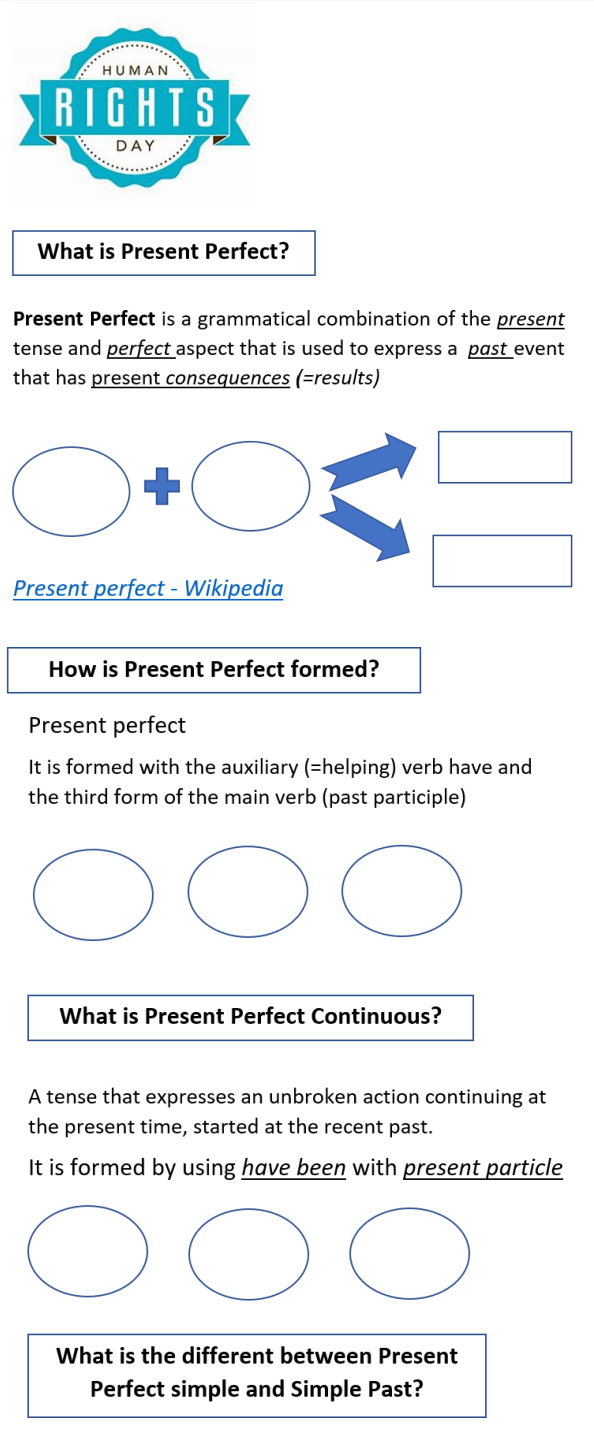
Discuss which geographical features in Exercise 1 you'd like to visit and why. You can use these questions:

What activities can you do there?

- What is the best type of clothing to wear?
- What are some good things to bring with you?
- Who would you like to visit the place with and why?

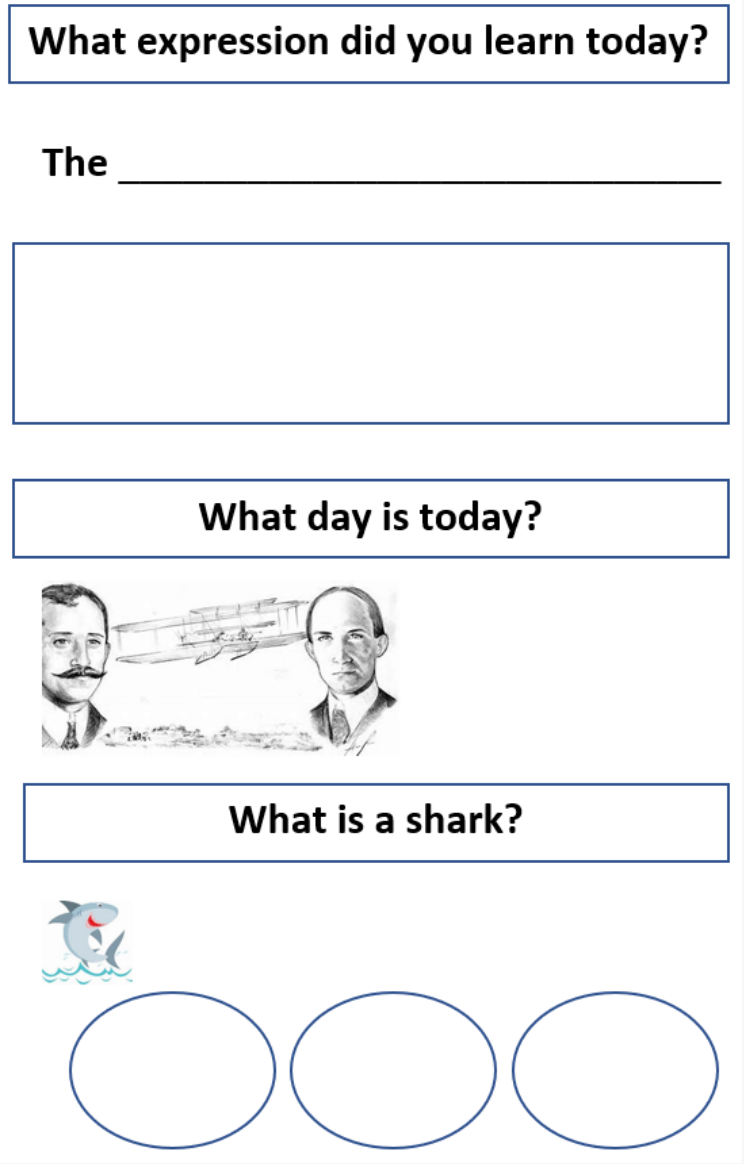
Activity 2: Today Alexa (or ChatGPT) will help us with Grammar!

The educator and the students ask DA and DA answers providing the suitable information (more details at the Worksheet “Activity 2”)



Activity 3: Today Alexa (or ChatGPT) will help us with climate change

The educator and the students ask DA and DA answers providing the suitable information (more details at the Worksheet “Activity 3”)



Activity 4: Studying a phenomenon with the help of a DA in order the students to produce an Infographic

The aims of the activity is to understand the issue of Climate Change, to exploit a phenomenon and produce an infographic as a result of the use of information given by an AI Digital Assistant (Alexa, Siri, Google Assistant etc.).

The AI tool will give to the students all the necessary information. The educator should guide the students to move from the general to specific and keep only the data, which are useful for the construction of a successful Infographic.

Here is an example for the phenomenon of Climate Change. The steps of the deployment interacting with a digital assistant in class are:

. <u>Definition of the phenomenon:</u>

The student asks: *What is climate change ?*
DA: Presents information from one source (e.g. Wikipedia)

B. Causes of the phenomenon

Student asks: *Which are the causes of climate change?*
DA: Presents information from one source (e.g. EPA United States Environmental Protection Agency)
The students continue asking more questions and collect information in order to construct the Infographic.

C. Specific & explanatory data
1. Green house gases
2. Fluorinated gases
3. Burning Coal
4. Increasing livestock farming
5. Fertilizers containing nitrogen

D. Stakeholders statistics
1. UN data
2. Greenpeace
3. Scientific partners

Presentation - Reporting - Sharing

Documents, outputs, artifacts, products produced by the students with references, web links etc., for sharing to media

Extensions - Other Information

ChatGPT and ***Alexa*** are both language-based AI technologies, but they have different capabilities and uses. Alexa is a virtual assistant developed by Amazon, primarily used for voice-controlled tasks such as playing music, setting reminders, and controlling smart home devices. On the other hand, ChatGPT is a language generation model developed by OpenAI, which can generate human-like text based on a given prompt or context.

In terms of educational use, ChatGPT has several advantages over Alexa. Firstly, ChatGPT's ability to generate human-like text makes it well-suited for tasks such as writing essays, composing emails and more. Additionally, ChatGPT's ability to understand and respond to natural language makes it a valuable tool for language learning, as it can provide feedback and corrections in real-time.

In contrast, Alexa's primary function is to perform voice-controlled tasks, and it is not as well-suited for language-based educational tasks. Additionally, Alexa's responses are limited to pre-programmed options, whereas ChatGPT's responses can be more nuanced and context-specific.

Alexa can redirect users to a website for an answer if it is unable to provide an answer itself. This can be useful in certain situations, such as providing information on a specific topic or directing users to a specific resource. However, there are some limitations to this approach.

One limitation is that the information on the website may not be up-to-date or accurate, and users would need to verify the information themselves. Additionally, redirecting users to a website can be less convenient than providing an answer directly, as it requires the user to switch to a different device or application.

Another limitation is that Alexa doesn't have the ability to understand and interpret the web page as a human would, it can't give any context or review of the webpage.

In comparison, ChatGPT has the ability to generate text based on a given context, this allows it to provide more accurate and detailed answers to users' questions. Additionally, ChatGPT can be integrated into other applications and platforms, providing a more seamless experience for the user. While Alexa's ability to redirect users to a website for an answer can be useful in certain situations, it has some limitations. ChatGPT, on the other hand, is a more versatile and powerful tool for educational use, as it is able to provide more accurate and detailed answers to users' questions and integrated into other applications and platforms.

In summary, ChatGPT is a tool for language-based tasks and providing real-time feedback. Alexa is more suited for voice-controlled tasks and smart home automation.

Resources for the development of the FACILITATE AI Learning and Creativity Plan Template
In the case of learning AI by project based activity

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0. Review the problem and review it under more demanding conditions

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STAGE III: FACILITATE AI Actions and Cooperation in Creative Projects for school students

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STAGE	**Activities/Steps** Teacher 1(T1) Cooperation with T2 and student guidance	**Activities /Steps** **By Students** Age Group: ____	**Activities /Steps** Teacher 2 (T2) Cooperation with T1 and student guidance
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FACILITATE – AI
LEARNING & CREATIVITY PLAN (L&C PLAN):

Solving problems of movement, speed, organization of our movement within the city with the use of AI tools

1. Overview

Title	Solving problems of movement, speed, organization of our movement within the city with the use of AI tools
Driving Question or Topic	How fast can we get to our destination? What is the cheapest route? What means of transport can we use? How can we move as a team? How can we organize our movement to the important points of the city as quickly, economically, and efficiently as possible? Are there any AI tools that could make our lives easier?
Ages, Grades, …	AGES:16-18 10th - 12th grade
Duration, Timeline, Activities	16 LEARNING HOURS 8*90 MINUTES 5 ACTIVITIES
Curriculum Alignment	Solving movement and cost problems. Teaching, discussion on the points of historical, cultural, social, political importance of the city. Using AI tools to help us move around the city. Organizing our movement in the important parts of the city as quickly, economically, and efficiently as possible.
Contributors, Partners	
Abstract - Synopsis	Solving problems in mathematics and physics can be a very boring process for students. Solving problems in their real lives can be much more interesting, but sometimes it can be a very difficult process. An approach that links and combines the two with the use of some AI tools that are already available on their mobile phones, perhaps better pique students' interest. The combination of teaching between subjects such as mathematics, physics, history, computer science to approach a real need of our daily lives, seems to be now necessary.
References, Acknowledgements	

2. FACILITATE AI Framework

Teachers' Cooperation	1st Teacher 1 (T1)- Teacher of Mathematics or Physics Teaching movement and cost problems Classroom. 2nd Teacher (T2) – Teacher of History or Sociology or Art

	Teaching, discussion on the points of historical, cultural, social, political importance of the city. Classroom. 3rd Teacher (T3) - Teacher of Computer Science Teaching – Supporting the Use of AI tools to help us move around the city. Classroom or Computer Lab
FACILITATE-AI in Life (FiL) Organization	The last big goal is to be able to organize our movement to the important points of the city as quickly, economically, and efficiently as possible with the use of AI tools. In addition, there will be a discussion on suggestions for improving the AI tools, that will be sent to the development team of these tools but also on any new tools that are necessary for our fast and safe movement, but also on any special needs that must be considered.
Action Plan Formulation	**STAGE I**: Preparation by one or more teachers [STEPS 1-4], and **STAGE II**: Action Plan Formulation [Preparation STEPS 1-3] Refers to the creation of this Learning Plan, by teachers in collaboration. **STAGE II**: Action Plan Formulation [Development STEPS 4-18] Refers to the realization by the students of the five activities of the Learning Plan. The support, feedback and evaluation by the teachers is accompanying throughout the implementation of the activities.

3. Objectives and Methodologies

Learning Goals and Objectives	By the end of the L&C Plan, students should be able to know and complete the following: ● Calculate and solve problems of time, speed, shorter route, more economical route, more reliable route for planning in advance, etc. ● Information, acquaintance with the important points of the city from a historical, cultural, social, and political point of view. ● Use of AI tools to plan routes or make real-time trips.
Learning Outcomes and expected Results	By completing this series of activities, students, in addition to solving problems of time, speed, shorter route, more economical route, more reliable route, will realize that in their real-life things are even more complicated and many times there are huge amounts of data and information that they must manage quickly to make decisions. In fact, the data may not even be static, but they are constantly changing, and it is impossible to handle them without the use of technology. This is where the use of AI tools is needed, which make our lives easier, and which are in a constant process of improvement and development. Alongside familiarizing themselves with these AI tools, students will learn and get to know various historical, cultural, and other important parts of their city.
Prior Knowledge and Prerequisites	Basic algebra and problem-solving skills.
Motivation, Methodology, Strategies, Scaffolds	The teaching process is based on the interconnection of teaching the solution of basic movement and cost problems with real situations that occur in our daily lives in order to move within our city and carry out our daily needs. At the same time, getting to know the most important points of the city and using technology as an auxiliary tool to manage the large amount of data, which is constantly changing, so that we can make the best decisions, are very important motivations for students to engage with more interest in learning.

	Students will learn to work individually and in groups at various stages of the teaching process. Throughout this process there is continuous discreet support from teachers and evaluation, feedback for the deliverables at each stage.

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	The teaching of classical movement problems and the first acquaintance with the different important points of the city will be done by the teachers in the classroom. As the problems become more complex, the process of solving them can be supported by the IT teacher using AI tools such as Moovit, Google Maps, Uber, etc. Also, the acquaintance with important sights of the city can be done and organized also with the support of the IT teacher with the use of tools such as the Smart Guide or other similar ones. The use of AI tools can be done on mobile phones or tablets and can be assigned and organized as work in groups. The last activity will take place in three small groups that will move independently through the city accompanied by a teacher.
Resources, Tools, Material, Attachments, Equipment	Useful links for teaching problems of movement, speed: ● Motion in a straight line ● 3.E: Motion Along a Straight Line (Exercises) ● 3.S: Motion Along a Straight Line (Summary) ● Motion in One Dimension The websites of useful AI tools: ● *Moovit: Real Time Worldwide Public Transit App* ● *Google Maps* ● Explore the Uber Platform ● SmartGuide: Digital audio guide for your visitors There are also many similar tools like the ones above.
Health and Safety	

5. Implementation

Instructional Activities, Procedures, Reflections	The plan can be implemented in 14 learning hours. Only the first 2 will be simply theoretical with classical teaching methods. The next 6 will follow with two classroom activities with the support of AI tools to find the fastest, cheapest and most effective ways to move around the city, then get to know different important spots of the city and organize how to visit them in groups. Then 6 teaching periods will be devoted to touring the city in groups accompanied by a teacher. The last 2 will be dedicated to evaluating the activity and preparation of presentations with photos, videos as well as suggestions for improving the action. **Activity 1** **Teaching classical problems of movement, time, cost**

(2 learning hours)

(1st Teacher 1 (T1)- Teacher of Mathematics or Physics)

Teaching time problems, speed, shorter route, more economical route, more reliable route.

The problems will gradually become more difficult and the information that the students will have to manage will increase so that they gradually resemble real situations. It should be. include:

- Tables with arrivals – departures of buses from different points
- Information on bike rental locations or scooters available for rent
- Information about how to use taxis or Uber services.
- Information on increased traffic in the city or on closed roads

So, the first activity will close with the conclusion that it is almost impossible to manage so much information without the use of artificial intelligence technology and tools.

Activity 2

Use AI tools to plan routes

(3 learning hours)

(1st Teacher 1 (T1)- Teacher of Mathematics or Physics)

(3rd Teacher (T3) - Teacher of Computer Science)

We present (install and operate) the capabilities of some AI tools such as **Moovit, Google Maps, Uber** or other similar, which give us information about the different ways (buses, taxis or other vehicles, scooters, bicycles) that we have at our disposal to move around the city.

The information certainly includes the time we need to move from one point to another by each way we choose to move, but also the cost.

After the students become familiar with the use of the tools, with simple applications, they are asked to solve one of the complex problems with which activity 1 ended and were impossible to solve without the use of technology.

Activity 3

Information, acquaintance with the important points of the city from a historical, cultural, social, and political point of view

(3 learning hours)

(2nd Teacher (T2) – Teacher of History or Sociology or Art

(3rd Teacher (T3) - Teacher of Computer Science)

The students will get to know various historical, cultural and other important points of their city.

Teaching can be done using classical methods such as books and maps or tourist guides or related websites etc.

With the support of the IT teacher, you can also use AI tools such as **SmartGuide** that provides you with information about various important sights of the city as well as the ability to plan the order and the way of movement to visit them as well as continuous real-time information about each area you are in.

Activity 4

Organizing the movement of students, in groups, to the important points of the city as quickly, economically, and efficiently as possible with the use of AI tools**.**

(6 learning hours)

	(1st Teacher 1 (T1)- Teacher of Mathematics or Physics) (2nd Teacher (T2) – Teacher of History or Sociology or Art (3rd Teacher (T3) - Teacher of Computer Science) In this activity the students will be divided into 3 groups. Each group will select 5 important points of the city that they wish to visit. With the guidance and supervision of a teacher each group will organize and carry out the visit. Both for the organization and for the realization of the visit will be used AI tools such as Moovit, Google Maps, Uber, SmartGuide or other similar. The goal is to make the movement as fast, economical, and efficient as possible for each group separately. **<u>Activity 5</u>** **Presentation to the class of the plan of the visit and the experiences gained by each group of students from activity 4 and the help of AI tools** (2 learning hours) (1st Teacher 1 (T1)- Teacher of Mathematics or Physics) (2nd Teacher (T2) – Teacher of History or Sociology or Art (3rd Teacher (T3) - Teacher of Computer Science) Each group presents to the class the 5 points visited, but also the way the visit was organized, explaining the options they had and how this way of organizing the visit was chosen. There is talk of the pros and cons of each AI tool used as well as other features to provide as additional services. Based on the experience gained, suggestions are made for other apps that need to be developed to improve our daily lives.
Assessment - Evaluation	Assessment and evaluation is continuous and concurrent during all activities with continuous support and guidance from teachers to achieve the objectives of each activity.
Presentation - Reporting - Sharing	After activity 5, the students' presentations can be published on the school's website, relevant publications can be made in the school's newspaper.
Extensions - Other Information	Meetings can be held with software development specialists for discussion and possible development of an app that serves the needs suggested by the students.

Resources for the development of the FACILITATE AI Learning and Creativity Plan Template
In the case of learning AI by project based activity

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Title of Project: _____
Brief Description/Outline of Organizational Arrangements / Responsibilities for Action

STAGE	**Activities/Steps** Teacher 1(T1) Cooperation with T2, T3 and student guidance	**Activities /Steps** **By Students** Age Group: ____	**Activities /Steps** Teacher 2 (T2) Cooperation with T1, T3 and student guidance
A	Preparation of steps 1,2,3		Cooperation in step 3
B	Guidance in step 9	4,5,6,7,8,9,10	Support guidance in step 9
C	Creative Evaluation	11	Creative Evaluation
D	Guidance	12	Guidance
E	Guidance	13 (9+12)	Guidance
F	Organization (FIL) FACILITATE-AI in Life	14 Meeting with Business representatives	Organization (FIL) FACILITATE-AI in Life
G	Preparation of step 15		Cooperation in step 15
H	Guidance	16 (repetition 5-11)	Support Guidance
I	Guidance	17	Support Guidance
K	Creative Evaluation	18	Creative Evaluation

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FACILITATE – AI
LEARNING & CREATIVITY PLAN (L&C PLAN):

Applications of AI in the real world for improving the quality of life

1. Overview

Title	Applications of AI in real world for improving the quality of life		
Driving Question or Topic	1. What does it mean quality of life, why is it important and what action is needed for improving it? 2. How do technology and technological developments influence the human needs? 3. What scientific and technological background has been exploited in order to develop such applications? (ranging from antiquity to Turing's question and to modern approaches in the field of AI) 4. What human ideas/ creations were the ancestors that led to the developments of AI and to what extent do these reflect the evolution of applications relating to human needs 5. What are some applications of AI in the real world and what are their consequences on human life? 6. What are the pros and cons of these applications and how do we expect them to influence our way of living? 7. What are some areas of human activities where applications of AI are having or are expected to have repercussions? 8. What actions should be taken in order to alleviate such repercussions in order to guide humanity to the right way of quality of life? 9. What are some prospective areas for promoting and applying AI's methods and approaches that will have value added in the quality of life? 10. What actions can be suggested for enhancing the positive effects of the applications of AI and minimizing the negative effects?		
Ages, Grades, …	AGES: 16-18	10th - 12th grade	
Duration, Timeline, Activities	17 LEARNING HOURS	17*45 MINUTES at least	4 ACTIVITIES at least
Curriculum Alignment	Technological Developments in the area of AI and connections to various scientific fields as consequences of respective phenomena, processes, or models.		

	Consideration of historical events in the development of AI and their effects on Economy, Social Edifices and Activities, Civilization and Communication Uses/ applications of AI in various curriculum areas Philosophical reflection and debate, through the involvement of the students in the learning activities, is expected to develop their capabilities for consideration of applications of AI in a spirit that will be supporting humanity in its goal for quality of life. In this process, it is expected that the students will work in a context that will maximize the advantages and minimize the disadvantages of the application under consideration. Furthermore, this involvement is expected to have positive effects on the students as prospective creators/ users of further/ other applications.
Contributors, Partners Abstract - Synopsis	In the context of the consideration of this topic, it is going to be useful to include the cooperation of a number of experts/ teachers covering a broad spectrum of the realms of meaning. Thus, it is suggested to involve a teacher of Sociology/ History, a teacher of Economics, a teacher in the area of STEAM and a teacher of IT. The students are expected to be involved in project activities that will provide the opportunity for philosophical meditation, consideration of ethical and practical questions relating to a number of applications, as well as the scientific background and technological know-how that forms the backbone of AI. In this process, the students will be required to indulge in identifying various applications of AI in real life and study their effects on various social, economic and political factors that form the term quality of life. .
References, Acknowledgements	● Michael Negnevitsky: “Artificial Intelligence: A Guide to Intelligent Systems”, Pearson Education Limited, 2011 (Edition 3) ● S. Russell and P. Norvig: “Artificial Intelligence A Modern Approach” Pearson Education, Ltd., London. Webpages: ● Applications of Artificial Intelligence in real world - Ready For AI. ● What Is Quality of Life? Why It's Important and How to Improve It (investopedia.com) ● https://towardsdatascience.com/advantages-and-disadvantages-of-artificial-intelligence-182a5ef6588c

2. FACILITATE AI Framework

Teachers’ Cooperation	Teacher T1 (teacher of IT) with the main responsibility of identifying and promoting/ helping in the development of activities in areas of applications of AI. Teacher T2 (teacher of Sociology/ History/ Language) and Teacher T3 (teacher of Economics) with main responsibility of taking care of elements related to

	the effects/ impact of applications of AI in the real world and with consequences on the quality of life Teacher T4 (teacher of STEAM) with the main responsibility of dealing with the scientific/ mathematical aspects of the activities involved in the project
FACILITATE-AI in Life (FiL) Organization	The teachers should meet at the initial stages and identify a number (4-5) of applications of AI that are or will be expected to have an impact on real and everyday aspects of human life. In this context, they could consider the Driving Questions (above or if they have the opportunity to extend them) and based on these, develop a first draft of activities. Based on this they proceed to the Action Plan Formulation
Action Plan Formulation	**STAGE I**: Preparation by one or more teachers [STEPS 1-4], and **STAGE II**: Action Plan Formulation [Preparation STEPS 1-3] Refers to the creation of this Learning Plan, by teachers in collaboration. **STAGE II**: Action Plan Formulation [Development STEPS 4-18] Refers to the realization by the students of the five activities of the Learning Plan. The support, feedback and evaluation by the teachers are accompanied throughout the implementation of the activities.

3. Objectives and Methodologies

Learning Goals and Objectives	In the context of this L&C Plan, students are expected to be able for the following: 1. To identify and explain the meaning of quality of life (in the context of the contemporary world as well as in the context of various cultures and civilizations) 2. To identify and study the outcomes and impact of various applications of AI in the real world. 3. To study the basic constituents of the scientific and technical background of these applications aiming at understanding their way of influencing the human life 4. To identify the positive and negative effects of such applications of AI in relation to everyday human activities or conditions (work, health, etc.) 5. To provide suggestions or ideas that will set conditions that such applications will maximize the positive effects and minimize the negative effects 6. To provide solutions to problems arising from such applications so that the concept of quality of life will cruise in a moral society,
Learning Outcomes and expected Results	The involvement of students in the learning activities is expected to provide them with the capabilities for consideration of applications of AI in its spirit that will be supporting humanity in its goal for quality of life in a context that will maximize the advantages and minimize the disadvantages of the applications they considered. Furthermore, this involvement is expected to have positive effects on the students as prospective creators/ users of further applications.

Prior Knowledge and Prerequisites	Knowledge of the concepts of AI. The ability for critical consideration and capability for discussion, as well as indulging in investigating and analytical involvement
Motivation, Methodology, Strategies, Scaffolds	The students are provided with challenging events on various applications of Ai and are called to analyze, mediate and study their effects in the spirit of the critical driving questions presented earlier, thus forming views on the pros and cons of the applications and on the impact to the quality of life. The basic methodology should provide ample opportunities for discussion as well as for suggestions of approaches in the use of the application in the spirit of the human condition. Project work is also an important tool in the methodology of approaching this issue as it can provide the context for creating the background as well as the framework for investigation and consideration of the various issues that step out during the consideration of the driving questions identified in section 1.

4. Preparation and Means

Preparation, Space Setting, *Troubleshooting Tips*	The team of teachers that are to indulge in this topic must have a broad consideration of their own subject area as well as the impact that the applications of AI have on the quality of life. Thus, it is essential that T2 and/ or T3 set the context of the meaning of quality of life and develop ideas/ questions for reflection, both at the meetings of the group of teachers as well as at the work with the students. Thus T1 (teacher of IT) will be able to propose applications for consideration. Obviously, these topics are a matter of exchange of ideas and discussion by the teachers. Depending on the areas of realms of meaning involved in the previous ideas teacher or teachers (T4) will have to be involved to set the forum for scientific/ technological/ mathematical considerations. Based on the partnership the team of teachers will proceed to design the Steps of the Action Plan (see Section 2). With this in mind, one would expect meetings with the students that will involve classes where T1 will have the opportunity of presenting an Application, T2 or T3 will discuss the implications for the quality of life and T4 will consider the technological/ scientific/ mathematical aspects.
Resources, Tools, Material, Attachments, Equipment	The web is a very rich resource for information concerning this topic using as keywords the driving questions in Section 1. Furthermore, the whole issue is the object of consideration by many organizations like UNESCO, the OECD, the WORLD ECONOMIC FORUM, the WORLD BANK, etc. In addition, organizations like NASA and IBM provide ample material and resources. Thus, a basic tool for the investigation can be provided by the Computer Lab or by the Personal PC and the Internet.
Health and Safety	

Instructional Activities, Procedures, Reflections	An approach for the implementation is as follows: **Activity 1 (1 period (40 to 45 minutes)) Brainstorming activity** (Usually Under the auspices of T2/ T3 although any other teacher can be the facilitator) Brainstorming with the requirement of developing a project requiring to consider the examples of TALOS and Pandora Jar from Greek mythology. In the process of examining these examples, the students will have to identify elements relating to AI/ automation and then to proceed in identifying and discussing their effects on the quality of life in conjunction with the pros and cons of the adoption of the possibility of realizing these mythological entities. Discuss the possible improvements in the life of humans if these were realities. Search the web to identify applications of AI that could be considered as ideas that reflect mythical entities. **Activity 2** **Consider the Application of AI that leads to a *self-drive car*** Activity 2a (1 period in the class plus extra time for homework) T1 is the facilitator in the process of studying this application. T1 provides material to the students that set the context for understanding the principles (these principles are to be explored further at the stage of Activity 2b) on which a self-drive car is running. He/ she sets questions that help the students in indulging in the ideas and possibly technicalities of developing the algorithmic processes that allow a car to self-drive. In this effort, he/ she has as a guide the Driving questions of section 1 so that the students observe an eye on the expected impact on the human condition. He/ she suggests to the students to refer to their STEAM teacher T4 for support/ instruction on the consideration of the scientific, technological and mathematical tools that provide the means for the realization of the algorithmic process Activity 2b (1 period in class plus extra time for homework) T4 is now the facilitator for studying the application. As in the case of T1, he/ she provides material to the students that set the context for understanding the various technological, scientific and mathematical tools that enable a self-drive car to operate following the instructions of the algorithmic process developed earlier. He/ she sets questions that help the students in getting interested and involved in the ideas and scientific/ mathematical tools that govern (in the area of automation) the running of the self-drive car. In this effort, he/ she has as a guide the Driving questions of section 1 so that the students observe an eye on the expected impact on the human condition and the quality of life. He/ she suggests to the students to refer to their teacher T2 or T4 for support/ instruction on the consideration of the social, economic, political and ethical questions that provide the context for the realization of what could be identified as a quality of life. Activity 2c (2 periods in class plus extra time for homework) T2 or T4 is a facilitator for the development of project work and discussion/ debate based on the outcomes of Activities 2a and 2b as well as the Driving

questions of Section 1. The emphasis should be on the consideration of the needs of the real world and the aspects constituting the quality of life. In this process, the students should include documented claims for the goal of improving the quality of life through this Application of AI.
Thus, in the present activity, an important issue that has to be the object of discussion is the advantages that are offered to mankind through this application.
At this stage of this Activity, T2 or T4 would include facts, remarks and questions that are leading the students to be involved in project activities that will provide the opportunity for philosophical meditation, consideration of ethical and practical questions relating to a number of applications as well as to the scientific background and technological knowhow that forms the backbone of AI. In this process, the students will be required to get involved in identifying various applications of AI in real life and study their effects on various social, economic, and political factors that form the term quality of life
In the present case of the application of the self-drive car the following **observation/ problem/ issue** is a basis for developments based on the remarks just identified:
A self-driving car kills a child. How do you deal with this case?
Also, a blind person is using a self-driving car. What advantages does this case suggest?
What do you think about this? What ethical, political, and social issues have to be considered?
What changes do you suggest for improving the application or the way it is used?

Activity 3, 4, 5, …

The procedure of activity 2 is to be repeated for other applications of AI. In particular, the selection of applications would be useful to offer opportunities for consideration of the following problems:
(This selection could be the outcome of assigning to the students the consideration of the issues)

1. **The Job loss problem**. According to many studies due to a lot of applications of AI, quite a number of jobs have been lost and many millions of people are out of work. Actually, in view of the advances in the area of AI, more and more people (even skilled ones) will be out of work. How do we deal with this threat and to what extent do we consider it as an issue for the quality of life?
2. **The safety and personal life issues**. As a result of the developments in AI, we observe quite a number of problems concerning either the safety of the personal life or the personal data and property of a person. There are grave concerns that these developments might be catastrophic to humankind. On the other hand, these developments provide a broad range of positive impacts on the safety of a person and the fighting of crime. Thus, it is sound to set questions concerning our quality of life.
3. **The question of the extent of trusting** the outcomes of the various applications of AI, as for the majority of us it is not possible to check

	what they are proposing or suggesting to us. Thus, again it is sound to set questions about such developments in the context of the quality of life. **<u>Activity X</u>** Each of the teachers T1, T2/T3, T4 and in the context of his/her subject area would consider the ideas, conclusions and issues derived from activities 2, 3, …, assess the whole effort for developing AI applications and provide a context of the discussion that has to govern/ guide the adoption of such applications in real life
Assessment - Evaluation	Assessment and evaluation are continuous and concurrent during all activities with continuous support and guidance from teachers to achieve the objectives of each activity.
Presentation - Reporting - Sharing	After completing each activity, the students' presentations/ debates can be published on the school's website, relevant publications can be made in the school's newspaper.
Extensions - Other Information	Meetings can be held with software development specialists for discussion and possible development/ adaptation of an app that serves the needs/changes suggested by the students.

Resources for the development of the FACILITATE AI Learning and Creativity Plan Template
In the case of learning AI by project based activity

FACILITATE AI Prototype/Guide for Learning & Creativity Approach
Action Plan Formulation

Major steps in the FACILITATE AI learning approach:

STAGE I: Preparation by one or more teachers

1. Formulating initial thoughts on the thematic sectors/areas to be covered
2. Engaging the world of the wider environment / work / business / parents / society / environment/ ethics
3. Target Age Group of Students - Associating with the Official Curriculum - Setting Goals and Objectives
4. Organization of the tasks of the parties involved - Designation of Coordinator - Workplaces etc.

STAGE II: Action Plan Formulation (Steps 1-18)

<u>Preparation (by teachers)</u>

1. Relation to the Real World – Reflection
2. Incentive – Motivation
3. Formulation of a problem (possibly in stages or phases) resulting from the above

Development (by students) – Guidance & Evaluation (in 9-11, by teachers)

0. Background Creation - Search / Gather Information
0. Simplify the issue - Configure the problem with a limited number of requirements
0. Case Making - Designing - identifying materials for building / development / creation
0. Construction - Workflow - Implementation of projects
0. Observation-Experimentation - Initial Conclusions
0. Documentation - Searching Thematic Areas (AI fields) related to the subject under study – Explanation based on Existing Theories and / or Empirical Results
0. Gathering of results / information based on points 7, 8, 9
0. First group presentation by students

Configuration & Results (by students) – Guidance & Evaluation (by teachers)

0. Configure AI models to describe / represent / illustrate the results
0. Studying the results in 9 and drawing conclusions, using 12
0. Applications in Everyday Life - Suggestions for Developing 9 (Entrepreneurship - FIL Days)

Review (by teachers)

0. Review the problem and review it under more demanding conditions

Project Completion (by students) – Guidance & Evaluation (by teachers)

0. Repeat steps 5 through 11 with additional or new requirements as formulated in 15
0. Investigation - Case Studies - Expansion - New Theories - Testing New Conclusions
0. Presentation of Conclusions - Communication Tactics.

STAGE III: FACILITATE AI Actions and Cooperation in Creative Projects for school students

Title of Project: _____
Brief Description/Outline of Organizational Arrangements / Responsibilities for Action

STAGE	**Activities/Steps** Teacher 1(T1) Cooperation with T2, T3 and student guidance	**Activities /Steps** **By Students** Age Group: ____	**Activities /Steps** Teacher 2 (T2) Cooperation with T1, T3 and student guidance
A	Preparation of steps 1,2,3		Cooperation in step 3
B	Guidance in step 9	4,5,6,7,8,9,10	Support guidance in step 9
C	Creative Evaluation	11	Creative Evaluation
D	Guidance	12	Guidance
E	Guidance	13 (9+12)	Guidance

F	Organization (FIL) FACILITATE-AI in Life	14 Meeting with Business representatives	Organization (FIL) FACILITATE-AI in Life
G	Preparation of step 15		Cooperation in step 15
H	Guidance	16 (repetition 5-11)	Support Guidance
I	Guidance	17	Support Guidance
K	Creative Evaluation	18	Creative Evaluation

RESULT 1 - AI TEACHING GUIDE FOR TEACHERS FACILITATING THE LEARNING OF STUDENTS IN GRADES 7-12

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