

FACILITATE-AI

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

RESULT 3

**DYNAMIC ONLINE LEARNING
ENVIRONMENT WITH OER ON AI IN
INTERDISCIPLINARY STEAME SCHOOL
SUBJECTS WITH A SET OF BLUEPRINT
POLICY RECOMMENDATIONS**

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the European Union

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

Reference Number: 2021-1-CY01-KA220-SCH-000032567

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

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1.0 Introduction

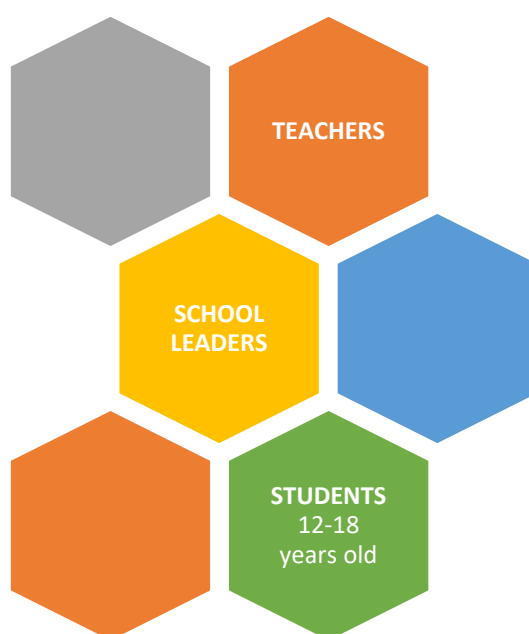
The main purpose of this document is to provide a set of blueprint recommendations for governments across Europe in their efforts to ease and facilitate the modernization of education including the application and implementation of new technologies like Artificial Intelligence. It involves also the challenges coming together with the vast array of opportunities. The objectives of the FACILITATE-AI project are to support school teachers (the facilitators of learning) in developing an inquiry-based 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.

Policy makers at the local, national, and international levels require access to well-informed insights regarding the challenges confronting educational institutions with the advent and use expansion of AI, as well as strategies for the effective formulation of policies, regulations, and integration approaches within their spheres of influence.

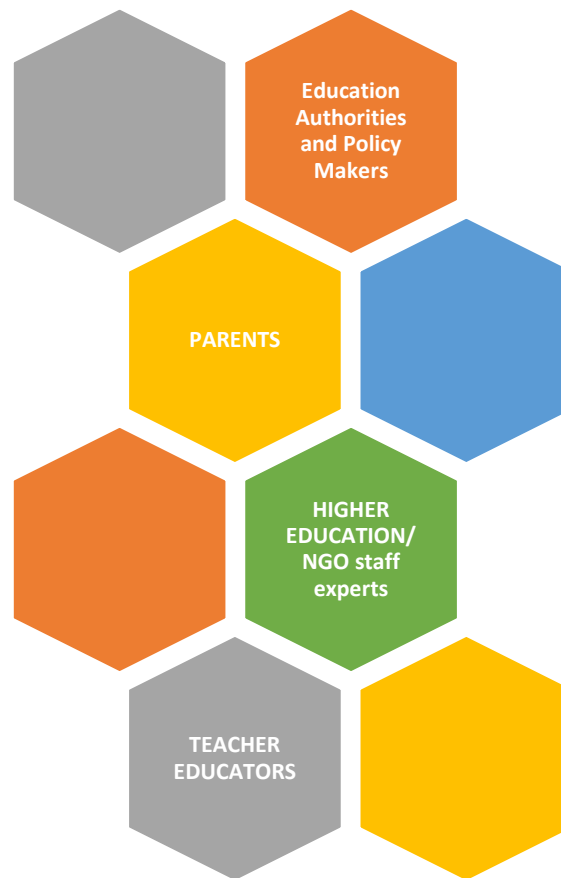
It is evident that researching the current challenges that school leaders and educators face and empowering them to overcome them, indirectly affects students. Through information dissemination and capacity development initiatives targeting the educational community and policy makers, the project endeavours to diminish apprehension surrounding AI. By empowering the educational community, the project aims to destigmatize AI usage, fostering a comprehensive understanding of the technology's potential among all stakeholders.

The partner countries that contributed to this report are Bulgaria, Cyprus, Greece, Italy, Portugal, and Romania. Since the beginning of the project, the consortium collected information and conducted research to comprehend the current situation and state of the art inputs. This is essential for ensuring the seamless integration of AI, fostering a smooth and effective process.

The main target groups are defined as follows:



In addition, the following stakeholders are also targeted:



2.0 Needs Analysis

Equipping students with important 21st century skills and knowledge is crucial and thus introducing students to the concept of AI will better enable them to understand and optimally utilize future technologies.

Emphasis is placed on related sectors and industries especially businesses who develop and provide AI-enabled services and products including those for education. Students are not only end users but also potential problem-solvers capable to use AI technologies in different scenarios, and even creating AI-driven hardware and software solutions to improve our society. AI literacy combines the principles of data science, computational thinking and multi-disciplinary knowledge, intertwining AI literacy with AI thinking.

As part of the framework for European policy cooperation in education and training (ET 2020), EU Member States have set the objective that less than 15% of 15-year-olds should be classified as 'low-achieving' in basic skills by 2020.

The Commission supports Member States in strengthening basic skills and key competences for all citizens by facilitating mutual learning and the exchange of best practices. The Council has adopted a Recommendation on Key Competences for Lifelong Learning based on a Commission proposal. The Recommendation identifies eight key competences necessary for personal fulfilment, a healthy and sustainable lifestyle, employability, active citizenship and social inclusion:

- Literacy
- Multilingualism
- Numerical, scientific and engineering skills
- **Digital and technology-based competences**
- Interpersonal skills, and the ability to adopt new competences
- Active citizenship
- Entrepreneurship
- Cultural awareness and expression

The Council Recommendation provides a common European reference framework on key competences for policymakers, education and training providers, social partners and learners themselves.

The Digital Education Plan sets out two strategic priorities and fourteen actions to support them:

Priority 1: Fostering the development of a high-performing digital education ecosystem

Priority 2: Enhancing digital skills and competences for the digital transformation

Under Priority 2 Action 8 is dedicated to AI: Updating the European Digital Competence Framework to include AI and data-related skills

Based on the aforementioned factors and conditions at EU level, the project FACILITAE-AI is developed by the mutual collaboration of NINE partners:

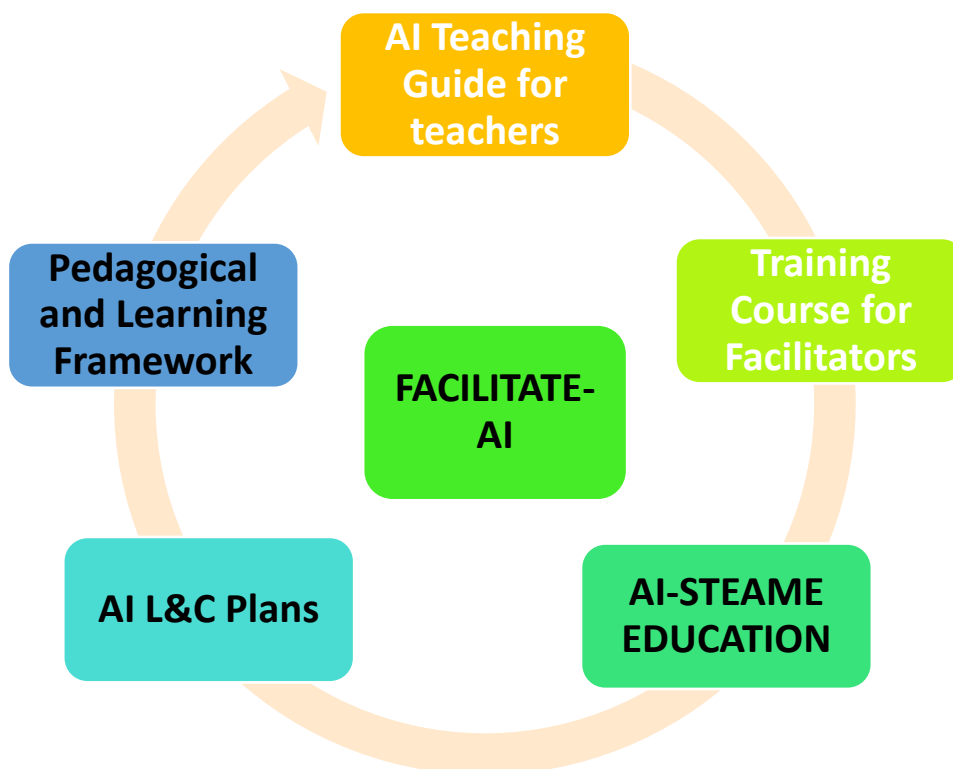
| | |
|--|----------|
| CYPRUS MATH SOCIETY | CYPRUS |
| PLOVDIV UNIVERSITY PAISIY HILENDARSKI | BULGARIA |
| DOUKAS SCHOOL | GREECE |
| PROF. IVAN APOSTOLOV HIGH SCHOOL | BULGARIA |
| POLYTECHNIC OF PORTO | PORTUGAL |
| SPIRU HARET UNIVERSITY | ROMANIA |
| ITC PACLE INSTITUTE "ELSA MORANTE" | ITALY |
| INSTITUTE OF ACCELERATING SYSTEMS AND APPLICATIONS | GREECE |
| UNIVERSITY OF CYPRUS | CYPRUS |

The Facilitate-AI project produced three main results complementing each other as a whole set of Guidelines for school leaders and teachers first and foremost to support the process of transformation and transition towards AI:

1. AI Teaching Guide for teachers facilitating the learning of students in grades 7-12
2. Training Course for Facilitators of learning in AI-STEAME education
3. Dynamic Online Learning Environment with OER on AI in interdisciplinary STEAME school subjected with a set of Blueprint Policy Recommendations

Some of the identified key success factors for the transition and transformation towards AI implementation are related to:

- Commitment by the school authorities and leadership
- Aligned work and collaboration between teachers
- Student-centered approach
- Interdisciplinary approach
- Application of new methodologies – project-based learning, inquiry-based learning, hybrid approach, flipped classroom, etc.
- New role of the teacher as a mentor, facilitator, coach
- New lesson plans – Learning & Creativity plans to nurture creativity of students
- Use of digital tools and technology-enabled process and spaces
- Co-creation and innovation at its core
- Development of personalized teaching and learning.



3.0 Organization and Participants of Focus Groups

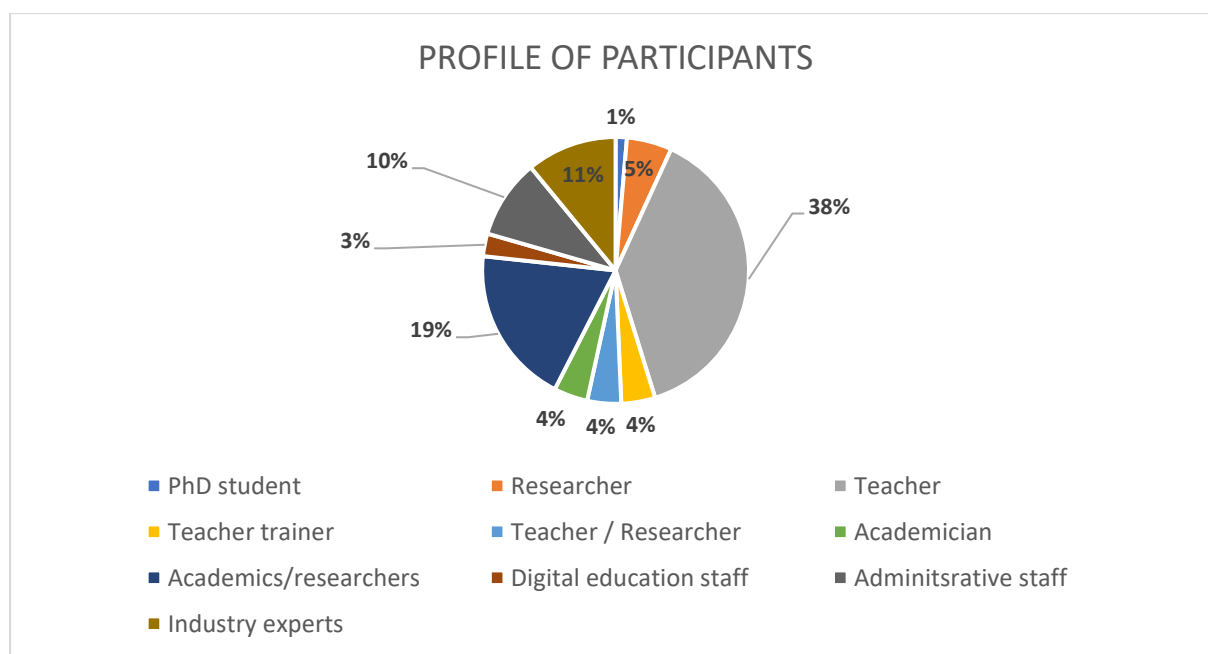
The focus groups within the project “Facilitate-AI”, No. 2021-1-CY01-KA220-SCH-000032567 were organized in aligned manner led by the leader of the third Project result within the project management context.

Result leaders prepared and shared the unified guidelines with the consortium, which included a description of the profile of the participants to be invited, a set of questions to be asked, the focus group’s duration, participants’ organisation, as well as approach and content in order to drive a fruitful and efficient discussion that leads to the validation and confirmation of the main findings and recommendations set within the PR3. This is aligned with the needs for enhancement of STEAME skills and competences of students starting at an early age, to better prepare them and inform them about the possibilities in these fields. Research shows that by introducing AI in school education we will secure the provision of skills by 2030. The speed at which technology is advancing is rapid and far surpasses the rate at which education systems are able to adapt. Thus, the early adoption of these skills in the learning process should lead to faster and easier adaptation of students to the work environment post-schooling. Additionally, HE studies can further equip them with the necessary tools and qualifications for the jobs of the future.

As AI is a very relevant and needed topic, it is very important for teachers to be prepared. This underscores the main reasons for developing R3; to ensure that the project, being digitally focused, fully embraces a digital approach and model for teaching. The main target groups are teachers and their students in grades 7-12 in, mainly, subjects of STEAME (Science, Technology, Engineering, Arts, Mathematics, Entrepreneurship) but not limited to these. The expected impact of the focus groups, besides sharing opinions, experiences and expertise, is the increase in digital competences and skills of the target groups, the ease of use and applicability, higher confidence in use of digital platforms, tools, approaches and methodologies. All participants across the consortium countries are involved in the education and training field from one side, and the IT/AI expertise – from another.

There were 78 participants in total across all partner countries.

The summarised profile is presented below:



3.1 Questions for focus groups for validation

All focus groups were guided by the following questions:

Q1: At what age the topic of AI should be introduced in the learning process? Please consider the below points

- *Can students use any type of AI in the learning process?*
- *If yes, at what age do they start?*
- *Should there be different levels of teaching AI: basics in grade ..., intermediary and advanced level at grade/programme of studies..., etc.*

Q2: What are the necessary teaching and learning methods to meet the challenges by AI? (including new ways of assessment and evaluation)

Q3: What are the key competences and expertise of teachers having in mind:

- *initial training of teachers*
- *pre-service teachers*
- *in-service training of teachers,*
- *which subject teachers should teach AI?*

Q4: Under which learning subject should AI be introduced to the students (i.e. math, computing, sciences, all?)

Q5: What is the least necessary equipment and technology for initial AI implementations? (e.g., hardware, software, learning spaces, etc.)

Q6: Are there any serious restrictions and challenges to be considered? (technological capacity of schools, teachers' competences, parents' role for and against it, GDPR, difficulties to make changes in the curriculum and syllabuses)

Q7: What are the main opportunities, good practices and other examples to ease the smooth introduction of AI in school systems?

Q8: What are the national strategic goals for AI in education? Is there any introduction of AI ethics?

Q9: What is the main support to be provided by the public authorities in your country including financial mechanisms?

Q10: Do you have any other suggestions not covered by the above questions?

The below templates were used to share particular best practices and examples to make them more structured and unified across countries.

| |
|---|
| BEST PRACTICES/EXAMPLES you can share: |
| |
| Main conclusions and recommendations: |
| |

4.0 Policy Recommendations

The main policy recommendations as derived from the focus groups conducted in each partner country are presented below. The project has identified recommendations in 6 main areas:

4.1 Teacher Competencies and Training

Foundation in AI Concepts: Develop a solid foundation in AI concepts by fostering a comprehensive understanding.

Distinguish between AI Tools and Development: Recognizing the distinction between using AI tools and actively developing AI to provide a foundational understanding and set the stage for hands-on skill development.

Comprehensive Teacher Training: Equipping teachers not only with technical knowledge but also key competencies such as adaptability, innovation, and strategic thinking for effective AI education.

Addressing Challenges: Recognize and address challenges, including financial considerations, shifts in mindset, and the necessity for ongoing teacher retraining.

Ongoing Professional Development: Creating strategies for regular teacher training to ensure that educators remain competent in teaching AI and can adapt to evolving AI technologies over time.

Programming Proficiency: Cultivate proficiency in programming languages crucial for AI development, with a specific emphasis on languages like Python for creating and implementing AI models.

Tailor AI Content for Effective Communication: The ability to tailor AI content to pupils' levels and needs, along with strong communication skills, is crucial for making AI concepts accessible and engaging in a classroom setting.

AI Communication: Enhance communication skills to convey AI concepts in an accessible manner, fostering interactive discussions and engaging activities for students.

Curricular Navigation: Stay familiar with existing curricula and available resources designed for teaching AI in schools.

Practical-AI Projects: Develop and coordinate practical AI-related projects within an educational framework, promoting hands-on learning experiences.

Observation and Support: Facilitate observation and support mechanisms, offering opportunities for teachers to observe experienced peers teaching AI and receive constructive feedback and guidance.

Collaborative Teaching: Foster collaboration between AI specialists and educators, working together to improve and enhance approaches to teaching AI.

4.2 Levels and fields of teaching

Establish an appropriate onset for AI Introduction: Set a minimum age for the introduction of AI to ensure a thoughtful and age-appropriate integration into the educational curriculum.

Integrating AI Education Across School Levels: Introduce AI classes in middle school and progress through high school grades, establishing a structured continuum for students to delve into AI concepts at varying depths.

Early Integration of AI Concepts: Initiate the introduction of AI concepts from preschool to high school to provide a solid foundation and support a seamless progression of understanding.

Different Levels of Teaching AI: Recognize the diverse levels at which AI can be taught, emphasizing the importance of tailoring instruction to suit the developmental stages and aptitudes of students.

Foster Computational Thinking from Early Years: Consider introducing computational thinking and basic AI concepts in kindergarten, laying the groundwork for a digital knowledge culture and nurturing early interest in technology.

Progressive Approach to Teaching AI: Establishing a tiered approach to teaching AI, covering learning **about** AI, designing **with** AI, and eventually designing **for** AI, to ensure a comprehensive and evolving understanding, empowering students with practical skills and critical thinking abilities.

4.3 Integration Across Subjects

Holistic Integration: AI's progressive integration extends across diverse academic subjects, presenting countless applications that enhance learning experiences.

Customized Learning: Tailor AI learning to different levels to align with students' varying skills and curricular paths, ensuring inclusivity and relevance.

Teacher Collaboration: Foster collaboration among teachers for the effective implementation of AI education, promoting the exchange of ideas, strategies, and best practices.

Partnerships for Practical Applications: Engage in partnerships with businesses and other organizations to enrich AI education, offering real-world insights, resources, and opportunities that bridge the gap between academic learning and practical applications.

4.4 Support by the national system and bodies

National Strategic Goals: Align educational objectives with national strategic goals, ensuring that AI education plays a pivotal role in preparing students for the evolving demands of the future.

Support from Public Authorities: Secure backing from public authorities, advocating for policies and resources that facilitate the seamless integration of AI education across schools and institutions.

Overall Reform in Education: Support a holistic reform in education, emphasizing the integration of AI into curricular frameworks to equip students with the skills needed in an increasingly AI-driven world.

Adaptation of Curricular Programs for Teaching AI: Modifying curricular programs to incorporate the teaching of AI ensuring that it is integrated seamlessly into the educational framework.

Inquiry with Education Ministries for AI Guidelines: Collaborate with education ministries to seek and establish clear guidelines for the integration of AI in schools, providing educators with a structured framework for effective implementation.

Promote evangelization of AI opportunities: Advocate and promote the awareness of AI opportunities and benefits among educators and school administrators, fostering a shared understanding of the positive impact AI can have on education.

Curriculum Alignment: Ensure alignment between AI education initiatives and existing curricula, fostering a cohesive educational experience that seamlessly integrates AI concepts and applications.

Share Good Practices: Establish mechanisms for the sharing of successful practices in AI education, creating a collaborative platform where educators can exchange insights, strategies, and innovative approaches for effective AI instruction.

4.5 Teaching and learning process

Implement Computational Thinking: Draw inspiration from successful initiatives, such as the implementation of computational thinking in kindergarten, even in the absence of digital tools, which has shown positive outcomes in early education.

Utilize AI for quick insights, as demonstrated by a college using learning analytics to identify and support students facing challenges.

Ethical Considerations: Engage students in thought-provoking discussions about the ethical considerations, regulatory aspects, and responsibilities associated with AI tools. This challenges them to critically examine the broader implications of AI and fosters a deeper understanding of its societal impact.

4.6 Infrastructure requirements

Hardware: Employ computers or laptops for basic projects, and for more intricate tasks, provide access to servers or cloud computing resources, ensuring a robust infrastructure to support the varying needs of AI projects.

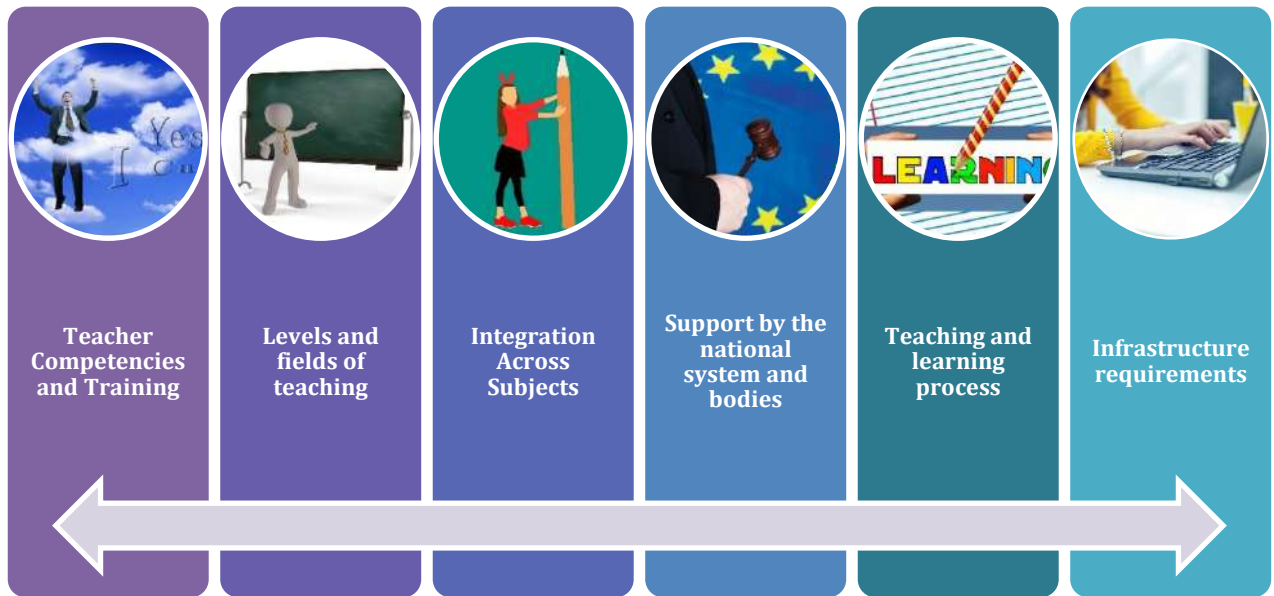
Software: Utilize a set of tools, including a development platform like Jupyter Notebook or PyCharm for coding, testing, and executing Python scripts. Embrace programming environments like Python and leverage cloud computing platforms such as MS Azure for scalability and efficiency in AI development.

Online Educational Platforms: Integrate reputable online platforms like Coursera or Khan Academy, offering courses and educational resources in AI. Additionally, provide comprehensive training and technical support for teachers, ensuring they are well-equipped to deliver effective AI education.

Connectivity and Networks: Establish high-speed internet access and fast connectivity to enable seamless access to online resources and facilitate real-time collaboration. Ensure a stable and secure network infrastructure, laying the foundation for effective AI learning experiences.

Security and Privacy: Implement cybersecurity measures to safeguard sensitive data and address potential threats, guaranteeing a secure environment for AI projects and educational activities.

Privacy Policies: Develop and enforce clear privacy policies, specifically tailored to protect students' personal information and data, fostering a secure and trustworthy AI learning environment.



Conclusion

Academics, researchers, teachers, industry representatives and general experts are in consensus of the importance of early introduction of Artificial Intelligence into the curriculum. They believe that the decision to introduce AI into the curriculum should be closely aligned to the strategic educational goals of the country and school.

Overall, a comprehensive approach that includes multiple disciplines can be beneficial to develop a deeper understanding of AI and its applications.

One of the main conclusions among all partner countries is the unanimous agreement that:

The potential of AI in education seems to be exhaustive!

AI may be used in a progressive way through many applications in various academic subjects. While some experts believe that AI may be gradually introduced as early as kindergarten, others believe that the fifth grade is the ideal age to begin interacting with it.

No matter where, how and when, students have to be prepared at two main levels:

- The use of AI in an ethical way and meeting the norms, learning to design **with** AI
- The concepts behind AI including programming, learning to design **for** AI

AI tools and apps exist under all learning subjects, hence, all learning subjects can incorporate AI in the learning process. However, it is important to distinguish the learning outcome. There are three different categories about teaching AI in education. Learn **about** AI, learn to design **with** AI, and design

for AI with the students. A distinction must also be made between *the use* of artificial intelligence and *the development* of artificial intelligence.

The learning of AI can be introduced in almost every learning subject. It is a question of selecting an implementation close to the field of expertise of each subject. A conservative approach could only include computing sciences, math, and languages. However, the focus group also suggested the inclusion of AI learning in subjects such as philosophy, so the student can assess and discuss the adoption of AI in society, its benefits and implications and opportunities and threats.

ANNEX I – Focus Groups in Partner Countries

BULGARIA

OVERVIEW AND ORGANISATION

The Focus Group in Bulgaria was organized by the partner “Prof. Ivan Apostolov” high school. An invitation was created and sent by email to teachers and educators, as well as AI experts in Bulgaria. The Focus Group was organized and hosted in person by the school. The focus group was part of a series of internal trainings, events and seminars organized in December by the school. It started with a short overview of the project, its objectives, goals and current outcomes and then continued with the Policy Recommendation Questions. Participants were informed at the beginning of the session that it would be recorded for the purposes of the report and pictures were taken with the same purpose.

TARGET GROUPS

Participants varied, from university teachers, teacher trainers, STEM Teachers, PhD students and researchers and the widest group of educators who are engaged in the education and training field in various roles and contexts.

CONCLUSIONS AND RECOMMENDATIONS

Q1: At what age the topic of AI should be introduced in the learning process? Please consider the below points

- *Can students use any type of AI in the learning process?*

All participants unanimously agreed that students are more prepared and aware of the existing tools and opportunities in general than their teachers. In most of the cases they use tools like Chat GPT to prepare homework and assignments.

- *If yes, at what age do they start?*

Depending on their age and system they are taught the AI is in their early ages, from their home and kindergarten. These examples are related mostly to fun games and activities to develop their creativity, learning skills and memorization.

- *Should there be different levels of teaching AI: basics in grade ..., intermediary and advanced level at grade/programme of studies..., etc.*

It is more relevant to relate the use and teaching of AI to the purpose and context, i.e. in the different subjects, in project-based learning, in game-based learning, gamification, and other. In most of the cases it is the teacher who leads the process and prompts the interest. The facts and knowledge behind AI should be explained early in the ages to explain why and how certain AI tools are used. Then later in the higher classes (e.g., in high school) the subject is taught in IT-related subjects from a more complex point of view.

Q2: What are the necessary teaching and learning methods to meet the challenges by AI? (including new ways of assessment and evaluation)

AI can be applied in different subjects and not necessarily implementing some innovative methods and approaches. It is related to the process of teaching and the outcomes that are pursued. Teachers themselves are not that prepared so the first step is to prepare the teacher trainers and equip teachers

with the tools and knowledge they need to possess. Most of the participants agreed that motivation and engagement of students is the key success factor and reason for AI integration into the teaching.

Q3: What are the key competences and expertise of teachers having in mind:

- *initial training of teachers*
- *pre-service teachers*
- *in-service training of teachers,*
- *which subject teachers should teach AI?*

What is really important in this respect is the subject field and the methods to be applied in class. The main competences are not specific to the type of teachers and their type. They are more connected with the purpose: communication, collaboration, presentation, assessment and feedback, facilitating learners' digital competence and other. It is applied in various subjects – both humanities and STEM, teachers in linguistic fields are also an example of use and application of AI. There are differences between teaching how to apply AI with focus on ethics and another point – theoretical knowledge about concepts, types, functionalities, programming behind AI which is very specific for IT-related subjects. In Bulgaria now with the profiling of studies after grade 10 (age 16) students can decide to follow the track of studies for Software and hardware studies. This is now the area where the most advanced AI should be taught when they are in school so that they can start even work after school with some trainings and not formal higher education which is a common case.

Q4: Under which learning subject should AI be introduced to the students (i.e. math, computing, sciences, all?)

AI can be introduced in any subject. One of the experts shared his opinion that the competences of teachers matter a lot. They need to be well-prepared and equipped with the technology, knowledge and skills how and what type of AI to be used depending on the activities in class. Again, all participants agreed that the subject is not that relevant as the type of methods and practical tasks. Collaboration with external experts in the field and trainers can really help in the Bulgarian school. A common example is given with school-business partnerships and specific projects, trainings, initiatives as shared databases, knowledge, tools to be used.

Q5: What is the least necessary equipment and technology for initial AI implementations? (e.g., hardware, software, learning spaces, etc.)

Knowledge of what exists and how to be applied is crucial. No specific requirements are necessary. Most of the schools already have good IT labs, smart boards, shared space, use of platforms and other resources so these physical conditions are met.

Q6: Are there any serious restrictions and challenges to be considered? (technological capacity of schools, teachers' competences, parents' role for and against it, GDPR, difficulties to make changes in the curriculum and syllabuses)

The biggest challenge is the preparation of teachers especially keeping in mind the aging teaching staff in Bulgaria. Knowledge about GDPR, ethical challenges and rules, the approaches, the curriculum, etc. The change start from within the school in one or two subjects. In most cases there is one or a small team of well-prepared teachers who lead the change within their fields/subjects. The lessons' sequence and content are difficult for change within the subjects' syllabi within the curriculum. The use is still limited to software and platforms like Open AI. For example, use of robots and more sophisticated AI is a long way for teachers and schools. However, students have to be prepared how to develop and use them as these are the jobs of the future.

Q7: What are the main opportunities, good practices and other examples to ease the smooth introduction of AI in school systems?

The main examples are related to the presence of business organisations in schools – i.e., work with experts, managers, who can be mentors like in the Junior Achievement program for student companies. Another example is the technical school like the one affiliated with the Technical university in Sofia – Technological School Electronic Systems (TUES), where professors and AI practitioners teach students. It is also common for IT companies to drive collaboration in order to prepare their workforce so specialists in AI become part-time teachers, provide summer internships, specific tasks and short-term projects where students can do real-life work and activities so they can gain practical experience in AI. This is still the best approach.

Q8: What are the national strategic goals for AI in education? Is there any introduction of AI ethics?

According to the latest news, in August 2023 it is expected that AI Implementation Framework for Schools to Be Developed. A framework for the implementation of artificial intelligence in school education, outlining the boundaries of its use, will be developed jointly with experts and social partners, according to the Bulgarian Education and Science Minister. Since 2022 launched the Institute for Computer Science, Artificial Intelligence and Technology (INSAIT). INSAIT has launched a new summer AI program for high school students. This is an example of collaboration beyond the preparation of teachers in pedagogical institutes and universities.

Q9: What is the main support to be provided by the public authorities in your country including financial mechanisms?

There is a program for STEM in school education in Bulgaria which is not directly related to AI but provides financing for STEM labs, equipment, new programs, and other projects to be funded.

Q10: Do you have any other suggestions not covered by the above questions?

The topic needs to be raised more often and public bodies have to collaborate closely with the private sector and at international level without boundaries for best practices and experience exchange.

ANNEXES

LIST OF PARTICIPANTS

| No. | Name | Surname | Organization | Occupation |
|-----|------------|-------------|--|----------------------------|
| 1 | Konstantin | Ilchev | Sofia university "St. Kliment Ohridski" | PhD in Physics |
| 2 | Deyan | Doykov | Joint Innovation centre, BAS | Researcher |
| 3 | Nikola | Tomov | UniBIT | Teacher in IT |
| 4 | Elena | Bouzova | Pearson BG | Teachers' trainer |
| 5 | Elena | Karaivanova | Bulgarian Academy of Science | Researcher |
| 6 | Yana | Shopova | Sofia university "St. Kliment Ohridski" | Teacher in Biology |
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| 9 | Julia | Ilcheva | University of mining and geology | Teacher in Mathematics |
| 10 | Veronika | Lozanova | Secondary school Juliot Curie | Educator/Teachers' trainer |

Main conclusions and recommendations:

1. Preparation of teachers:

- More knowledge and trainings are necessary for teachers. It should start with basics, ethical matters, examples, purpose of use and types of AI tools.
- Teaching of teachers about collaboration with external organisations including businesses and interdisciplinary approaches for application of AI and new methods of teaching.

2. Different levels and fields of teaching:

- The new law for school education requires students to select their study programmes (profiles) since age of 14, 8th grade. This means IT-related subject teachers should cover the topics of AI in a more complex way including programming and fundamentals.

3. Collaboration of schools:

- Teachers need to work closer with practitioners as the technology is advancing too fast to react alone.
- There are good examples and best practices for partnership between schools and companies in different aspects and fields – e.g., development of student start-ups, internships, trainings for teachers, etc.
- Business is really open nowadays for collaboration and this opportunity should be taken. They realize the need to future talent for the workforce only in few years. These people are now students in school.

4. Support by the national system and bodies:

- Operational programme Operational Programme Science and Education for Smart Growth
- Erasmus+ programme
- Financial mechanisms by various NGOs, programs and tools
- Existence of platforms like the "digital backpack" developed by the Ministry of Education and Science

- New strategies and reforms with focus on STEM
- Existence of institutes and organisations like INSAIT with the aim to turn Bulgaria into an AI research powerhouse
- 5. Teaching and learning process:**
- AI is purposefully applied when new methods, approaches and models are used in the process.
- The focus is on students' motivation and active work in class as well as extra-curricular activities.
- News assessment methods are sought in the process, too.

GREECE

OVERVIEW AND ORGANISATION

The Focus Group was organized in collaboration with Doukas School and IASA. An invitation was created and sent by email to teachers and educators, as well as AI experts in Greece. The Focus Group was organized online and hosted by Doukas School. The focus group commenced with a short overview of the project, its objectives, goals and current outcomes and then continued with the Policy Recommendation Questions. Participants were informed at the beginning of the session that it would be recorded for the purposes of the report.

TARGET GROUPS

Participants, including professors, associate professors, School Advisors, and Coordinators of Primary Education, contributed diverse insights, enriching the recommendations with perspectives from higher education, school administration, and primary education coordination. This varied input provides a comprehensive understanding of the challenges and opportunities in introducing AI to education.

CONCLUSIONS AND RECOMMENDATIONS

Use the questions to summarize the answers as follow:

Q1: At what age the topic of AI should be introduced in the learning process? Please consider the below points

- *Can students use any type of AI in the learning process?*
- *If yes, at what age do they start?*
- *Should there be different levels of teaching AI: basics in grade ..., intermediary and advanced level at grade/programme of studies..., etc.*

Someone suggested that subjects related to AI should be introduced in the early years of high school. We're moving into an era where AI is becoming an essential tool, and covering its applications in just one lesson is nearly impossible. Another perspective is that AI, in terms of computational thinking, should be integrated into education starting from preschool, adapting the integration approach at each age level. Another participant mentioned the idea of introducing machine learning even at the kindergarten level, aligning with how humans naturally learn. Starting in kindergarten, according to another participant, helps instill a digital knowledge culture in children and students. This is crucial because dealing with technology knowledge beyond basic use or play becomes challenging when a child hasn't been exposed to it early on.

Q2: What are the necessary teaching and learning methods to meet the challenges by AI? (including new ways of assessment and evaluation)

There are three different categories about teaching AI in education. Learn about AI, learn to design with AI, and design for AI with the students. A distinction must also be made between the use of artificial intelligence and the development of artificial intelligence. In addition to simple use, there is development where we can teach how to develop AI agents through Scratch, i.e. programming language for children. Navigating classic programming versus machine learning programming presents a distinct challenge, as the methodology employed in traditional programming diverges significantly from the mindset required for machine learning. This shift entails a complete transformation in programming philosophy.

Q3: What are the key competences and expertise of teachers having in mind:

- *initial training of teachers*
- *pre-service teachers*
- *in-service training of teachers,*
- *which subject teachers should teach AI?*

Effective teachers for teaching AI possess a range of key competences and expertise, encompassing more than just technical knowledge. In addition to confidence, innovation, initiative, problem-solving, critical thinking, action-oriented culture, and curiosity, teachers need horizontal skills that emphasize adaptability to change, an open mind, and acceptance rather than conservatism.

Beyond technical proficiency, educators must instil in students a clear understanding of the results they aim to achieve with AI tools and the appropriate methodologies for utilizing these tools. This involves cultivating a strategic mindset, where users not only comprehend the capabilities of AI but also grasp how to align them with specific goals. The ability to guide students in articulating their objectives and selecting the right tools and methods underscores the teacher's role in fostering a purpose-driven and informed use of AI. This holistic approach ensures that learners not only acquire technical skills but also develop a strategic and ethical perspective when engaging with artificial intelligence technologies.

Q4: Under which learning subject should AI be introduced to the students (i.e. math, computing, sciences, all?)

- *Generating questions related to teaching subjects: Computing*
- *Creating summaries: All subjects*
- *Designing lesson plans: All subjects*
- *Producing content for instructional use (stories, poems, interviews with historical figures): All subjects*
- *Building quizzes: Math, Computing*
- *Correcting assignments and usage by students (comparing with real texts, recognizing AI-generated texts, correcting and enriching AI-generated texts): Computing*

Q5: What is the least necessary equipment and technology for initial AI implementations? (e.g., hardware, software, learning spaces, etc.)

For initial AI implementations, minimal equipment suffices, such as basic laptops or desktops for coding and experimentation using generic programming languages. Advanced hardware accelerators, specialized learning spaces, and extensive datasets are not imperative at the beginning. Basic integrated development environments and accessible online resources can provide a solid foundation

for understanding fundamental AI concepts before exploring more complex frameworks or technologies.

Q6: Are there any serious restrictions and challenges to be considered? (technological capacity of schools, teachers' competences, parents' role for and against it, GDPR, difficulties to make changes in the curriculum and syllabuses)

Cost poses a significant challenge, and a noteworthy hurdle lies in the shift of mindset. A forthcoming and formidable obstacle is the fact that IT educators are typically versed in and have been trained to teach programming in the conventional manner, rather than in the domain of machine learning.

Q7: What are the main opportunities, good practices and other examples to ease the smooth introduction of AI in school systems?

With simple concrete examples being the quick answer. Also, one participant mentioned that because it is the third year that they have introduced the course of computational thinking in kindergarten, it has already begun and it shows the result, which is amazing, and they did not expect it. Teachers noticed a difference in first grade. And it's really the digital alphabet, computational thinking in preschool. A separate curriculum has been created that has no digital tools, i.e. everything is for computational thinking without the use of computers or other screens (with bee bots). Also, games in space for students, involving movement, direction, orientation and classification. AI could even be used as an inspiration tool if by capturing an idea in an LLM you ask it to produce a relevant result.

Examples:

- *Magic School (www.magicschool.ai): An AI platform that includes various tools for educators and students (Summary creation from YouTube videos, generated questions from YouTube videos, suggestions for addressing student behavior issues, vocabulary lists, Text Scaffold, Conceptual Understanding Generator, Student Feedback Tool, etc.)*
- *Twee (<https://app.twee.com/>): Converts YouTube videos into text, generates questions from videos or text, creates quizzes and tests, includes grammar exercises, and provides ideas for home assignments.*
- *Diffit (<https://beta.diffit.me>): Analyzes a topic to be taught, generates questions about it, outlines the basic vocabulary, and presents essential information. It transforms text to be comprehensible for various age levels.*

Q8: What are the national strategic goals for AI in education? Is there any introduction of AI ethics?

The Ministry of Education confirms that computational thinking should be introduced as early as preschool education without devices in lessons and included in the curriculum. With the basic principles of how we classify, how we direct for example with very basic things that we encounter with the spiral model constantly in front of us.

Q9: What is the main support to be provided by the public authorities in your country including financial mechanisms?

A workshop was mentioned that focuses on the "Pedagogical Utilization of Artificial Intelligence in eTwinning Projects and Classroom Teaching." It spans approximately 6 months, from October 2023 to May 2024, with a minimum weekly time commitment of around 3 hours. The workshop has attracted over 1200 educators. As Artificial Intelligence plays an increasingly significant role and already influences education, it is transforming how schools, educators, and students operate. The workshop explores the impact of artificial intelligence on education within this context.

Q10: Do you have any other suggestions not covered by the above questions?

One person mentioned that they use AI in college through a learning analytics system to quickly figure out which students might be struggling and what kind of support they need in physics and math. They keep tabs on this through learning analytics to identify students who had challenges before entering college and might give up if not supported in time. They've implemented habits like weekly assignments, questions after each lesson, and a mix of Scrum and other elements to reduce the chances of students dropping out. Additionally, AI tools provide reinforcement learning and even offer results and suggestions beyond traditional prediction models.

ANNEXES

LIST OF PARTICIPANTS

| No. | Name | Surname | Organization | Occupation |
|-----|--------------|--------------|-----------------------------|----------------------------------|
| 1 | Konstantinos | Petridis | University of Crete | Associate professor |
| 2 | Tasos | Ladias | Greek Ministry of Education | School IT Advisor |
| 3 | Konstantinos | Mantes | Open University of Cyprus | Professor |
| 4 | Maria | Philippi | Doukas School | Head of Digital Education |
| 5 | Petros | Provelengios | Greek Ministry of Education | Coordinator of Primary Education |

BEST PRACTICES

| BEST PRACTICES/EXAMPLES |
|---|
| AI Agents with Scratch Computational thinking in kindergarten: A separate curriculum with no digital tools, i.e. without the use of computers or other screens (with the use of bee bots). xGames in space for students, involving movement, direction, orientation and classification. |
| Main conclusions and recommendations: |
| Introduce AI concepts early in the learning process, considering a gradual integration from preschool to high school. Consider the introduction of computational thinking and basic AI concepts in kindergarten to foster digital knowledge culture. Implement a tiered approach to teaching AI, covering learning about AI, designing with AI, and eventually designing for AI. Recognize the distinction between using AI tools and developing AI, including hands-on development opportunities. Equip teachers with not only technical knowledge but also key competences such as adaptability, innovation, and a strategic mindset. Acknowledge challenges such as cost, mindset shifts, and the need for teacher retraining. |

Embrace successful examples, like the introduction of computational thinking in kindergarten without digital tools, yielding positive results.

Utilize AI for quick insights, as demonstrated by a college using learning analytics to identify struggling students and provide timely support.

OVERVIEW AND ORGANISATION

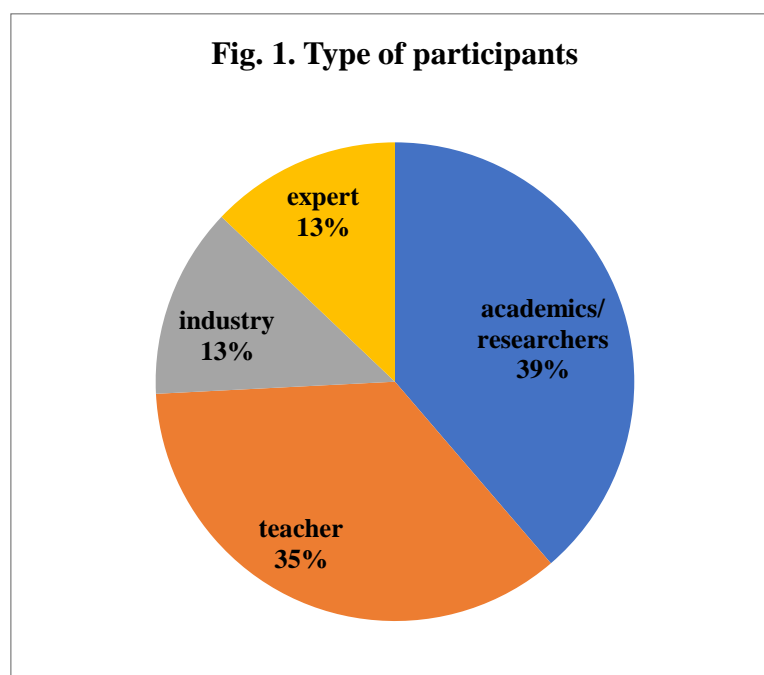
As director of USH Probusiness and Vahahia HUB, prof. Lianu Costin sent online official invitations to many academics/researchers and industry personalities. As dean of Engineering and Informatics Faculty in Spiru Haret University, prof. Grigore Albeanu sent online official invitation to many teachers and experts in the field. The meeting was held online on Monday 27 .11 at 10.30.

The focus group result will be disseminated within project website, social media, ITC classes, other convex classes, industry field. Based on project results and focus group results we will design a policy recommendation report to be available for Ministry of Education and other national organization with decision in the field.

TARGET GROUPS

The focus group was attended by:

- ✓ **12 academics/researchers (39%)** from ICI Bucuresti, Institutul Național pentru Fizica Laserilor, Plasmei și Radiației, Agentia Spatuala Română si diferite universitati,
- ✓ **11 teachers (35%)** from Colegiul National de Informatică, Tudor Vianu, Liceul Teoretic Mihai Eminescu, Cluj Napoca, Colegiul National Nicolae Bălcescu, Brăila, Colegiul Național Tudor Vladimirescu, Tg Jiu, Liceul Teoretic Alexandru Ghica, Alexandria, Școala Gimnaziala nr.28, Galați, Colegiul Spiru Haret, Ploiesti, Colegiul National Ienachita Vacarescu, Targoviste, Inspector Scolar ISJ Cluj, Scoala Gimnaziala Conțești, Dâmbovița, Școala gimnazială Săgeata, Buzău
- ✓ **4 industry (13%)** from DAPYX Solutions SRL, București, ITC Bucuresti, F.B.N. Alset SRL, private company
- ✓ **4 experts (13%)** from Liceul Teoretic Nicolae Balcescu, Cluj-Napoca, Clubul elevilor Spiru Haret, Bârlad, Colegiul National Gh. M. Murgoci, Braila, Academia Oamenilor de Stiinta din Romania.



CONCLUSIONS AND RECOMMENDATIONS

Q1: At what age the topic of AI should be introduced in the learning process? Please consider the below points

- *Can pupils use any type of AI in the learning process?*
- *If yes, at what age do they start?*
- *Should there be different levels of teaching AI: basics in grade ..., intermediary and advanced level at grade/programme of studies..., etc.*

Academics/ researchers believe that AI might be incorporated in different applications. Some of them believe that the subject can be introduced from the first grades, teaching children how to use AI as a learning tool, not as a substitute for learning. The subject of AI should be introduced as early as possible, probably even at the age of 10, after children have learned to write, read and count, because anyway they will interact with AI at home. Others believe that subject IA should be introduced gradually, in the learning process, starting with the 7th grade (or even earlier, the 5th grade) or the 8th grade. 3 academics believe that pupils cannot use any type of AI in the learning process, and 3 of them are of the opposite opinion. A point of view was expressed regarding the ethics of IT development should be inserted into a general education discipline and notions of AI in high school, in informatics.

Teachers consider Introducing the subject of Artificial Intelligence (AI) into learning can begin gradually, starting at younger ages and expanding as pupils progress through the learning cycles, but it is important to adapt content and teaching methods to the level of cognitive development of pupils. The pupils can study AI from the 5th grade: for example basics 5th and 6th grade, intermediate 7th, 8th and 9th grade, advanced 10th-12th grade. Thus, the introduction of Artificial Intelligence (AI) concepts into the learning process can vary depending on several factors, and the appropriate strategy depends on the educational objectives, the level of preparation of the pupils and the available resources.

Age of AI in Learning:

- Middle school classes: Basic concepts of AI can be integrated through a more playful and interactive approach. Educational games or simple projects can facilitate understanding of fundamental concepts such as algorithms and data processing.

- High school grades: More complex aspects of AI, such as machine learning and neural networks, can be covered in these stages. Pupils can begin to develop more advanced projects and understand how AI can be applied in various fields.

- At the gymnasium and at different learning levels

The **industry** considers that the basic concepts of AI can be introduced even at the primary school level. At this age, pupils can begin to understand simple concepts related to algorithms, logical thinking, and how computers can be used to solve problems. They can also start using AI-based tools to improve their learning, but educational programs must adjust the difficulty of the materials according to the pupils' level of understanding. They can be introduced even in primary school. AI can be taught at different levels of complexity, for example: elementary level (primary and secondary schools), where the focus is on understanding basic concepts and developing critical and logical thinking; intermediate level (high school), where pupils can learn more complex algorithms, programming and the use of AI in various fields; advanced level (university and graduate programs),

where more complex topics such as machine learning, neural networks, ethics in AI, and applications in research and industry can be explored.

Some **experts** consider the access to AI from the youngest ages: “I believe that AI applications should be introduced under parental control from kindergarten, for the development of education through games, respecting the rules of navigation in the cyber ecosystem. The basics should be taught, institutionally, in primary education classes. These must include numerous presentations of situations and practical exercises through which a child can differentiate cyber threats and risks from the constructive challenges of current life”. The others consider that 5th grade would be a better solution.

Q2: What are the necessary teaching and learning methods to meet the challenges by AI? (including new ways of assessment and evaluation)

Academics/ researchers believe that AI should support learning through data interpretation and the provision of personalized learning, which allows bridging learning gaps. This objective also includes AI-powered and computerized assessment. The "Hybrid" method (physical presence + online learning) can provide efficiency for teaching and learning. Learning using online modules (open-source platforms) can provide personalized learning to each student.

- ✓ Teaching and learning to meet the challenges posed by artificial intelligence (AI) requires a holistic approach that incorporates technical, ethical and social aspects of AI.
- ✓ Here are some important teaching and learning methods for this purpose:
- ✓ Teaching AI fundamentals: University or online courses dedicated to AI, covering algorithms, machine learning techniques, deep learning, natural language processing, computer vision and other relevant fields.
- ✓ Practical exercises: Working with real datasets and AI development platforms to gain practical skills in developing and implementing AI models.
- ✓ Interdisciplinarity: Promote collaboration between disciplines as diverse as computer science, mathematics, psychology, ethics and sociology to understand the complex implications of AI in society.
- ✓ Ethical approach: Include courses or modules that focus on ethical aspects of AI, such as human rights, responsibility in AI development, and prevention of algorithmic discrimination.
- ✓ Communication and argumentation: Teaching communication and argumentation skills to help pupils express their ideas and concerns about AI in a coherent and effective way.
- ✓ Understanding social impact: study the effects of AI on the economy, jobs, health, education and other fields to understand and address social and economic challenges.
- ✓ Practical projects and collaborations: Development of group projects addressing AI issues in a real-world context, such as developing applications to solve social or environmental problems.
- ✓ Lifelong learning: Encourage pupils and AI professionals to continue their lifelong learning as technology changes rapidly.
- ✓ Events and conferences: Attend AI-related conferences and events to stay up-to-date with the latest developments and interact with professionals in the field.
- ✓ Global approach: AI teaching and learning should be global and take into account cultural and geographical diversity to address the specific challenges of each region.

Teachers are in consensus with researchers. They also provide information regarding assessment methods: digital portfolios, continuous assessment and constant feedback, certifications and recognition of digital skills and educational games.

The use of AI in the learning process:

- ✓ Pupils can be encouraged to explore tools and platforms that integrate AI into the learning process, including assisting with problem solving, customizing learning materials, or even creating AI-involved projects.
- ✓ It is essential to have adequate supervision and guidance to ensure that pupils properly understand the concepts and applications of AI. Teachers should play an active role in guiding pupils in exploring this area.

The **industry and experts** also mentions the methods above and the use of online and open source resources, global and contextual awareness, blended learning system, intensive IA classes.

Q3: What are the key competences and expertise of teachers having in mind:

- *initial training of teachers*
- *pre-service teachers*
- *in-service training of teachers,*
- *which subject teachers should teach AI?*

Academics/ researchers believe that the key competences required of teachers to successfully teach artificial intelligence (AI) in schools vary depending on the level of experience and stage of professional development. Some relevant competencies for each category:

1. Initial teacher education:

1.1 Fundamental understanding of AI concepts: Teachers should have a solid foundation in understanding basic concepts of AI, such as algorithms, machine learning, and neural networks.

1.2 Programming skills: Knowledge of programming languages relevant to AI development, such as Python, is essential to be able to create and implement AI models.

1.3 Pedagogy and teaching methodology: Teachers need to be prepared to tailor AI content to pupils' level and needs and develop effective teaching methods.

1.4 Communication and interaction: Communication skills to explain AI concepts in an accessible way to pupils and facilitate interactive discussions and activities.

2. Teachers in training:

2.1 AI curriculum: Familiarity with the curriculum and resources available for teaching AI in schools.

2.2 Practical projects: Developing skills to create and coordinate practical AI-related projects in an educational context.

2.3 Observation and support: Opportunities to observe experienced teachers teaching AI and receive feedback and guidance.

2.4 Lifelong learning: Preparing to continue learning and updating with AI as technology evolves.

3. In-service teacher education:

3.1 Update knowledge: Attend training courses and workshops to stay up-to-date with the latest developments in AI.

3.2 Development of teaching skills: Refine AI-specific teaching and learning techniques to improve the effectiveness of education.

3.3 Collaboration with experts: Collaborate with AI specialists and educators to improve the approach to AI teaching.

4. Topics teachers should teach in an AI context may include:

4.1 Introduction to AI: Definitions, history, and scopes of AI.

4.2 Algorithms and data structures: Fundamentals of algorithms and data structures relevant to AI.

4.3 Machine learning: Basic concepts and techniques such as classification and regression.

4.4 Deep learning: Neural networks, convolutional deep learning, and recurrent deep learning.

4.5 Applications of AI: Case studies and practical examples in various fields such as natural language processing, computer vision and robotics.

4.6 Ethics and social impact: Discussions about AI ethics, responsibility in AI development, and prevention of algorithmic discrimination.

4.7 Project development: Create practical projects where pupils can apply the knowledge gained in developing AI models.

The **teachers** are in consensus with academics. They also emphasize that addressing topics related to diversity and inclusion in the context of AI, highlighting the importance of diversity in the development and application of this technology are recommended.

The **industry and experts** have similar opinions

- ✓ Initial teacher education: technological competences, innovative teaching methodologies, critical and analytical thinking, communication and presentation skills
- ✓ Teachers in training: pedagogical practice, educational design, feedback and reflection, collaboration and professional learning
- ✓ In-service teacher training: updating technological knowledge, continuous professional development, pedagogical innovation, educational leadership
- ✓ topics to teach in the context of AI: fundamentals of AI, ethics and responsibility in AI, applications of AI, programming and algorithms, impact of AI on the job market, literacy in data and statistics"
- ✓ Practical applications of AI (presentation of how AI is used in different fields such as medicine, transport and industry), AI-based projects and experiments (organisation of practical activities where pupils can experiment and apply concepts related to AI), ethics and social implications of AI (discussing the impact of AI on society, including ethical issues, bias, privacy and security), critical and creative thinking (encouraging pupils to think critically about technology and explore creative solutions to AI-related problems)."

Q4: Under which learning subject should AI be introduced to the pupils (i.e. math, computing, sciences, all?)

Academics/ researchers, teachers, industry and specialist are in consensus. They believe that the decision to introduce AI into the curriculum may also depend on the educational goals of the country or school concerned. Overall, a comprehensive approach that includes multiple disciplines can be

beneficial to develop a deeper understanding of AI and its applications. AI should be taught especially in Computer Science, Mathematics, for algorithms and Science - for applicability, ethics and collaboration, but it can be extended to all subjects.

Q5: What is the least necessary equipment and technology for initial AI implementations? (e.g., hardware, software, learning spaces, etc.)

It is important to note that resources and needs may vary depending on the level of AI introduction (eg, basic or advanced), the number of pupils involved, and the educational goals. Initial implementation can start with minimal resources and grow as the AI teaching program develops and resources become more available. As minimum infrastructure requirements for the initial implementation of IA **academics** mentioned Hardware, software, learning spaces, IT laboratory, internet access.

The teachers gave some examples of infrastructure requirements:

- ✓ Hardware: Computers or Laptops and for more complex projects access to Servers or Cloud Computing:
- ✓ Software: development platform (such as Jupyter Notebook or PyCharm to write, test and execute Python code), Programming Environments (Python,...); Cloud Computing Platforms (MS Azure)
- ✓ Online Educational Platforms: Access to online educational platforms that offer courses and educational resources in the field of AI, such as Coursera or Khan Academy.
- ✓ Connectivity and Networks: High Speed Internet Access, fast internet connectivity to enable access to online resources and real-time collaboration.
- ✓ Reliable Network Infrastructure: A stable and secure network infrastructure to ensure the efficient transfer of data and information.
- ✓ Training and Support: Access to online educational resources and training platforms to support AI teacher training.
- ✓ Technical Support: Providing adequate technical support for teachers and pupils in the effective management and use of AI technologies.
- ✓ Security and Privacy: Implementing cybersecurity measures to protect sensitive data and prevent potential threats.
- ✓ Privacy Policies: Developing and enforcing clear privacy policies to protect pupils' personal information and data."

The **industry and experts** agreed with the same infrastructure, but they also mentioned interactive whiteboards, VR systems.

Q6: Are there any serious restrictions and challenges to be considered? (technological capacity of schools, teachers' competences, parents' role for and against it, GDPR, difficulties to make changes in the curriculum and syllabuses)

The **academics/researchers** believe that introducing AI into schools can provide pupils with valuable opportunities to learn and prepare for the ever-changing technological world, and help develop the skills needed for the future. Solutions may vary depending on the specific context of each school or country, but the approach must be carefully planned and tailored to overcome potential obstacles. As restrictions were mentioned the GDPR agreement, ethical considerations, the competences of teaching staff, the level of understanding of pupils, usefulness, applicability, the difficulties of making changes in the curriculum and school programs, the technological capacity of schools, the deterrence of plagiarism through the use of AI tools.

Someone said: “The first challenge is the awareness of the fact that AI exists and does not disappear if we do not use it in education. Any evolution meets resistance, but I believe that every teachers can make a difference”.

The **teachers** are in consensus with academics. They also mentioned as restrictions the differences between rural/urban schools, social inequalities, informing parents, and ethics and responsibility of AI implementation/ utilization, the role of parents regarding AI.

The **industry and specialists** consider that above the information already mentioned, the process of reviewing changes to curricula and school programs can be lengthy and arduous. They talk about

- Cross-disciplinary integration: The difficulty of seamlessly incorporating artificial intelligence (AI) into the curriculum while maintaining its current structure.

- Standardization: Guaranteeing equitable access to resources for all educational institutions and maintaining a benchmark for the caliber of AI training.

They also added: equity in education (ensuring that all pupils, regardless of background or school resources, have equal access to AI education), continuous updating of content (AI is a field in rapidly evolving, so learning materials and teaching resources need to be constantly updated), assessment and feedback (developing assessment and feedback methods that are relevant to AI-related competencies), ethical aspects of AI (integrating discussions of ethics, social impact and responsibility in the use of AI).

Q7: What are the main opportunities, good practices and other examples to ease the smooth introduction of AI in school systems?

The **academics/researchers** believe the AI:

Opportunities are:

- ✓ knowing the consequences of using AI, training teachers, discussing the elements of ethics and responsibility in the use of AI.

Good practices:

- ✓ partnerships with industry, knowledge of ethical principles, educational resources, collaboration between schools, communities and the business environment to provide pupils with opportunities to connect with experts and understand the practical applications of AI.

The **teachers** believe that the AI

Opportunities are:

1. Development of specialized courses or modules covering the fundamental concepts of AI, adapted to the level and capabilities of the pupils.
2. Involvement of AI specialists in the learning process, either through teaching sessions, presentations or hands-on projects.
3. Promoting the use of online platforms and resources that provide interactive educational materials and games to make learning about AI more attractive.

Good practices:

1. Starting with basic concepts and gradually increasing the complexity according to the pupils' progress and interest.
2. Identifying ways in which AI concepts can be integrated into existing subjects, creating relevant connections with other fields.
3. Offer regular feedback and formative assessment to guide student progress and identify areas for improvement.
4. Emphasis is placed on hands-on projects and activities that involve developing practical skills in using and understanding AI.

Practical examples:

1. Organizing AI project events or competitions in the school to encourage active and competitive student engagement.
2. Using online platforms that provide interactive resources such as virtual experiments and simulations.
3. Inviting AI specialists for presentations or school visits to share their experiences and inspire pupils.
4. Finding material in any field, simulations, using testers, finding defects, deficiencies, 3D representations, etc.

The industry believes that the AI

Opportunities are: developing skills for a future career (pupils can acquire essential skills for future careers, including critical thinking, solving complex problems and understanding emerging technologies), interdisciplinary collaborations (AI offers opportunities for interdisciplinary projects, linking computational sciences, mathematics, social sciences and even arts), ethics in technology (discussions about AI provide excellent opportunities for exploring the topics of ethics and digital responsibility), personalization of education (the use of AI in education allows the personalization of the learning process, adapting it to the level and needs of each student).

Best practices: integrated curriculum (integrating AI into existing curriculum in relevant and applicable ways such as math, science, and social studies), teacher training (providing resources and continuing education for teachers to help them understand and effectively teach AI-related topics), use of online resources and MOOCs (inclusion of online educational resources such as open online courses (MOOCs), which provide additional lessons and study material), AI-based projects (implementation of AI-based projects that allow pupils to apply knowledge in practical situations), collaborations with industry and universities (partnerships with companies and academic institutions can provide additional resources and practical insights).

Discussions: Ethics and Social Implications of AI (discussing ethical and social issues related to AI, including algorithm bias, data privacy, and impact on jobs), Tackling Technology Anxiety (addressing AI fears and anxieties, including concerns about automation and the impact on the future of jobs), inclusiveness (ensuring that all pupils have equal access to AI learning resources), adaptability and flexibility (openness to changes and adaptations in curriculum and teaching methods, taking into account the rapid evolution of AI technology)."

The **experts** consider:

Opportunities - physical and cyber games for training skills and for strengthening the knowledge taught, online collaborations between members of the ad hoc group (per class, organized around a goal, etc.)

Good practices - models of total/partial inclusion in the institutional environment, in forcing parents to apply parental control and in offering support for educational programs

Q8: What are the national strategic goals for AI in education? Is there any introduction of AI ethics?

The **academics/ researchers** consider that national strategic goals for artificial intelligence (AI) in education may vary from country to country, depending on each country's specific priorities and needs. However, there are some general goals and global trends related to the introduction of AI into the education system education:

1. Developing technological skills: A key objective is to develop technological skills and digital literacy among pupils so that they are prepared for an increasingly digitized world.
2. Promoting critical and creative thinking: AI education should promote critical and creative thinking, and pupils should learn how to approach complex problems and develop innovative solutions using AI.
3. Increasing interest in science and technology: The introduction of AI can increase pupils' interest in science, technology, engineering and mathematics (STEM), which can help develop the future technology workforce.
4. AI ethics and responsibility: AI education should include discussion and training on ethics and responsibility in the development and use of AI, to form responsible and aware citizens.
5. Equity and access: An important goal is to ensure that all pupils, regardless of their socio-economic or geographic background, have access to quality AI education and adequate resources.
6. Professional development of teachers: Training and professional development of teachers is essential to ensure that they can effectively teach AI and guide pupils in learning this technology.

In terms of introducing AI ethics into education, this is becoming increasingly important as AI technology spreads throughout society. Ethics-related objectives may include:

1. Understanding of ethical principles: Pupils should understand the basic ethical principles that must be applied in the development and use of AI, such as human rights, transparency and non-discrimination.
2. Responsibility and consent: Discussions about the responsibility of AI developers and the importance of obtaining consent for the collection and use of personal data.
3. Social and economic impact: Pupils should be aware of the impact that AI can have on society and the economy, including jobs and the environment.
4. Addressing ethical issues in AI development: AI education should encourage pupils to develop ethical solutions to AI-related issues and be able to discuss and debate these issues.

In conclusion, national strategic goals for AI in education include developing technological skills, promoting critical thinking and creativity, increasing interest in STEM, addressing the ethics and responsibility of AI, and ensuring equal access to education. Introducing AI ethics into the educational

curriculum is an important trend to prepare pupils to understand and properly approach AI technology in an increasingly digitized society.

The **teachers** mentioned 3 strategic objectives (OS) for Romania

OS3.1. Development of fundamental and applied scientific research specific to the field of AI, as well as at an interdisciplinary level

OS3.2. Reducing the fragmentation of AI R&D resources and efforts by conjugating and synchronizing them within specialized national innovation centers and groups connected to international AI centers and resources

OS3.3. Supporting and promoting AI innovation

The **industry** mentioned the strategic objective of Facilitate AI project and the Decision of the Superior Council of National Defense no. 148/27.09.2022, the Interinstitutional Commission for the elaboration of Romania's National Strategy for Artificial Intelligence was established (<https://www.mcid.gov.ro/strategia-inteligenta-artificiala/>). Within the Ministry of Research, Innovation and Digitization, the Scientific and Ethical Council in Artificial Intelligence was also established, which includes renowned specialists to provide expertise in the development of AI in Romania (<https://www.mcid.gov.ro/sistemul-de-cercetare/organisme-consultative/consiliul-stiintific-si-de-etica-in-inteligenta-artificiala/>).

The **experts** affirm that there is an optional discipline for grade 11th -12th. There is a 2023-2027 national strategic framework developed by the Authority for Digitization of Romania and a coordinated EU AI Plan and a National Strategy in the field of AI at the Ministry of Research.

Q9: What is the main support to be provided by the public authorities in your country including financial mechanisms?

The **academics/ researchers** consider that in order to facilitate the successful introduction of AI in education in Romania, public authorities must adopt a comprehensive approach and allocate adequate resources to support both teachers and pupils in this constantly developing field, they have to offer financial mechanisms, professional training, educational resources and collaboration with interested parties can contribute to the achievement of these objectives with binding educational policies, financial and infrastructure support, access to the database and access to software licenses and increased awareness among staff teaching about AI.

The **teachers** also mention the:

- ✓ Sponsorships for the purchase of necessary didactic materials, to ensure the link between different fields of activity, to provide legislative support, programs for grants in schools, especially through PNRAS, training courses for teachers.
- ✓ Advice and Guidance: Funds to develop educational policies to guide the integration of AI into the curriculum and to provide assistance and consultation in the implementation process.
- ✓ Regulatory Compliance: Investments to ensure compliance with data protection regulations and ethics in the use of AI technologies in education.

The **industry and specialists** think the institutional and regulatory support refer at:

- ✓ Initiate and implement educational policies that advocate for the incorporation of artificial intelligence (AI) principles throughout the system. This may involve making necessary adjustments to curricula and learning standards.
- ✓ Legislation to promote educational equity: Establish regulations that guarantee fair access to AI education for every student, regardless of their socioeconomic status.
- ✓ Financial assistance - Allocating dedicated funds for technology equipment, educational resources and teacher training programs constitutes direct funding for schools; Innovative Projects Grants and Grants: Making grants available to educators and institutions creating innovative educational projects related to artificial intelligence.; Promoting public-private partnerships that foster collaboration between the public and private sectors to provide financial resources and assistance for educational initiatives related to artificial intelligence.
- ✓ Support for teachers: Implementation of training and professional development initiatives: Coordinating seminars, workshops and courses to help teachers acquire the necessary skills to teach artificial intelligence; Provision of teaching resources and materials: Provision of software and teaching materials for the purpose of improving artificial intelligence pedagogy.
- ✓ Foundations and resources: Investing in high-speed Internet connections and modern hardware and software for educational institutions is one way to improve the technology infrastructure; Establishing AI centers and labs of excellence: Build dedicated environments that facilitate student learning and exploration of AI technologies.
- ✓ Collaboration and joint ventures: Promote collaborations between academic institutions and research universities and higher education institutions to facilitate the exchange of resources and knowledge; Establishing industry connections: Fostering partnerships with companies in the technology sector to provide hands-on learning opportunities and access to specialist professional knowledge for pupils.
- ✓ Assessment and observation: Evaluating the Impact of Initiatives: Monitoring and consistently evaluating the effects that artificial intelligence is having on educational initiatives and programs; Continuous adaptation of strategies: The ability to modify approaches in response to technological advances and evolving educational requirements.
- ✓ Main elements of support: funding and grants (investment in technological infrastructure: allocating funds to modernize IT infrastructure in schools and universities, including the purchase of hardware and software necessary for AI; research grants and subsidies: providing grants and subsidies for research in the field of AI, including for collaborative projects between educational institutions and industries; financial incentive program: creation of an incentive program for schools and universities that develop and implement educational programs related to AI), development of curriculum and educational programs (support for curriculum development: assistance in developing and updating curricula to include AI and related subjects professional training for teachers: funding professional training programs for teachers to help them effectively teach AI-related subjects public-private partnerships (collaborations with industry: encouraging partnerships between the public educational sector and private technology companies to facilitate the transfer of knowledge and resources; internship and mentorship programs: creating internship and mentorship programs with the support of companies in the AI industry), policies and regulations (innovation-friendly legislation: adopting policies and regulations to facilitate AI innovation and development, including data protection and ethics issues ; creating centers of excellence: supporting the establishment of AI centers of excellence to serve as hubs for research, innovation and education).

Q10: Do you have any other suggestions not covered by the above questions?

The **academics/ researchers** the involvement of decision-makers and the provision of schools with the necessary equipment and the teacher's obligation to use AI every hour.

Some **industry** said that there are pros and cons opinions about ChatGPT in the educational process. High school students already have access to ChatGPT and are even encouraged by teachers to use it.

The **specialists** recommend forming an AI community, among teachers, and creating open resources for teaching, learning, evaluating various subjects, using AI and collaboration of ministries involved, collaboration of universities - CCD - school units. They also recommend as the Ministry of Education should generate a scientometrics based on quality if quality is desired. Currently, all the rules are based on statistical analyzes that follow but the quantity. A teacher/trainer must report the number of works and that's about it, regardless of their quality or the situation in which a quality work can be the result of a project spanning a period of several years.

ANNEXES

LIST OF PARTICIPANTS

| No. | Name | Surname | Organization | Occupation |
|-----|----------------|----------------|---|-----------------------|
| 1 | Ella Magdalena | Ciuperca | ICI Bucuresti | academics/researchers |
| 2 | Alina Gabriela | Boca | Colegiul National de Informatică, Tudor Vianu | teacher |
| 3 | Marius Iulian | Mihailescu | DAPYX Solutions SRL, București | industry |
| 4 | Stefania | Nita | ITC Bucuresti | industry |
| 5 | Gheorghe | Carmocanu | Liceul Teoretic Mihai Eminescu, Cluj Napoca | teacher |
| 6 | Adriana | Cheres | Liceul Teoretic Nicolae Balcescu, Cluj-Napoca | expert |
| 7 | Nusa | Dumitriu-Lupan | Clubul elevilor Spiru Haret, Bârlad | expert |
| 8 | Aurelia | Stroe | COLEGIUL NATIONAL NICOLAE BALCESCU, BRAILA | teacher |
| 9 | Set | Nadia | F.B.N. Alset SRL | industry |
| 10 | Cristina Elena | Anton | Colegiul National Gh. M. Murgoci, Braila | expert |
| 11 | Valentina | Marascu | Institutul Național pentru Fizica Laserilor, Plasmei și Radiației | academics/researchers |
| 12 | Mihaela | Pîrvulescu | Colegiul Național Tudor Vladimirescu, Tg Jiu | teacher |
| 13 | Alina | Luchian | Companie privată | industry |

| | | | | |
|----|-----------------|------------|---|-----------------------|
| 14 | Daniela Ioana | Tataru | Liceul Teoretic Alexandru Ghica, Alexandria | teacher |
| 15 | Ulpia | Botezatu | Agentia Spatiala Română | academics/researchers |
| 16 | Dragos | Iordache | ICI Bucuresti | academics/researchers |
| 17 | Rodica | Tirim | Școala Gimnaziala nr.28, Galați | teacher |
| 18 | Magdalena | Iorga | Universitate | academics/researchers |
| 19 | Luminita | Radu | Colegiul Spiru Haret, Ploiesti | teacher |
| 20 | Adrian | Pricop | Universitatea Națională de știință si tehnologie Politehnica, București | academics/researchers |
| 21 | Carmen | Grigoroiu | Universitatea Națională de știință si tehnologie Politehnica, București | academics/researchers |
| 22 | Camelia | Branet | Universitatea Națională de știință si tehnologie Politehnica, București | academics/researchers |
| 23 | Nicolae | Cruceru | Institutul de Speologie Emil Racoviță, Academia Româna; Universitatea din București | academics/researchers |
| 24 | Olga | Bucovetchi | Universitatea Națională de știință si tehnologie Politehnica, București | academics/researchers |
| 25 | Sorin | Topor | Academia Oamenilor de Stiinta din Romania | expert |
| 26 | Alin | Zamfiroiu | ICI Bucuresti | academics/researchers |
| 27 | Cătălina Estera | Vlad | Colegiul National Ienachita Vacarescu, Targoviste | teacher |
| 28 | Ionut | Petre | ICI Bucuresti | academics/researchers |
| 29 | Marian | Dragoi | Universitatea din Suceava | academics/researchers |
| 30 | Adrian | Pintea | Inspector Scolar ISJ Cluj | teacher |
| 31 | Elena | Paraschiv | ICI Bucuresti | academics/researchers |
| 32 | Elena | Maruntelu | Scoala Gimnaziala Conțești, Dâmbovița | teacher |
| 33 | Marcel | Sultanescu | Școala gimnazială Săgeata, Buzău | teacher |

Main conclusions and recommendations:

The potential of AI in education seems to be exhaustive!

AI may be used in a progressive way through many applications in various academic subjects. While some experts believe that AI may be gradually introduced as early as kindergarten, others believe that the fifth grade is the ideal age to begin interacting with it.

AI's Age of Learning:

- ✓ Classes in middle school: AI fundamentals may be included with a more lighthearted and participatory style. Basic projects or instructional games can help students grasp basic ideas like data processing and algorithms.
- ✓ High school grades: During this time, students can study about more advanced AI topics like machine learning and neural networks. Students can start working on increasingly complex projects and learn how artificial intelligence can be used in a variety of sectors.- At the gymnasium and at different learning levels
- ✓ Artificial intelligence (AI) presents issues for teaching and learning that need for a comprehensive strategy that takes into account the social, ethical, and technological components of AI. For this reason, the following crucial teaching and learning strategies are listed: instructing students on the principles of AI, Exercises that are practical, Multidisciplinary moral methodology, Speaking and debating, Recognizing the societal implications, Realistic undertakings and partnerships, lifetime education, Conferences and events, worldwide strategy.

The key competences and expertise of teachers having in mind:

- ✓ Fundamental understanding of AI concepts.
- ✓ Knowledge of programming languages relevant to AI development, such as Python, is essential to be able to create and implement AI models.
- ✓ Teachers need to be prepared to tailor AI content to pupils' level and needs and develop effective teaching methods.
- ✓ Communication skills to explain AI concepts in an accessible way to pupils and facilitate interactive discussions and activities.
- ✓ Familiarity with the curriculum and resources available for teaching AI in schools.
- ✓ Create and coordinate practical AI-related projects in an educational context.
- ✓ Observation and support: Opportunities to observe experienced teachers teaching AI and receive feedback and guidance.
- ✓ Preparing to continue learning and updating with AI as technology evolves.
- ✓ Update knowledge
- ✓ Development of teaching skills
- ✓ Collaborate with AI specialists and educators to improve the approach to AI teaching.
- ✓ The infrastructure requirements for teaching AI:
 - ✓ Hardware: Computers or Laptops and for more complex projects access to Servers or Cloud Computing:
 - ✓ Software: development platform (such as Jupyter Notebook or PyCharm to write, test and execute Python code), Programming Environments (Python and other); Cloud Computing Platforms (MS Azure)
 - ✓ Online Educational Platforms: that offer courses and educational resources in the field of AI (such as Coursera or Khan Academy) and Training and Technical Support for teachers
 - ✓ Connectivity and Networks: High Speed Internet Access, fast internet connectivity to enable access to online resources and real-time collaboration and a stable and secure network infrastructure.
 - ✓ Security and Privacy: Implementing cybersecurity measures to protect sensitive data and prevent potential threats.
 - ✓ Privacy Policies: Developing and enforcing clear privacy policies to protect pupils' personal information and data.

The GDPR agreement, ethical concerns, the proficiency of teaching staff, the comprehension level of students, usefulness, applicability, the challenges of implementing curriculum and program changes, the technological capacity of schools, the use of AI tools to deter plagiarism, financial constraints, technological limitations, legislative climate, etc. were mentioned as limitations on the use of AI in teaching. Someone said: "The first challenge is the awareness of the fact that AI exists and does not disappear if we do not use it in education. Any evolution meets resistance, but I believe that every teacher can make a difference, the role of parents regarding AI".

National strategic goals for AI in education include developing technological skills, promoting critical thinking and creativity, increasing interest in STEM, addressing the ethics and responsibility of AI, and ensuring equal access to education. Introducing AI ethics into the educational curriculum is an important trend to prepare pupils to understand and properly approach AI technology in an increasingly digitized society. There is a 2023-2027 national strategic framework developed by the Authority for Digitization of Romania and a coordinated EU AI Plan and a National Strategy in the field of AI at the Ministry of Research.

3 strategic objectives for Romanian system were mentioned:

OS3.1. Development of fundamental and applied scientific research specific to the field of AI, as well as at an interdisciplinary level

OS3.2. Reducing the fragmentation of AI R&D resources and efforts by conjugating and synchronizing them within specialized national innovation centers and groups connected to international AI centers and resources

OS3.3. Supporting and promoting AI innovation

In order to enable the effective integration of artificial intelligence (AI) into education in Romania, public authorities need to take a comprehensive approach and provide sufficient funding to assist educators and students in this rapidly evolving field. They also need to collaborate with interested parties and offer financial mechanisms, professional development, and educational resources. Moreover, enforceable policies, infrastructure support, database access, software license access, and greater awareness of AI among teaching staff are all necessary to help achieve these goals.

One expert concluded: "AI in education is a challenge! The importance of teacher training is crucial to create a change that meets the needs of pupils. The design of the curriculum for the Future is done now, if we design based on the experience gained previously and involve AI in education, as an adaptation to the digital society in continuous evolution!"

PORTUGAL

OVERVIEW AND ORGANISATION

The Focus Group was organized in collaboration with the School of Management and Technology, Polytechnic Institute of Porto. An invitation was created and sent by email to teachers and educators and researchers in Portugal. The Focus Group was organized online and hosted by the School of Management and Technology, Polytechnic Institute of Porto. After an initial introduction of the project and contextualization of its objectives the discussion regarding policy recommendations was initiated. Participants allowed the capture of audio and video from the meeting for the purposes of this report.

TARGET GROUPS

Participants in this focus groups included 3 elements with experience teaching in secondary schools in Portugal, grades 7-12. The other elements are currently teachers in Higher Professional Technical Courses in Portugal and also researchers in the field of AI.

CONCLUSIONS AND RECOMMENDATIONS

Q1: At what age the topic of AI should be introduced in the learning process? Please consider the below points

- *Can students use any type of AI in the learning process?*

There was a consensus in the focus group that the introduction of AI in learning process should be done sooner than later. It is irrevocable that students are exposed to AI from an early age, and it is best to educate and shape consciousness of AI its use, benefits and implications. Current generations of students can be considered digital natives, and AI is being adopted a mainstream tool in most if not all fields. Thus, the focus group deliberated that, not allowing, or refusing this scenario will not stop the use of AI as a tool for current and future students.

- *If yes, at what age do they start?*

According to the focus group the rather than debating the age, is more useful to debate how AI is taught and exposed to students. AI can be introduced in an early age perhaps even sooner than grade 7, as long as, the materials are adapted to the psychological and cognitive capabilities of students.

- *Should there be different levels of teaching AI: basics in grade ..., intermediary and advanced level at grade/programme of studies..., etc.*

Despite all participants agreeing that there should be different levels of teaching AI, there was a debate on how these levels should be defined. If in an initial grade there should be a basics demonstration of tools and experimentation, in intermediate and advanced levels the requirements may be adjusted to the curricular path of a particular group of students.

Q2: What are the necessary teaching and learning methods to meet the challenges by AI? (including new ways of assessment and evaluation)

Teaching AI in 7-12 may require different learning methods used the classroom. The participants in the focus group determined that although the expositive and demonstrative methods could be used an introduction of AI concepts there were perhaps better approaches.

From this discussion the focus group proposed the consideration of the following learning methods: flipped classroom, station rotation and tutorials and guided worksheets. The objective is to make students active participants in the learning process, increase motivation and foster active learning.

Q3: What are the key competences and expertise of teachers having in mind:

- *initial training of teachers*

From the experience and knowledge of the focus group, in Portugal there is a need for training teachers which will have the responsibility to teach AI. It is proposed to consider not only, initial training for teachers but also study cycles in which teachers can experiment, observe and improve skills related to teaching AI.

- *pre-service teachers*
- *in-service training of teachers,*

Both pre-service and in-service training was deemed valid by the study group. The main justification is the ever-changing scope and applications of AI currently being adopted in mainstream scenarios. The pace at which this field evolves is much faster than traditional ones.

- *which subject teachers should teach AI?*

The participants in the focus group agreed that the natural option would be teacher with expertise in informatics and knowledgeable in AI. However, it was discussed that perhaps there could be a certification of teachers to teach AI as an additional competence acquired through training such as study cycles. This could be a strategy to enlarge the population of teachers able to teach AI.

Q4: Under which learning subject should AI be introduced to the students (i.e. math, computing, sciences, all?)

Due to the several faces of AI, the focus group, agreed that, perhaps, the learning of AI can be introduced in almost every learning subject. It is a question of selecting an implementation close to the field of expertise of each subject. A conservative approach could only include computing sciences, math, and languages. However, the focus group also suggested the inclusion of AI learning in subjects such as philosophy, so the student can assess and discuss the adoption of AI in society, its benefits and implications and opportunities and threats.

Q5: What is the least necessary equipment and technology for initial AI implementations? (e.g., hardware, software, learning spaces, etc.)

AI is currently directly associated with computer sciences and although there could be some interesting alternatives the focus deliberated a classroom with computers and an internet connection the least necessary equipment. Other alternatives could include mobile devices, and dedicated hardware for AI tasks. For instance, in the case of augmented reality an augmented reality headset could allow different experiences, but as it is not strictly necessary the focus group agreed upon the suggested minimal equipment proposed above.

Q6: Are there any serious restrictions and challenges to be considered? (technological capacity of schools, teachers' competences, parents' role for and against it, GDPR, difficulties to make changes in the curriculum and syllabuses)

There are some challenges identified with teaching AI. As state before teachers training is a key challenge to consider. Also, school regulations could also have to be revised as some schools are currently limiting student access to AI tools or outright forbidding their use. Both at school or for any subject assignments. An evolution of mentalities and a coherent message by ministry of education, schoolboards need to accommodate the need for teaching AI and accept its existence.

Other valid points of concern include changes in the curriculum and syllabuses as, currently most subjects have extensive curricular programs without much time to spare including learning AI. It is a

serious concern demonstrated by all of the focus group participants which also struggle to meet all curriculum objectives within the time provided.

Q7: What are the main opportunities, good practices and other examples to ease the smooth introduction of AI in school systems?

The current generation of students is already considered a digital native generation and very skilled in the use of digital tools. Including the learning of AI, has the main opportunity to shape how students use those tools and educate them about their value, what is acceptable and what is not. Instead of ignoring what already exists, a better approach is to incorporate new tools in learning process. In the focus group one participant compare the AI tools as the appearance of calculators in the field of mathematics. Though there was also some resistance to their use, today they are accepted as a tool that students can use. If we incorporate these tools, then we necessarily also make teachers aware and understanding of such tools. This creates the opportunity to change learning process and, perhaps, increase learning outcomes.

Q8: What are the national strategic goals for AI in education? Is there any introduction of AI ethics?

The participants of the focus group are unaware of any national strategy for AI or AI ethics in education in Portugal. Some of the participants, included in the focus group, teaching grades 7-12 in Portugal state that there are exercised with AI tools in some education manuals for some subjects, such as technologies of information and communications, but as it is not a standard directive from the ministry of education, not all available manuals for those subjects have them. As added context, in the case of the Portuguese reality each schools may choose the manual from an existing list of option and two student from different schools may have different manuals for the same subject.

Q9: What is the main support to be provided by the public authorities in your country including financial mechanisms?

The focus group interpreted this question to fund the education of AI in schools in Portugal. Although there is no direct initiative for AI, there are some initiatives that can be used towards such objective.

Schools can apply for the creation of technological centers and laboratories of digital learning. Though these initiatives do not require AI, school can provide such experiences to students. Other alternative are the laboratories of digital education which again bring the focus on digital environments and not necessarily AI.

The focus group stated that the learning system is still oriented to digital learning and does not take the learning of AI as a fundamental necessity. In a way, although these initiatives could create the conditions to learn AI in school they are necessary geared towards such objective.

Q10: Do you have any other suggestions not covered by the above questions?

Following the discussion generated by the above questions, the focus group stated some suggestions to include in creation of AI learning curriculums. For instance, ethics and challenges of AI applications should be presented as topics of discussion and experimentation for students. AI as a tool is not always a perfect tool and a critical conscience need to be developed by all participants in the teaching of AI. Other suggestions included an introduction to AI regulation, EU AI regulation and responsibility in the use of AI tools.

ANNEXES

LIST OF PARTICIPANTS

| No. | Name | Surname | Organization | Occupation |
|-----|--------|-----------|--|----------------------|
| 1 | David | Teixeira | High School of Felgueiras | Teacher |
| 2 | José | Ribeiro | School of Management and Technology, Polytechnic Institute of Porto | Teacher / Researcher |
| 3 | João | Fonseca | High School of Lousada | Teacher |
| 4 | Miguel | Guimarães | School of Management and Technology, Polytechnic Institute of Porto | Teacher / Reseacher |
| 5 | Sérgio | Gonçalves | High School of Martins Sarmiento | Teacher |

In the below template you can generate the list with all participants including information about their profile. (Try to generate at least one example).

| Main conclusions and recommendations: |
|--|
| <ul style="list-style-type: none"> 1 – Inclusion of different level for AI learning based on skill and curricular path of students 2 – Create strategies for training teacher to become able to teach AI 3 – Adapt curricular programs to include and make possible the teaching AI 4 – Inquiry education ministry for guidelines for AI in school 5 – Promote evangelization of AI opportunities and benefits to educators and school administrators 6 – Challenge students with characteristic of AI tools regarding ethics, regulation and responsibility |

CYPRUS

OVERVIEW AND ORGANISATION

The Focus Group was organized in collaboration with the University of Cyprus. An invitation was created and sent by email to teachers and educators, as well as AI experts in Cyprus. The Focus Group was organized online and hosted by the Cyprus Mathematical Society. The focus group commenced with a short overview of the project, its objectives, goals and current outcomes and then continued with the Policy Recommendation Questions. Participants were informed at the beginning of the session that it would be recorded for the purposes of the report.

TARGET GROUPS

Participants varied, from Math teachers and teacher trainers, to STEAM Teachers and academics/post-doc researchers. One of the participants came from the Cyprus Pedagogical Institute, associate partner of the Facilitate-AI project.

CONCLUSIONS AND RECOMMENDATIONS

Use the questions to summarize the answers as follow:

Q1: At what age the topic of AI should be introduced in the learning process? Please consider the below points

- *Can students use any type of AI in the learning process?*

According to the participants' responses, it is believed that students are much more advanced and confident with technology, than teachers. Students can use any type of AI in the learning process and in any module, granted that the learning objectives are clear. Students can be exposed very early to the basic ideas that thinking can be studied in a systematic way and hence that it can be automated to a certain degree. Students can grow with this idea that machines can think.

- *If yes, at what age do they start?*

Even pre-school students have the ability to learn through AI. A lot of tools have been in their lives from a very young age. Teachers can use these tools to convey learning definitions and content.

- *Should there be different levels of teaching AI: basics in grade ..., intermediary and advanced level at grade/programme of studies..., etc.*

Teaching AI can start from a very young age through the style of communication. Then, as students grow older, it can be used for more complex activities/questions and definitions. What is important is that the activities introduced in class, align with the curriculum so that they are current and relevant.

Q2: What are the necessary teaching and learning methods to meet the challenges by AI? (including new ways of assessment and evaluation)

AI tools and apps exist under all learning subjects, hence, all learning subjects can incorporate AI in the learning process. However, it is important to distinguish the learning outcome: Does the teacher want to teach how to programme AI code, or how to use AI properly? For instance, IT classes can be used to teach students how to programme AI. So, it all depends on whether one wants to be a creator of AI code or a user of AI code.

Another thing to keep in mind is that using AI in the teaching process is still at an introductory stage and there is still a long way to go in order for AI to be fully integrated in class. As a starting point, teachers can use introductory AI activities under any module.

Another participant said that students need to be able to separate the process of solving problems by simply applying a known solution with the process of using underlying knowledge to put together a solution. Hence methods that promote analytical and critical thinking are of importance. Also methods that help students develop a clear form of expression are needed.

Finally, it is important that evaluation and self-improvement mechanisms are established, in order to facilitate teachers with the teaching process, as these mechanisms are non-existent at the moment.

Q3: What are the key competences and expertise of teachers having in mind:

- *initial training of teachers*
- *pre-service teachers*

- *in-service training of teachers,*
- *which subject teachers should teach AI?*

Participants claimed that initial training of teachers and training of pre-service teachers are not that much important, rather than what experiences a teacher can bring through AI Activities. Furthermore, with the rapid development of AI, what is of outmost importance is the knowledge educators should have on adaptability to change, so that they can adapt their learning content and always be up-to-date.

Another participant claimed that they need to be able to explain to the students the ideas of analytical, critical thinking and clear form of expression. They need to be able to illustrate these ideas with the use of AI systems showing how they help us achieve these qualities in problem solving. It is very important that teachers are able to generate examples using AI tools for this task: theory should be combined with concrete examples from the use of AI technology.

Q4: Under which learning subject should AI be introduced to the students (i.e. math, computing, sciences, all?)

Focus Group participants agree that AI can be taught through all modules, Geography, Math, Art, Physics, etc. All modules can integrate AI in the learning process. It is also recommended that AI should be taught using STEAME Education, where educators can combine two or more modules in order to provide a more holistic approach to AI learning.

Another participant supports that it is better to have a separate bespoke series of modules for AI as AI is a multi-discipline.

One challenge is that the huge growth of AI in the past year intrudes with the school and HE curriculum. For this reason, activities should be designed for all modules, where educators and students can serve as users. New tools that facilitate immensely one's job are constantly being published. These activities can be enriched with such new tools, along with a continuous content update system, so that all information is up to date.

Q5: What is the least necessary equipment and technology for initial AI implementations? (e.g., hardware, software, learning spaces, etc.)

Nothing special is required. Access to generative and conversational AI platforms is sufficient.

Q6: Are there any serious restrictions and challenges to be considered? (technological capacity of schools, teachers' competences, parents' role for and against it, GDPR, difficulties to make changes in the curriculum and syllabuses)

There is certainly a difficulty to make changes to the current curriculum. This is why AI should be aligned with the curriculum and its teaching should be implemented in the form of small and no time-consuming activities that can take place within one learning hour.

Another participant suggests that the main difficulty is that of the cultural change that AI although a scientific field it is also a humanities field: AI is a horizontal universal from Philosophy of Ethics to the Science of Computation.

Q7: What are the main opportunities, good practices and other examples to ease the smooth introduction of AI in school systems?

There are examples and suggestions, but they must be incorporated by the Ministry of Education, to make the situation more directed in the teaching process. Educators and teachers do not adopt some things easily and therefore they must be given very specific instructions. With training this can be achieved. Furthermore, a feedback system is needed within the education system. Central action is recommended so that teachers can access important information such as where or how an activity can take place in the classroom and always be up-to-date with important advancements.

Another participant mentioned that in order to ease the smooth introduction of AI in school systems, AI education needs to start early with the large picture of systematizing human thought from Mathematics to Dialectic Oratory. See also above Q1-Q3.

Q8: What are the national strategic goals for AI in education? Is there any introduction of AI ethics?

There are no strategic goals for the introduction of AI in education, per se. This is why an interdisciplinary approach is recommended.

Q9: What is the main support to be provided by the public authorities in your country including financial mechanisms?

There is no support provided at the moment.

Q10: Do you have any other suggestions not covered by the above questions?

As mentioned above Education needs a major reform to include horizontally a multidisciplinary AI track to accompany language, mathematics and science.

ANNEXES

LIST OF PARTICIPANTS

| No. | Name | Surname | Organization | Occupation |
|-----|-----------|--------------|------------------------------|--------------------------------|
| 1 | Kyriacos | Mattheou | Livadia High School | Mathematics Teacher |
| 2 | Eleni | Papageorgiou | Cyprus Pedagogical Institute | Teacher Trainer in Mathematics |
| 3 | Andreas | Demetriou | The English School | Mathematics Teacher |
| 4 | Stavroula | Neokleous | The English School | Assistant Head |
| 5 | Yiannis | Lazarou | Pagkyprion Gymnasion | STEAM Mathematics Teacher |
| 6 | Savvas | Savvides | | PostDoc Researcher |

Main conclusions and recommendations:

1. Early Introduction of AI:

- Participants suggest introducing AI at an early age, even in pre-school, as students are familiar with technology from a young age.
- Emphasis on the fact that students can use various types of AI in the learning process, provided that learning objectives are clear.

2. Integration Across Subjects:

- Recommendation that AI should be taught across all subjects, including Geography, Math, Art, Physics, etc.
- Recommendation to start using STEAME Education (Science, Technology, Engineering, Arts, Mathematics, and Ethics) for a holistic approach to AI learning.

3. Different Levels of Teaching AI:

- Teaching AI at different levels, starting with basic communication styles at a young age and progressing to more complex activities as students grow older.
- Highlighting the importance of aligning AI activities with the curriculum for relevance.

4. Teaching and Learning Methods:

- Stressing the need to distinguish between teaching how to program AI code and how to use AI properly.
- Recommending methods that promote analytical and critical thinking, along with clear forms of expression.
- Acknowledging that using AI in teaching is still in its introductory stage, and suggests starting with basic AI activities.

5. Teacher Competencies and Training:

- Emphasis on the importance of teachers' adaptability to change and staying up-to-date with AI developments.
- Recognizing the significance of teachers being able to explain analytical and critical thinking concepts using AI systems.

6. Curriculum Alignment:

- Acknowledging the challenge of making changes to the curriculum but suggests aligning AI with the existing curriculum through small, non-time-consuming activities.
- Highlighting the cultural change aspect of AI, emphasizing its interdisciplinary nature from Ethics to the Science of Computation.

7. Opportunities and Good Practices:

- Recommending specific instructions and training for educators to adopt new practices easily.
- Calling for a feedback system within the education system to keep teachers informed about advancements and activities in the classroom.

8. National Strategic Goals:

- Questioning the national strategic goals for AI in education and proposition of considering the introduction of AI ethics.

9. Support from Public Authorities:

- Discussing the need for support from public authorities, including financial mechanisms, to facilitate the integration of AI in education.

10. Overall Reform in Education:

- Advocating for a major reform in education to include a multidisciplinary AI track alongside language, mathematics, and science.

ITALY

OVERVIEW AND ORGANIZATION

The Focus Group was organized at ITC Morante in Limbiate on December 13th 2023. An invitation was created and sent by email to teachers, educators, university students, as well as managers. The Focus Group was organized and hosted by the ITC Morante of Limbiate on site and open to an online attendance as well.

The focus group followed the multiplier event. The participants, a smaller group with respect to the multiplier event, were able to have an overview of the project, its objectives, goals and current outcomes and then continued with the Policy Recommendation Questions. Participants' attendance was recorded by signing their presence on the report sheet for statistical and reporting purposes.

TARGET GROUPS

The participation in the event was open to a diverse audience to gather multiple perspectives and to collect inputs and feedback from different stakeholders.

Participants in this focus group were teachers in middle schools (grades 6-8), teachers of High Secondary Technical Schools, some of them expert in the field of AI, Principal of High Secondary Technical Schools, elementary and middle school teachers, school administration members, University student of subjects that involves AI, managers who use AI in industrial environment in Italy.

CONCLUSIONS AND RECOMMENDATIONS

Q1: At what age the topic of AI should be introduced in the learning process? Please consider the following points

- *Can students use any type of AI in the learning process?*
- *If yes, at what age do they start?*
- *Should there be different levels of teaching AI: basics in grade ..., intermediary and advanced level at grade/programme of studies..., etc.*

The question of the minimum age of introduction of AI has seen some different views. Some people have expressed concerns about very young age while others have taken a more open stance. After a quick discussion, however, broad consensus has been reached that there is no minimum age to start using AI. Of course, the contents and teaching methodologies must be modulated on the basis of age. In this regard, the school context is important, but the family context is critical. It is essential that, especially for the young ones, there is adult supervision. This introduces the problem that children often know how to use technological tools better than adults. This may represent a critical factor to be considered in the approach to AI introduction.

Q2: What are the necessary teaching and learning methods to meet the challenges by AI? (including new ways of assessment and evaluation)

Inductive method and reasoning, critical thinking, intuition and the study of algorithms have been pointed out as key elements for building up a robust teaching method for AI. A lexical approach may be useful too. In general, methods should be adjusted by school grade.

Some participants suggested an approach based on different levels. AI is nowadays represented by a very broad range of tools. It is increasingly difficult to generalize, and the teaching methods could be different as well, reflecting this widening of the AI solutions.

An approach based on projects and examples of use is surely to be preferred to a traditional class approach.

It has been highlighted that almost all the Artificial Intelligence algorithms have multiple levels of learning depth:

- Intuition level, meaning the understanding of the possible application of the AI solution and the main uses, without technical explanations.
- Deep dive, which includes the understanding of the mathematical background. This is a specialist level, maybe not suitable for everyone.
- Deployment level, meaning Code writing and deployment (including data cleaning, and data wrangling)

Particular relevance should be given to proceed by gradually experimenting, building on smaller success to show the feasibility of the program and increasing the complexity after some initial simple learnings.

External experts should be involved as well, especially if they can bring real life examples and present in engaging ways.

A point of discussion has been the need to integrate the AI study within the standard curriculum. Merging the two will ensure the best benefits in terms of learning opportunity but it could be initially difficult given the fact that the Teachers must reach a proficiency level on the topic as well, at least in the initial stage of deployment.

Common ground is the fact that the teaching method should give up the traditional approach of cumulative knowledge increase, moving towards an approach that favors a critical selection of relevant info.

Q3: What are the key competences and expertise of teachers having in mind:

- *initial training of teachers*
- *pre-service teachers*
- *in-service training of teachers,*
- *which subject teachers should teach AI?*

AI as we see it today is new compared to educational models of the past. The teachers who are in school today have not received any training regarding AI. Specific and targeted training is necessary for these teachers. They should be enabled to experiment with the various tools that AI offers.

Some participants pointed out that the training for teachers is very important at any level because they all have to master the functions and potentialities AI can offer at different levels and stages of the learning process. For new teachers, even though not specifically studying AI, specific in-depth teaching subjects may already be provided in their courses of study. A participant compared AI to the process of the mobile phone's widespread adoption in society, from a stage of basic and elementary functionalities to its evolution and its daily use in nearly all fields. This means that continuous updating and training is necessary.

According to some teachers, mathematics and ICT are of the utmost importance, according to others the training must be carried out focusing on the reasons it may be used for. Each discipline can benefit from the use of AI and teachers can find the tools that best suit their subjects.

Q4: Under which learning subject should AI be introduced to the students (i.e. math, computing, sciences, all?)

There has been a discussion regarding which learning subject should AI be introduced to the students. The majority of participants think that mathematics and ICT are the subjects mainly involved in the introduction to the students. According to others, all the subjects may be interested. Each subject is compatible, particularly if associated with a specific tool. For example: NLP (Large Language Models) - English and Italian; Machine Learning - Mathematics, Computer Science, Economics; GAN (Generative Adversarial Network) - Art. Others think that AI requires a deep and complex knowledge of its software.

However, if we think that simple forms of AI can be introduced from the first years of life, we certainly cannot talk about disciplines. Again, it depends on what the purpose of using AI is.

Q5: What is the least necessary equipment and technology for initial AI implementations? (e.g., hardware, software, learning spaces, etc.)

First, with beginners, paper and pencil are also fine. In reality, there are many open-source tools and they are often low code/no code tools, so no particular IT skills are needed. Schools and learning institutions should be provided with basic, elementary technologies proper learning environment, online resources, voice and speech recognition, digital assistants

Q6: Are there any serious restrictions and challenges to be considered? (technological capacity of schools, teachers' competences, parents' role for and against it, GDPR, difficulties to make changes in the curriculum and syllabuses)

There aren't proper restrictions but mainly challenges. AI requires an overall change in the school setting, technological equipment and daily organization. Teachers need to get rid of curricular programmes to work with their colleagues in a variety of fields.

Another challenge may be represented by the family and the parents. They need to be trained too and get the competences to support their children in a new learning process.

Q7: What are the main opportunities, good practices and other examples to ease the smooth introduction of AI in school systems?

The first good practice suggested is learning by doing. All teachers should incorporate AI applications during their lessons as a tool to help the development of the lesson. It is necessary to slowly integrate the instrument in the lessons not to abuse it. This is important also to draw boundaries in which teachers and students can use the AI during lessons.

Another practice suggested is the organization of training for teachers in order to properly use the AI during classes. Another tool that can be used is a creation of a network among schools to collect all the best practices concerning AI.

Being able to involve students and making them protagonists and promoters of the concept would be a key element. They could, for instance, lead an AI project and create a podcast where they explain how they have worked and what they have reached.

Q8: What are the national strategic goals for AI in education? Is there any introduction of AI ethics?

The strategic plans and goals are still to be evaluated. All the members of the European Union have been working on a common governance regarding AI.

Concerning this the European Union, after a first attitude of complete “laissez faire” has issued an AI governance which considers the use of AI as a key concept of education.

Q9: What is the main support to be provided by the public authorities in your country including financial mechanisms?

The first step has certainly already been taken, that is, the recognition of the importance of AI. The Italian Prime Minister also clearly underlined how we need to focus on the development of skills regarding AI. Certainly the state must modernize the technological systems of schools, which are sometimes obsolete. Furthermore, it should support teacher training also from a financial point of view. Participation in targeted courses and the in-depth study of these topics is often left to the good will of teachers who use their free time and economic resources.

Q10: Do you have any other suggestions not covered by the above questions?

The introduction of AI into education today is accompanied by STEAME teaching, which projects transversal paths which, although exciting, often require many hours of work. Traditional teaching is still linked to ministerial programs and we teachers often give up on trying out methodologies for fear of not being able to complete the 'programs'. The possibility of being able to design and experiment with new teaching/learning methods would be a great help to the development of new skills.

ANNEXES

LIST OF PARTICIPANTS

| No. | Name | Surname | Organization | Occupation |
|-----|------------------|--------------|----------------------|--|
| 1 | Aniello | Coppola | ITI 'E. Fermi' Desio | Administrative Assistant |
| 2 | Antonio | Sproviero | ITC e Pacle Limbiate | Principal |
| 3 | Antonietta | Miele | ITC e Pacle Limbiate | Coordinator of the innovation team and vice principal |
| 4 | Gessica | Barbieri | ITC e Pacle Limbiate | Administrative Assistant |
| 5 | Veronica | Cutuli | ITC e Pacle Limbiate | Teacher |
| 6 | Angela | Pinetti | | Law teacher |
| 7 | Maria Anna | Di Benedetto | | French teacher |
| 8 | Rosa | Sessa | Comune di Senago | Education Department officer |
| 9 | Piermatteo | Pizzi | Kone | R&D director - Head of Engineering Tools and Variants Management |
| 10 | Giuseppe Alberto | Tunzi | ITC e Pacle Limbiate | Digital Marketing Manager and teacher |
| 11 | Paola | Todesco | ITC e Pacle Limbiate | teacher |
| 12 | Mario | Ardiri | ITC e Pacle Limbiate | Law and Economics teacher |

| | | | | |
|----|------------|-------------|----------------------|---------------------------|
| 13 | Alessandro | Scaglione | ITC e Pacle Limbiate | English teacher |
| 14 | Valeria | Del Vescovo | ITC e Pacle Limbiate | support teacher |
| 15 | Loredana | Ficara | ICPaderno | Italian teacher |
| 16 | Lucia | Giuliani | ICPaderno | Maths and Science teacher |
| 17 | Gianpiero | Famiglietti | ICPaderno | English teacher |
| 18 | Angela | Masino | Gramsci _Paderno D. | Spanish teacher |
| 19 | Donatella | | Allende_ Paderno D. | French teacher |

Main conclusions and recommendations:

1. Minimum age for the Introduction of AI:

- Consensus has been reached that there is no minimum age to start using AI. Of course, the contents and teaching methodologies must be modulated on the basis of age
- Adult supervision could be a driving factor, especially for young age students.

2. Learning Subjects:

- Each discipline can benefit from the use of AI and teachers can find the tools that best suit their subjects

3. Teaching and Learning Methods:

- It has been highlighted that almost all the Artificial Intelligence algorithms have multiple levels of learning depth: Intuition level, deep dive, deployment level. Different levels could be more suitable to different grades.
- Inductive method and reasoning, critical thinking, intuition and the study of algorithms have been pointed out as key elements for building up a robust teaching method for AI.
- Some participants suggested an approach based on different levels. AI is nowadays represented by a very broad range of tools. It is increasingly difficult to generalize, and the teaching methods could be different as well, reflecting this widening of the AI solutions.

4. Key Competencies and Training:

- Specific and targeted training is necessary for these teachers who should be enabled to experiment with the various tools that AI offers.

5. Restrictions and Challenges

There aren't proper restrictions but some challenges should be considered. AI requires an overall change in the school setting, technological equipment and daily organization. Teachers need to get rid of curricular programmes to work with their colleagues in a variety of fields.

6. Good practices:

- The first good practice suggested is learning by doing. All teachers should incorporate AI applications during their lessons avoiding the possible abuse.
- Organization of training for teachers in order to properly use the AI during classes.

- Creation of a network among schools to collect all the best practices concerning AI.
- Being able to involve students and making them protagonists
- The strategic plans and goals are still to be evaluated. All the members of the European Union have been working on a common governance regarding AI.
- Concerning this the European Union, after a first attitude of complete “laissez faire” has issued an AI governance which considers the use of AI as a key concept of education.

7. Public authorities:

- Certainly the state must modernize the technological systems of schools, which are sometimes obsolete.
- Support of the teacher training also from a financial point of view.
- The introduction of AI into education today is accompanied by STEAME teaching, which projects transversal paths which, although exciting, often require many hours of work. Traditional teaching is still linked to ministerial programs and we teachers often give up on trying out methodologies for fear of not being able to complete the 'programs'. The possibility of being able to design and experiment with new teaching/learning methods would be a great help to the development of new skills.

ANNEX II – Policy Recommendations Executive Summaries in Partner Languages

(EN) POLICY RECOMMENDATIONS – EXECUTIVE SUMMARY

The project “Facilitate-AI: Guidelines for facilitating the learning of Artificial Intelligence (AI) by School Students of Grades 7-12” was developed and implemented by nine European partners between February 2022 and January 2024:

- Cyprus Mathematical Society – Cyprus (Coordinating organization)
- University of Plovdiv Paisii Hilendarski – Bulgaria
- Instituto Politécnico Do Porto – Portugal
- Spiru Haret University – Romania
- Prof Ivan Apostolov Private English Language School – Bulgaria
- ITC Paole Morante Limbiate – Italy
- Institute of Accelerating Systems and Application - Greece
- Douka Ekpaideftiria AE-Palladion Lykeion-Doukas School – Greece
- University of Cyprus – Cyprus

The Facilitate-AI project has developed the following results:

- R1. AI Teaching Guide for teachers facilitating the learning of students in grades 7-12
- R2. Training Course for Facilitators of learning in AI-STEAME education
- R3. Dynamic Online Learning Environment with OER on AI in interdisciplinary STEAME school subjects with a set of Blueprint Policy Recommendations

The project has identified recommendations in 6 main areas:

1. Teacher Competencies and Training

- Recognizing the distinction between using AI tools and actively developing AI to provide a foundational understanding and setting the stage for hands-on skill development.
- Equipping teachers with technical knowledge and key competencies such as adaptability, innovation, and strategic thinking.
- Creating strategies for regular teacher training to ensure that educators remain competent in teaching AI and can adapt to evolving AI technologies over time.

2. Levels and fields of teaching

- Setting a minimum age for the introduction of AI to ensure a thoughtful and age-appropriate integration into the curriculum.
- Initiating the introduction of AI concepts from preschool to high school to provide a solid foundation and support a seamless progression of understanding.
- Establishing a tiered approach, covering learning **about** AI, designing **with** AI, and eventually designing **for** AI, to ensure a comprehensive and evolving understanding.

3. Integration Across Subjects

- Tailoring AI learning to different levels to align with students' varying skills and curricular paths, ensuring inclusivity and relevance.
- Fostering collaboration among teachers for the effective implementation of AI education, promoting the exchange of ideas, strategies, and best practices.
- Engaging in partnerships with businesses and other organizations to enrich AI education, offering real-world insights, resources, and opportunities that bridge the gap between academic learning and practical applications.

4. Support by the national system and bodies

- Modifying curricular programs to incorporate the teaching of AI ensuring that it is integrated seamlessly into the educational framework.
- Securing strong support from public authorities, as it drives policy development and resource allocation.
- Advocating AI awareness among educators and school administrators to create understanding of the positive impact of AI on education.

5. Teaching and learning process

- Draw inspiration from successful initiatives, such as the implementation of computational thinking in kindergarten, even in the absence of digital tools, which has shown positive outcomes in early education.
- Utilize AI for quick insights, as demonstrated by a college using learning analytics to identify and support students facing challenges.
- Engage students in discussions about the ethical considerations, regulatory aspects, and responsibilities associated with AI tools to challenge them to think critically and create an understanding of its societal impact.

6. Infrastructure requirements

- Establishing high-speed internet access, fast connectivity, and a stable, secure network infrastructure for accessing online resources and facilitating real-time collaboration.
- Implementing cybersecurity measures and enforcing clear privacy policies to protect sensitive data and create a secure learning environment.
- Integrating reputable online platforms like Coursera or Khan Academy to provide valuable courses and educational resources in the field of AI.

(GR) ΣΥΣΤΑΣΕΙΣ ΠΟΛΙΤΙΚΗΣ – ΣΥΝΤΟΜΗ ΠΕΡΙΓΡΑΦΗ

Το έργο "Facilitate-AI: Κατευθυντήριες γραμμές για τη διευκόλυνση της εκμάθησης της Τεχνητής Νοημοσύνης (TN) από μαθητές των τάξεων 7-12" αναπτύχθηκε και υλοποιήθηκε από εννέα Ευρωπαίους εταίρους μεταξύ Φεβρουαρίου 2022 και Ιανουαρίου 2024:

- Κυπριακή Μαθηματική Εταιρεία - Κύπρος (Συντονιστικός οργανισμός)
- Πανεπιστήμιο της Φιλιππούπολης Paisii Hilendarski - Βουλγαρία
- Πολυτεχνείο του Πόρτο - Πορτογαλία
- Πανεπιστήμιο Spiru Haret - Ρουμανία
- Ιδιωτικό Σχολείο Prof Ivan Apostolon - Βουλγαρία
- ITC Pacla Morante Limbiate - Ιταλία
- Ινστιτούτο Επιταχυντικών Συστημάτων και Εφαρμογών - Ελλάδα
- Εκπαιδευτήρια Δούκα - Ελλάδα
- Πανεπιστήμιο Κύπρου - Κύπρος

Το έργο Facilitate-AI έχει αναπτύξει τα ακόλουθα αποτελέσματα:

- R1. Οδηγός διδασκαλίας AI για εκπαιδευτικούς που διευκολύνουν τη μάθηση των μαθητών δευτεροβάθμιας εκπαίδευσης
- R2. Σεμινάριο κατάρτισης εκπαιδευτικών που διευκολύνουν τη μάθηση AI-STEAME στην εκπαίδευση
- R3. Δυναμικό διαδικτυακό περιβάλλον μάθησης με ανοικτές εκπαιδευτικές πηγές (OER) για την TN, σε διαθεματικά σχολικά μαθήματα STEAME, με ένα προσχέδιο συστάσεων πολιτικής

Το έργο έχει προσδιορίσει συστάσεις σε 6 κύριους τομείς:

1. Ικανότητες και κατάρτιση των εκπαιδευτικών

- Αναγνώριση της διάκρισης μεταξύ της χρήσης των εργαλείων TN και της ενεργού ανάπτυξης TN, για την παροχή θεμελιώδους κατανόησης και δημιουργία των βάσεων για την πρακτική ανάπτυξη δεξιοτήτων.
- Εξοπλισμός των εκπαιδευτικών με τεχνικές γνώσεις και βασικές ικανότητες, όπως η προσαρμοστικότητα, η καινοτομία και η στρατηγική σκέψη.
- Δημιουργία στρατηγικών για την τακτική κατάρτιση των εκπαιδευτικών, ώστε να διασφαλιστεί ότι παραμένουν ικανοί στη διδασκαλία της TN και μπορούν να προσαρμοστούν στις εξελισσόμενες τεχνολογίες της TN με την πάροδο του χρόνου.

2. Επίπεδα και τομείς διδασκαλίας

- Καθορισμός ελάχιστης ηλικίας για την εισαγωγή της TN, ώστε να διασφαλιστεί η προσεκτική και κατάλληλη για την ηλικία ενσωμάτωση στο πρόγραμμα σπουδών.
- Εισαγωγή των εννοιών της TN από την προσχολική ηλικία έως το Λύκειο, ώστε να παρέχεται ένα στέρεο θεμέλιο και να υποστηρίζεται μια απρόσκοπτη εξέλιξη της κατανόησης.

- Καθιέρωση μιας κλιμακωτής προσέγγισης, η οποία θα καλύπτει την εκμάθηση της ΤΝ, τον σχεδιασμό με ΤΝ και τελικά τον σχεδιασμό για ΤΝ, ώστε να εξασφαλιστεί μια ολοκληρωμένη και εξελισσόμενη κατανόηση.

3. Ενσωμάτωση σε όλα τα θέματα

- Προσαρμογή της μάθησης της ΤΝ σε διαφορετικά επίπεδα, ώστε να ευθυγραμμίζεται με τις διαφορετικές δεξιότητες των μαθητών και τα προγράμματα σπουδών, διασφαλίζοντας την ενσωμάτωση και τη συνάφεια.
- Προώθηση της συνεργασίας μεταξύ των εκπαιδευτικών για την αποτελεσματική εφαρμογή της εκπαίδευσης στην ΤΝ, προωθώντας την ανταλλαγή ιδεών, στρατηγικών και βέλτιστων πρακτικών.
- Συμμετοχή σε συνεργασίες με επιχειρήσεις και άλλους οργανισμούς για τον εμπλουτισμό της εκπαίδευσης στην ΤΝ, προσφέροντας πραγματικές γνώσεις, πόρους και ευκαιρίες που γεφυρώνουν το χάσμα μεταξύ της ακαδημαϊκής μάθησης και των πρακτικών εφαρμογών.

4. Στήριξη από το εθνικό εκπαιδευτικό σύστημα και άλλους φορείς

- Τροποποίηση των προγραμμάτων σπουδών για την ενσωμάτωση της διδασκαλίας της ΤΝ, διασφαλίζοντας ότι ενσωματώνεται απρόσκοπτα στο εκπαιδευτικό πλαίσιο.
- Εξασφάλιση ισχυρής υποστήριξης από τις δημόσιες αρχές, καθώς αυτό οδηγεί στην ανάπτυξη πολιτικής και στην κατανομή πόρων.
- Προώθηση της ευαισθητοποίησης των εκπαιδευτικών και των Διευθυντών σχολείων σχετικά με την ΤΝ, ώστε να υπάρξει κατανόηση του θετικού αντίκτυπου της ΤΝ στην εκπαίδευση.

5. Διαδικασία διδασκαλίας και μάθησης

- Άντληση έμπνευσης από επιτυχημένες πρωτοβουλίες, όπως η εφαρμογή της υπολογιστικής σκέψης στο νηπιαγωγείο, ακόμη και χωρίς ψηφιακά εργαλεία, η οποία έχει δείξει θετικά αποτελέσματα στην πρώιμη εκπαίδευση.
- Αξιοποίηση της τεχνητής νοημοσύνης για γρήγορες γνώσεις, όπως έδειξε ένα κολέγιο που χρησιμοποιεί μαθησιακή ανάλυση για να εντοπίσει και να υποστηρίξει τους μαθητές που αντιμετωπίζουν προκλήσεις.
- Εμπλοκή των μαθητών σε συζητήσεις σχετικά με τις ηθικές εκτιμήσεις, τις ρυθμιστικές πτυχές και τις ευθύνες που σχετίζονται με τα εργαλεία τεχνητής νοημοσύνης, ώστε να σκεφτούν κριτικά και να κατανοήσουν τον κοινωνικό αντίκτυπό της.

6. Απαιτήσεις υποδομής

- Δημιουργία πρόσβασης στο διαδίκτυο υψηλής ταχύτητας, γρήγορης συνδεσιμότητας και σταθερής, ασφαλούς δικτυακής υποδομής για την πρόσβαση σε διαδικτυακούς πόρους και τη διευκόλυνση της συνεργασίας σε πραγματικό χρόνο.
- Εφαρμογή μέτρων κυβερνοασφάλειας και επιβολή σαφών πολιτικών προστασίας της ιδιωτικής ζωής για την προστασία ευαίσθητων δεδομένων και τη δημιουργία ασφαλούς μαθησιακού περιβάλλοντος.

- Ενσωμάτωση αξιόπιστων διαδικτυακών πλατφορμών όπως το Coursera ή το Khan Academy για την παροχή πολύτιμων μαθημάτων και εκπαιδευτικών πόρων στον τομέα της ΤΝ.

(RO) POLITICI RECOMANDATE – REZUMAT

Proiectul “Facilitate-AI: Guidelines for facilitating learning of Artificial Intelligence (IA) by School Students of Classes 7-12” a fost dezvoltat și implementat de nouă parteneri europeni între februarie 2022 și ianuarie 2024:

- Cyprus Mathematical Society – Cyprus (Instituție coordonatoare)
- University of Plovdiv Paisii Hilendarski – Bulgaria
- Instituto Politécnico Do Porto – Portugal
- Universitatea Spiru Haret – Romania
- Prof Ivan Apostolov Private English Language School – Bulgaria
- ITC Pacle Morante Limbiate – Italy
- Institute of Accelerating Systems and Application - Greece
- Douka Ekpaideftiria AE-Palladion Lykeion-Doukas School – Greece
- University of Cyprus – Cyprus

Proiectul Facilitate-IA s-a concretizat în următoarele rezultate:

- R1. Ghid de predare a Inteligenței artificiale (IA) pentru profesori care coordonează învățarea elevilor din clasele 7-12
- R2. Curs de formare pentru coordonatorii învățării în programele educaționale AI-STEAME
- R3. Mediu dinamic de învățare online cu RED bazat pe IA în materiile/subiectele școlare interdisciplinare STEAME cu un set de recomandări de politici de implementare IA în educație.

Proiectul propune recomandări în 6 domenii principale:

1. Competențele necesare și formarea profesorului

- Recunoașterea distincției dintre folosirea instrumentelor IA și dezvoltarea activă a IA pentru a oferi o înțelegere fundamentală și pentru a facilita procesul de dezvoltarea abilităților practice.
- Formarea profesorilor cu competențe cheie și cunoștințe tehnice, cum ar fi adaptabilitatea, inovația și gândirea strategică.
- Crearea de strategii pentru formarea continuă profesorilor pentru a se asigura că educatorii au competențe în predarea IA și se pot adapta la evoluția tehnologiilor IA.

2. Niveluri și domenii de predare

- Stabilirea unei vârste minime pentru introducerea IA pentru a asigura o integrare atentă și adecvată vârstei în curriculum.

- Inițierea introducerii conceptelor IA de la preșcolar până la liceu pentru a oferi o bază solidă și pentru a sprijini o progresie fără întreruperi a înțelegerii.
- Stabilirea unei abordări pe niveluri, care să acopere învățarea **despre** IA, proiectarea **cu** IA și, eventual, proiectarea **pentru** IA, pentru a asigura o înțelegere cuprinzătoare și evolutivă.

3. Integrarea IA printredisciplină

- Adaptarea învățării IA la diferite niveluri pentru a se alinia cu diferitele abilități și trasee curriculare ale elevilor, asigurând incluziunea și relevanța.
- Promovarea colaborării între profesori pentru implementarea eficientă a studiului IA, promovarea schimbului de idei, strategii și bune practici.
- Angajarea în parteneriate cu întreprinderi și alte organizații pentru a îmbogăți educația în domeniul IA, oferind perspective, resurse și oportunități din lumea reală care reduc decalajul dintre învățarea academică și aplicațiile practice.

4. Sprijin din partea autorităților naționale și locale

- Modificarea programelor curriculare pentru a încorpora predarea IA, asigurându-se că aceasta este integrată perfect în cadrul educațional.
- Asigurarea unui sprijin puternic din partea autorităților publice pentru a stimula dezvoltarea politicilor și alocarea resurselor.
- Susținerea conștientizării IA în rândul educatorilor și administratorilor școlilor pentru a înțelege impactul pozitiv al IA asupra educației.

5. Procesul de predare și învățare

- Învățarea din inițiative de succes, cum ar fi implementarea gândirii matematice îngrădiniță, chiar și în absența instrumentelor digitale, care a demonstrat rezultate pozitive în educația timpurie.
- Utilizarea IA pentru a obține informații rapide, așa cum a demonstrat un colegiu care a folosit “analiza învățării”, pentru a identifica și sprijini elevii care se confruntă cu provocări.
- Implicarea elevilor în discuții despre considerentele etice, aspectele de reglementare și responsabilitățile asociate cu instrumentele IA pentru a-i provoca să gândească critic și să creeze o înțelegere a impactului său social.

6. Cerințe de infrastructură

- Accesul la internet de mare viteză, conectivitate rapidă și o infrastructură de rețea stabilă și sigură pentru accesarea resurselor online și facilitarea colaborării în timp real.
- Implementarea măsurilor de securitate cibernetică și aplicarea unor politici clare de confidențialitate pentru a proteja datele sensibile și pentru a crea un mediu de învățare sigur.
- Integrarea unor platforme online de renume, cum ar fi Coursera sau Khan Academy, pentru a oferi cursuri și resurse educaționale valoroase în domeniul IA.

(BG) ПРЕПОРЪКИ ЗА РАЗВИТИЕ - ОБОБЩАВАЩО РЕЗЮМЕ

Проектът "Facilitate-AI: Насоки за модерирание на обучението в сферата на Изкуствения интелект (ИИ) на ученици от 7. до 12. клас" е разработен и приложен на практика от девет европейски партньора в периода февруари 2022 и януари 2024:

- Кипърско математическо общество – Кипър (Координираща организация)
- Пловдивски университет "Паисий Хилендарски" – България
- Политически институт на Порто – Португалия
- Университет "Спиру Харет" – Румъния
- Частна езикова гимназия „Проф. Иван Апостолов „– България
- ITC Paole Morante Limbiate – Италия
- Институт за ускоряващи системи и приложения - Гърция
- Douka Ekpaideftiria AE-Palladion Lykeion-Doukas School – Гърция
- Университет на Кипър – Кипър

Проектът Facilitate-AI разработи следните резултати:

- P1. Ръководство за учители, улесняващи преподаването а вна учениците в класове 7-12
- P2. Обучителен курс за обучението в сферата AI-STEAME
- P3. Динамична онлайн среда за обучение в сферата на ИИ с образователни ресурси със свободен достъп по интердисциплинарни учебни предмети STEAME с набор от препоръки за развитие.

Проектът определя следните препоръки в 6 основни области:

1. Компетентности и обучение на учители

- Определяне на разликите между използването на инструментите на изкуствения интелект и активното разработване на такива, за да се осигури основополагащо разбиране и подготовка за практическо развитие на уменията.
- Подпомагане на учителите с технически познания и ключови компетенции като адаптивност, иновации и стратегическо мислене.
- Създаване на стратегии за нвременно обучение на учители, за да се гарантира, че преподавателите остават компетентни в преподаването на ИИ и могат да се адаптират към развиващите се технологии в тази сфера с течение на времето.

2. Нива и сфери на преподаване

- Определяне на минимална възраст за въведение в темите на ИИ за осигуряване на подходяща за възрастта интеграция в учебната програма.
- Инициране на въвеждането на концепции за ИИ от предучилищна възраст до гимназиален етап на обучение, за да се осигури стабилна основа и да се подкрепи успешното усвояване на знания и умения.
- Създаване на стъпаловиден подход, обхващащ изучаването на ИИ, проектирането с ИИ и в крайна сметка програмирането на/с ИИ, за да се осигури цялостно и развиващо се разбиране.

3. Интегриране на учебни предмети

- Приспособяване на обучението по изкуствен интелект към различни нива, за да се приведе в съответствие с различните умения и развитие на учениците, като се гарантира приобщаване и уместност.
- Насърчаване на сътрудничеството между учителите за ефективно прилагане на образованието по ИИ, насърчаване на обмена на идеи, стратегии и добри практики.
- Ангажиране в партньорства с бизнеса и други организации за обогатяване на образованието по ИИ, предлагайки актуални тенденции, ресурси и възможности, които преодоляват пропастта между академичното обучение и практическите приложения.

4. Подкрепа от националната система и органи

- Промяна на учебните програми, с цел включване на темите на ИИ, като се гарантира, че те са интегрирани безпроблемно.
- Осигуряване на силна подкрепа от страна на публичните органи, тъй като тя стимулира разработването на политики и разпределението на ресурсите.
- Повишаване на осведомеността за ИИ сред преподавателите и училищните администратори, за да се създаде разбиране за положителното въздействие на ИИ върху образованието.

5. Учене и преподаване

- Използване на примери и добри практики от успешни инициативи, като например прилагането на техники за в детската градина, дори при липса на цифрови инструменти, което е показало положителни резултати в ранните етапи на образование.
- Използване на ИИ за бързо генериране на идеи, както показва опита на един колеж, използващ анализи на обучението, за да идентифицират предизвикателствата и да се подкрепят студентите.
- Ангажиране на учениците в дискусии относно етичните проблеми, регулаторните аспекти и отговорностите, свързани с инструментите на ИИ, за да се насърчи критичното мислене и разбирането за неговото обществено въздействие.

6. Изисквания за инфраструктура

- Осигуряване на достъп до високоскоростен интернет, свързаност и стабилна, сигурна мрежова инфраструктура за достъп до онлайн ресурси и улесняване на сътрудничеството в реално време.
- Прилагане на мерки за киберсигурност и прилагане на ясни политики за поверителност с цел защита на чувствителните данни и създаване на сигурна учебна среда.
- Интегриране на реномирани онлайн платформи като Coursera или Khan Academy за предоставяне на полезни курсове и образователни ресурси в областта на ИИ.

(IT) MISURE DA ADOTTARE – SINTESI

Il progetto “Facilitate-AI: Linee guida per facilitare l’apprendimento dell’intelligenza artificiale (AI) da parte degli studenti scolastici dei gradi 7-12” è stato sviluppato e implementato da nove partner europei tra febbraio 2022 e gennaio 2024:

- Cyprus Mathematical Society – Cipro (Organizzazione coordinatrice)
- Università di Plovdiv Paisii Hilendarski – Bulgaria
- Instituto Politécnico Do Porto – Portogallo
- Università Spiru Haret – Romania
- Scuola Privata di Lingua Inglese Prof Ivan Apostolov – Bulgaria
- ITC Pacle Morante Limbiate – Italia
- Istituto di Sistemi e Applicazioni di Accelerazione – Grecia
- Douka Ekpaideftiria AE-Palladion Lykeion- Doukas School – Grecia
- Università di Cipro – Cipro

Il progetto Facilitate-AI ha sviluppato i seguenti risultati:

- R1. Guida didattica sull'intelligenza artificiale per insegnanti che facilitano l'apprendimento degli studenti.
- R2. Corso di Formazione per Facilitatori dell'apprendimento nella didattica AI-STEAME
- R3. Ambiente dinamico di formazione Online con OER sull'intelligenza artificiale nella scuola interdisciplinare STEAME, soggetto a una serie di raccomandazioni politiche sul progetto.

Il progetto ha individuato diverse raccomandazioni in 6 aree principali:

1. Competenze e formazione degli insegnanti

- Riconoscere la distinzione tra l’utilizzo degli strumenti di intelligenza artificiale e lo sviluppo attivo dell’intelligenza artificiale per fornire una comprensione fondamentale e preparare il terreno per lo sviluppo di competenze pratiche.
- Fornire agli insegnanti conoscenze tecniche e competenze chiave come adattabilità, innovazione e pensiero strategico.
- Creare strategie per la formazione degli insegnanti per garantire che gli educatori rimangano competenti nell’insegnamento dell’intelligenza artificiale e possano adattarsi all’evoluzione delle tecnologie dell’intelligenza artificiale nel tempo.

2. Livelli e ambiti di insegnamento

- Fissare un’età minima per l’introduzione dell’intelligenza artificiale per garantire un’integrazione ponderata e adeguata all’età nel curriculum.
- Avviare l’introduzione dei concetti di intelligenza artificiale dalla scuola materna alla scuola superiore per fornire una solida base e supportare una progressione fluida della comprensione della stessa.

- Stabilire un approccio a più livelli, che copra l'apprendimento dell'intelligenza artificiale, la progettazione con l'intelligenza artificiale e, infine, la progettazione per l'intelligenza artificiale, per garantire una comprensione completa e in evoluzione.

3. Integrazione tra soggetti

- Adattare l'apprendimento dell'intelligenza artificiale a diversi livelli per allinearlo alle diverse competenze e ai percorsi curriculari degli studenti, garantendo inclusività e pertinenza.
- Promuovere la collaborazione tra gli insegnanti per un'efficace implementazione dell'educazione all'IA, promuovendo lo scambio di idee, strategie e migliori pratiche.
- Impegnarsi in partnership con aziende e altre organizzazioni per arricchire la formazione sull'intelligenza artificiale, offrendo approfondimenti, risorse e opportunità del mondo reale che colmino il divario tra apprendimento accademico e applicazioni pratiche.

4. Sostegno da parte del sistema e degli organismi nazionali

- Modificare i programmi curriculari per incorporare l'insegnamento dell'IA garantendo che sia perfettamente integrato nel quadro educativo.
- Garantire un forte sostegno da parte delle autorità pubbliche, poiché guida lo sviluppo delle politiche e l'allocazione delle risorse.
- Promuovere la consapevolezza dell'IA tra gli educatori e gli amministratori scolastici per creare comprensione dell'impatto positivo dell'IA sull'istruzione.

5. Processo di insegnamento e apprendimento

- Trarre ispirazione da iniziative di successo, come l'implementazione del pensiero computazionale nella scuola dell'infanzia, anche in assenza di strumenti digitali, che ha mostrato risultati positivi nell'educazione dell'infanzia.
- Utilizzare l'intelligenza artificiale per ottenere informazioni rapide, come dimostrato da un college che utilizza l'analisi dell'apprendimento per identificare e supportare gli studenti che affrontano sfide.
- Coinvolgere gli studenti in discussioni sulle considerazioni etiche, sugli aspetti normativi e sulle responsabilità associate agli strumenti di intelligenza artificiale per sfidarli a pensare in modo critico e creare una comprensione del suo impatto sociale.

6. Requisiti infrastrutturali

- Stabilire un accesso a Internet ad alta velocità, una connettività veloce e un'infrastruttura di rete stabile e sicura per accedere alle risorse online e facilitare la collaborazione in tempo reale.
- Implementare misure di sicurezza informatica e applicare chiare politiche sulla privacy per proteggere i dati sensibili e creare un ambiente di apprendimento sicuro.
- Integrazione di piattaforme online affidabili come Coursera o Khan Academy per fornire corsi e risorse formative di valore nel campo dell'intelligenza artificiale.

(PT) RECOMENDAÇÕES SOBRE POLÍTICAS - SUMÁRIO EXECUTIVO

O projeto “Facilitate-AI: Guidelines for facilitating the learning of Artificial Intelligence (AI) by School Students of Grades 7-12” foi desenvolvido e implementado por nove parceiros em países Europeus entre fevereiro de 2022 e janeiro de 2024:

- Sociedade Matemática do Chipre – Chipre (Organização coordenadora)
- Universidade de Plovdiv Paisii Hilendarski – Bulgária
- Instituto Politécnico Do Porto – Portugal
- Universidade Spiru Haret – România
- Escola de Inglês Professor Ivan Apostolov – Bulgária
- ITC Paclé Morante Limbiate – Itália
- Instituto de Aceleração e Aplicação de Sistemas - Grécia
- Escola Douka Ekpaideftiria AE-Palladion Lykeion-Doukas – Grécia
- Universidade do Chipre – Chipre

O projeto Facilitate-AI desenvolveu os seguintes resultados:

- R1. Guia de Ensino de IA para professores, facilitando a aprendizagem de estudantes entre os anos curriculares 7 a 12
- R2. Curso de formação para facilitadores de aprendizagem em educação IA-STEAME
- R3. Ambiente Dinâmico de Aprendizagem Online com Recursos Educativos Abertos (OER) em IA e tópicos interdisciplinares académicos STEAME, com um conjunto modelo de recomendações sobre políticas

O projeto identificou recomendações em 6 áreas principais:

1. Competências e Formação do Docente

- Reconhecer a distinção entre o uso de ferramentas de IA e o desenvolvimento ativo de IA para fornecer uma compreensão fundamental e preparar o terreno para o desenvolvimento prático de competências.
- Dotar os professores de conhecimentos técnicos e competências chave, como adaptabilidade, inovação e pensamento estratégico.
- Criar estratégias para a formação regular de professores, para garantir que os educadores permaneçam competentes no ensino da IA e possam adaptar-se à evolução das tecnologias de IA ao longo do tempo.

2. Níveis e áreas de ensino

- Estabelecer uma idade mínima para a introdução da IA, para garantir uma integração ponderada e adequada à idade no currículo.
- Iniciar a introdução de conceitos de IA desde a pré-escola até ao ensino secundário, para fornecer uma base sólida e apoiar uma progressão contínua da compreensão.
- Estabelecer uma abordagem hierárquica, abrangendo aprender **sobre** IA, projetar **com** IA e, eventualmente, projetar **para** IA, para garantir uma compreensão abrangente e evolutiva.

3. Integração entre tópicos

- Adaptar a aprendizagem da IA a diferentes níveis para se alinhar com as diferentes competências e percursos curriculares dos alunos, garantindo a inclusão e relevância.
- Fomentar a colaboração entre professores para a implementação eficaz da educação em IA, promovendo o intercâmbio de ideias, estratégias e melhores práticas.
- Envolvimento em parcerias com empresas e outras organizações para enriquecer a educação em IA, oferecendo *insights*, recursos e oportunidades do mundo real que preenchem a lacuna entre a aprendizagem académica e aplicações práticas.

4. Apoio do sistema e dos organismos nacionais

- Modificar os programas curriculares para incorporar o ensino da IA, garantindo que esta é integrada sem problemas no quadro educativo.
- Garantir um forte apoio das autoridades públicas, uma vez que impulsiona o desenvolvimento de políticas e a afetação de recursos.
- Defender a sensibilização para a IA entre educadores e administradores escolares, para criar uma consciência do impacto positivo da IA na educação.

5. Processo de ensino e aprendizagem

- Inspirar-se em iniciativas bem-sucedidas, como a implementação do pensamento computacional no jardim de infância, mesmo na ausência de ferramentas digitais, que tem mostrado resultados positivos na educação infantil.
- Utilizar a IA para *insights* rápidos, como demonstrado por uma faculdade usando análises de aprendizagem para identificar e apoiar os alunos que enfrentam desafios.
- Envolver os alunos em discussões sobre as considerações éticas, aspetos regulatórios e responsabilidades associadas às ferramentas de IA para desafiá-los a pensar criticamente e criar uma compreensão de seu impacto social.

6. Requisitos de infraestrutura

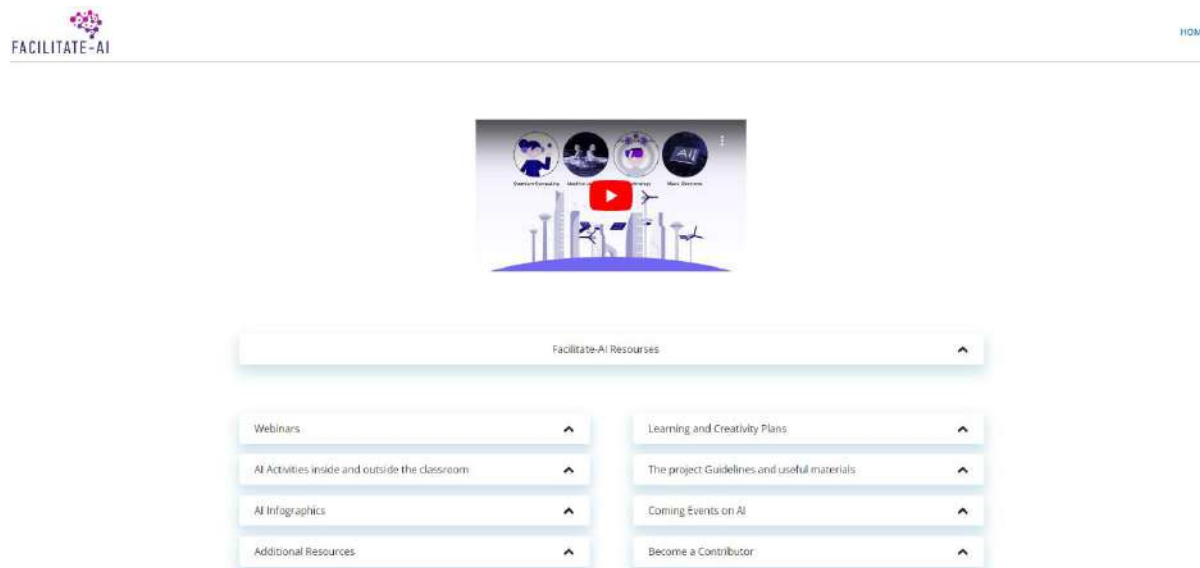
- Estabelecer acesso à Internet de alta velocidade, conectividade rápida e uma infraestrutura de rede estável e segura para aceder a recursos *online* e facilitar a colaboração em tempo real.
- Implementar medidas de cyber-segurança e aplicar políticas de privacidade claras para proteger dados sensíveis e criar um ambiente de aprendizagem seguro.
- Integrar plataformas online reputadas, como o Coursera ou a Khan Academy, para fornecer cursos e recursos educacionais valiosos no campo de AI.

ANNEX III – Design of the Facilitate-AI Learning Environment

The [Facilitate-AI Learning Environment](#) is an innovative platform that includes the [Facilitate-AI Observatory](#) and the [Facilitate-AI Open Education Resource \(OER\)](#). The Facilitate-AI Learning Environment is accessible through the project website: www.facilitate-ai.eu.



I. Facilitate-AI Observatory



The [FACILITATE-AI Observatory](#), accessible via the [FACILITATE-AI PLATFORM](#), is a dynamic resource primarily designed for school teachers. Its main goal is to support the integration and adaptation of a STEAME (Science, Technology, Engineering, Arts, Mathematics, and Entrepreneurship) Curriculum in schools. This platform is not only continually updated with new content, but it also encourages teachers from Europe and beyond to contribute and stay informed.

Teachers can share a variety of resources on the platform, such as Learning and Creativity Plans (a novel approach to lesson planning), information about schools conducting FACILITATE-AI activities,

details of FACILITATE-AI-related training courses, descriptions of FACILITATE-AI experiments or tasks performed in schools, related videos, and information about past and upcoming FACILITATE-AI events. The platform is continuously evolving, with more features and options being added.

The FACILITATE-AI Observatory is a valuable resource for educators seeking to incorporate AI and STEAME subjects into their teaching, offering a collaborative and growing repository of knowledge and tools.

II. Facilitate-AI OER



For the development of the Facilitate-AI OER, Moodle was utilized. Moodle is a widely used open-source learning management system (LMS), known for its flexibility and robust functionality. Below is a detailed description of its technical characteristics, capabilities, and how it benefits both teachers and students:

1. Technical Characteristics:

- **Open-Source:** Moodle is open-source software, meaning it's free to use and can be modified by anyone. This allows for a high degree of customization.
- **Platform Independent:** It runs on multiple platforms, including Windows, macOS, and Linux.
- **Language Support:** Moodle supports multiple languages, making it accessible to a global audience.
- **Scalability:** It's designed to scale from small classes to large university environments with thousands of students.
- **Security:** Regular updates and a large community contribute to its strong security features.

2. Capabilities:

- **Course Creation and Management:** Teachers can create and manage courses, including uploading course material, creating assignments, and organizing resources.
- **Assessment Tools:** Moodle provides various assessment tools like quizzes, assignments, and workshops, allowing for both automated and manual grading.
- **Collaboration Tools:** It includes forums, wikis, and databases to facilitate collaboration among students and between students and teachers.
- **Customization:** Users can customize Moodle with plugins and themes to suit their specific needs.
- **Tracking and Reporting:** Moodle tracks student progress and activity, offering detailed reports for teachers to monitor and assess student performance.

3. Benefits for Teachers:

- **Efficient Course Management:** Teachers can easily create, update, and manage courses and content.
- **Flexible Teaching Methods:** Moodle supports various teaching methodologies, from traditional learning to blended and online learning.
- **Automated Processes:** Grading and feedback can be partially or fully automated, saving time and effort.
- **Resource Sharing:** Teachers can share resources and collaborate with colleagues within and across institutions.

4. Benefits for Students:

- **Accessible Learning:** Students can access materials and participate in courses anytime, anywhere.
- **Interactive Learning Experience:** Various interactive tools and resources enhance the learning experience.
- **Self-Paced Learning:** Moodle allows students to learn at their own pace, revisiting materials as needed.
- **Collaboration and Communication:** Features like forums and group projects facilitate peer-to-peer interaction and teamwork.

5. Why Educational Institutions Choose Moodle:

- **Cost-Effective:** Being open-source, it's free to use, which is particularly appealing to educational institutions with limited budgets.
- **Customizability:** Institutions can tailor Moodle to their specific needs.
- **Community Support:** A large community of users and developers continuously improves the platform.

- **Proven Track Record:** Moodle's widespread adoption and positive feedback from educational institutions worldwide testify to its reliability and effectiveness.

Moodle's combination of flexibility, comprehensive features, and strong community support makes it a popular choice among educational institutions of all sizes and types.

1. Assessment Tools:

- **Diverse Assessment Types:** Moodle supports various types of assessments, including quizzes, essays, and practical assignments. It allows for multiple-choice questions, true/false questions, short answer, and other question formats.

- **Automated Feedback and Grading:** Many types of assessments can be graded automatically, providing instant feedback to students. For subjective assessments, Moodle facilitates streamlined manual grading.

- **Rubrics and Marking Guides:** Educators can create detailed rubrics and marking guides, enhancing the transparency and consistency of grading.

- **Peer and Self-Assessment:** Moodle supports peer and self-assessment activities, encouraging students to engage critically with their own and others' work.

2. Collaboration Tools:

- **Forums:** Moodle's forums are a versatile tool for discussion, encouraging student interaction and facilitating class discussions.

- **Wikis:** Wikis in Moodle allow students to collaboratively create and edit a collection of web pages. This is particularly useful for group projects and collaborative learning activities.

- **Workshops:** The workshop activity enables students to submit and peer-assess each other's projects. This interactive process helps in developing critical thinking and self-evaluation skills.

- **Database Activity:** This feature enables students and teachers to build, display, and search a bank of record entries about any conceivable topic.

3. Customization:

- **Plugins:** Moodle's extensive library of plugins allows institutions to add specific functionality to their LMS, such as attendance tracking, plagiarism detection, or additional quiz question types.

- **Themes:** Moodle can be visually customized with themes to match the branding and aesthetic preferences of the institution.

- **Integration:** It can be integrated with other systems like student information systems, content repositories, and cloud services, ensuring a cohesive and efficient digital environment.

4. Tracking and Reporting:

- **Activity Completion Tracking:** Teachers can set completion criteria for activities and resources, and Moodle will automatically track students' progress.
- **Detailed Reporting:** Moodle provides detailed reports on student engagement, activity participation, grades, and more. These reports are invaluable for monitoring student progress and identifying areas where additional support may be needed.
- **Analytics and Predictions:** Advanced analytics tools can help in predicting student performance and identifying at-risk students, allowing for timely intervention.
- **Customizable Reports:** Educators can create custom reports to track specific metrics or to align with institutional requirements.

These enhanced functionalities in Moodle significantly contribute to its effectiveness as an educational tool. The combination of flexible assessment options, collaborative learning tools, wide-ranging customization, possibilities, and comprehensive tracking and reporting capabilities make Moodle a powerful platform for both teaching and learning. These features align well with modern pedagogical practices, emphasizing interactive, personalized, and data-informed education.

Additionally, Moodle's capacity to adapt to different educational contexts, from small schools to large universities, and its ability to support various teaching strategies, from face-to-face learning to fully online courses, make it a versatile and appealing choice for educational institutions worldwide. Its continual development and improvement by a global community ensure that it remains responsive to the evolving needs of educators and students.

1. Benefits for Educational Institutions:

- **Cost Efficiency:** As an open-source platform, Moodle is free to download and use, significantly reducing the overhead costs associated with commercial LMS solutions.
- **Customization and Scalability:** Institutions can customize Moodle to fit their unique needs, from branding and layout to specialized plugins. Its scalability makes it suitable for small schools as well as large universities.
- **Compliance and Standardization:** Moodle supports various e-learning standards (like SCORM and xAPI), ensuring compatibility with other systems and adherence to international e-learning standards.
- **Data Ownership and Control:** Institutions have complete control over their data and how it's managed, a significant advantage over hosted solutions where data control can be a concern.
- **Community and Support:** Access to a global community of Moodle users and developers means institutions can benefit from shared knowledge, resources, and solutions to common challenges.
- **Integration Capabilities:** Moodle can be integrated with other systems like student information systems (SIS), content management systems (CMS), and various third-party tools, creating a seamless IT infrastructure.

2. Benefits for Teachers:

- **Flexible Course Design:** Teachers have the freedom to design courses that match their teaching style and curriculum requirements, using a wide range of activities and resources.
- **Efficient Management of Online and Blended Learning:** Moodle simplifies the management of online and blended courses, including scheduling, content delivery, and communication with students.
- **Enhanced Student Assessment and Feedback:** Teachers can use Moodle's diverse assessment tools to provide timely and constructive feedback, essential for student growth and learning.
- **Collaborative Teaching Opportunities:** Moodle facilitates collaborative teaching methods, allowing teachers to work together on courses and share best practices.
- **Professional Development and Networking:** Teachers can participate in Moodle's extensive global community for professional development and networking opportunities.

3. Benefits for Students:

- **Engaging and Interactive Learning:** Moodle's range of activities, like forums, quizzes, and wikis, provides a more engaging and interactive learning experience.
- **Personalized Learning Pathways:** Students can benefit from personalized learning experiences, where they can track their progress and access learning materials at their own pace.
- **Access to Resources and Support:** Moodle gives students easy access to course materials, resources, and support, all in one place.
- **Improved Communication and Collaboration:** Tools like forums and group projects enhance communication with peers and instructors, fostering a sense of community and collaboration.
- **Preparation for Digital Work Environments:** Using Moodle familiarizes students with digital tools and platforms, an essential skill in the increasingly digital work world.

These detailed benefits highlight how Moodle can be an invaluable asset to educational institutions, teachers, and students, providing a comprehensive, flexible, and cost-effective solution for managing and enhancing the educational process.

RESULT 3
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