DIG 4 FUTURE

Digital competencies, Inclusion and Growth
for Future generations

ARTIFICIAL INTELLIGENCE AT SCHOOL: THE PIONEERING EXPERIENCE OF DIG4FUTURE

Co-funded by the
Erasmus+ Programme
of the European Union

Acknowledgment

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We appreciate the many contributions and feedback from colleagues across the consortium.
We are also very grateful to the training operators, teachers and students who took part in the project with great effort and enthusiasm, their experiences and feedback have been invaluable.

Erasmus+ Project DIG4Future - Digital competencies, Inclusion and Growth for Future generations
Key Action 3: Support to policy reform - Social inclusion through education, training and youth
Project Number: 621507-EPP-1-2020-1-IT-EPPKA3-IPI-SOC-IN

Co-funded by the Erasmus+ Programme of the European Union

This publication was supported by the Erasmus+ Programme of the European Commission.
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The Consortium

The collaboration who have come together to create DIG4Future includes representatives from Italy, Greece, Bulgaria and Romania.
The consortium is represented by organisations active in research and/or training of teachers and schools.

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INTRODUCTION

PURPOSE AND SCOPE OF THE PROJECT

DIG4Future is an **Erasmus+** project co-funded by the **European Commission** which **Save the Children Italy** is coordinating, 4 European partners are also taking part to the project, **Fondazione Bruno Kessler** (Italy), **Salvati Copiii** (Romania), **Partners Bulgaria Foundation** (Bulgaria), **KMOP** (Greece).

The project aims to improve the digital skills of digitally excluded young people, living in disadvantaged contexts in urban/rural areas.

DIG4Future promotes a critical and responsible use of digital technologies that allow us to be part of a technology-driven world, where digitalisation iTesto correntetudents were implemented across two school years (2021-2022 and 2022-2023).

Beneficiaries of the project are 11-14 year-old children attending schools and youth centres in disadvantaged areas in Bulgaria, Italy, Greece and Romania.

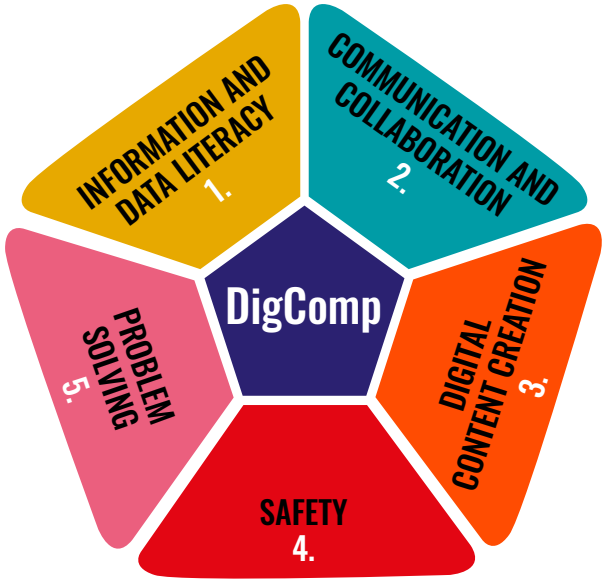
These are contexts with strong material and educational poverty, whereas children's rights to learn and develop skills and competences as well as to nurture their wishes and talents are significantly undermined. This also negatively affects their growth and the possibility to aspire to a different future. A future where artificial intelligence may pervade all the fields of the labour market, from less qualified jobs up to highly qualified profiles.

In this scenario, young people are at high risk to be further marginalised in adulthood.

THE APPROACH ADOPTED

Nowadays children are often referred to as digital natives, they are likely to own at least one smartphone and use social networks, but their digital skills, awareness and critical thinking is often inadequate. This is particularly visible among children from disadvantaged backgrounds who need guidance accordingly; however, families might not be able to provide them the necessary support.

This is why the main targets of the project are motivated teachers and educators who are keen to implement new educational paths.



The project intends to strengthen their skills and competencies and offer them sustainable solutions to work within the DigComp framework.

DigComp competencies are indeed developed through activities that allow teachers, educators and young people to discover key concepts of artificial intelligence and to develop a critical perspective on AI-based technology.

Through a series of lessons and activities, teachers and educators are supported in training their students' digital competences while exploring the ethical implications that such technical concepts entail, such as algorithmic bias, targeted advertising and fake news generation.

Digital inclusion of young people living in disadvantaged backgrounds requires innovation, for this reason the project is adopting an approach with a high degree of flexibility:

- to respond to different learning needs of young people living in the four countries;
- to ensure easy-to-use solutions for teachers/educators;
- to limit costs while ensuring high quality of teaching and effectiveness in transferring and assessing DigComp to young people;
- to approach complex but critical themes as Artificial Intelligence with poorly digitally skilled teachers/educators and young people.

Moreover the project is putting DigComp path at its core to:

- discuss concepts such as privacy, security, netiquette, economic arguments around AI technology;
- bring up-to-date innovation in the age range of target users;
- foster a honest and critical discussion about AI, making use of real-world examples of applications of AI;
- support young people in understanding how AI-based technologies work so the they can best use them;
- enable teachers/educators and young people to become more conscious creators, developers and users of AI technology, as well more informed citizens;
- mitigate the ethical risks around AI technology, improving awareness and challenging stereotypes and myths on AI;
- create the basis for a real participation in innovation for boys and in particular girls.

CHAPTER 1
THE PROBLEM FACED BY THE PROJECT AND WHY ACTION IS URGENTLY NEEDED

THE DIGITAL COMPETENCIES GAP IN EUROPE

The EU acknowledges the vital role of digital competence for all learners as one of the eight key competences for lifelong learning. This recognition stems from the increasing influence of digitization on various aspects of life, including interactions, education, and employment. Digital competences encompass a broad spectrum of knowledge, skills, and attitudes, encompassing creative utilisation of digital technologies, responsible and secure usage, as well as proficiency in handling data.

Within this framework, digital competence is defined as "the confident, critical and responsible use of, and engagement with, digital technologies for learning, work, and participation in society".[1]

The previous concept has been further developed within the European Digital Competence Framework (DigComp), featuring 21 competences and five 'main competence areas': information and data literacy, communication and collaboration, digital content creation, safety and problem solving.

The most recent iteration of DigComp, version 2.2 released in 2022[2], also provides specific examples of the knowledge, skills, and attitudes relevant to each competence. These examples address contemporary societal issues such as disinformation and misinformation, data-driven practices, and interaction with emerging technologies, including AI systems.

1 European Commission, Directorate-General for Education, Youth, Sport and Culture, Key competences for lifelong learning, Publications Office, 2019, https://data.europa.eu/doi/10.2766/569540

2 Vuorikari, R., Kluzer, S. and Punie, Y. (2022). DigComp 2.2: The Digital Competence Framework for Citizens - With new examples of knowledge, skills and attitudes, EUR 31006 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-76-48882-8, doi:10.2760/115376, JRC128415.

All EU Member States are committed to facilitating their citizens' acquisition of digital competence, allowing them to effectively navigate the challenges and opportunities presented by the digital transformation over their lifetimes. This dedication extends to integrating digital competence into educational curricula and after-school programs. Nevertheless, there are notable disparities in their ability to achieve this, both among countries and within individual nations.

Three of the four countries involved in this project (Bulgaria,Italy,Romania) have the lowest rankings among EU countries in terms of digital skills among young populations.
Their rates fall below the EU average of 71.2% of young people aged 16 to 24 years with at least basic overall digital skills[3].

Moreover, approximately half of disadvantaged pupils in Greece are low achievers, underscoring the imperative to address education quality and equity issues—a challenge also present in the Italian, Bulgarian, and Romanian educational systems[4].

These four countries exhibit wide and persistent regional disparities in learning outcomes, falling far behind the EU average in maths, reading, and science (from PISA 2018[5]). Equity challenges exist between Northern and Southern regions in Italy, as well as urban and rural areas in Greece, Romania and Bulgaria.

Moreover, these countries allocate a relatively low percentage of GDP to education, ranging from 3.2% to 4.3% in 2021, compared to the EU average of 4.8%[6].

These countries also face high rates of early school dropout and teacher turnover[7]. Schools in disadvantaged contexts within these countries operate within challenging educational systems, further complicated by cultural and social complexities, such as the coexistence of immigrants and marginalised groups (e.g., Roma), families with low literacy, high unemployment rates, and high crime rates.

These factors contribute to high dropout rates, increased numbers of children and young people with special needs and language barriers (especially for foreigners), low family engagement in children's school life, and a high turnover of teachers.
Consequently, young people in these contexts have limited access to the opportunities offered by digital tools, including AI-based technology.

3 Vuorikari, R., Jerzak, N., Karpinski, Z., Pokropek, A., & Tudek, J. (2022). Measuring Digital Skills across the EU: Digital Skills Indicator 2.0. Publications Office of the European Union, Luxembourg. Data retrieved from https://ec.europa.eu/eurostat

4 European Commission, Directorate-General for Education, Youth, Sport and Culture (2022). Education and training monitor 2022 – Comparative report, Publications Office of the European Union https://data.europa.eu/doi/10.2766/117416

5 European Commission, Directorate-General for Education, Youth, Sport and Culture (2019). PISA 2018 and the EU – Striving for social fairness through education, Publications Office. https://data.europa.eu/doi/10.2766/964797

6 Eurostat (2022). Educational Expenditure Statistics. European Commission.

7 European Commission, Directorate-General for Education, Youth, Sport and Culture, Education and training monitor 2022 – Comparative report, Publications Office of the European Union, 2022, https://data.europa.eu/doi/10.2766/117416

DIGITAL COMPETENCIES AND THE RISE OF AI

Studies reveal a significant gap in AI readiness, with Southern and Eastern European countries falling behind. Specifically,Bulgaria, Italy, Greece, and Romania rank below the EU average (in some cases, in the bottom 25%) in terms of AI readiness and human skills compared to other EU countries[8].

The primary driver of these differences is slower AI adoption in less prepared countries, limiting the potential benefits of the competitive AI race and resulting in lower skills to harness AI's advantages.

According to the European Parliament, addressing the availability of practical skills and labour market changes should be accompanied not only by policies fostering new competences in younger generations but also by initiatives promoting awareness of AI technologies and their potential impact.
Ensuring an inclusive and ethically responsible adoption of AI is crucial to prevent economic and social divisions in EU societies. Today, digital competences are equally essential to comprehend AI-related technologies such as search engines, social networks, and various communication technologies.

Promoting initiatives that enhance people's basic understanding of what Artificial Intelligence is (and is not) and raising AI literacy is essential for well-informed citizens and critical consumers.

AI LITERACY

AI literacy can be defined as the ability to understand and use AI tools and methods, together with the ability to analyse and identify the long-term benefits, social and ethical aspects of AI. A set of skills that enables people to critically evaluate AI-based technologies, communicate and collaborate effectively with AI and use AI as a tool in everyday life, online and in the workplace[9].

AI literacy has emerged as a prominent subject in education, gaining recognition as an essential field of study for the future. However, despite the increasing significance of AI in our society, access to AI education remains limited for many individuals, particularly those from underrepresented groups.
Inclusive AI education is crucial to ensure that everyone has the opportunity to comprehend and participate in the development and responsible utilisation of AI technologies.

By promoting inclusivity and providing AI education, we can assist younger generations in developing awareness on the role of AI in our societies and employing AI in ethical and responsible manners, thus ensuring widespread distribution of its benefits and effective management of its risks.

If digital education is usually seen as a necessary prerequisite for full AI literacy, the challenge pursued by the project is to combine these two educational fields, promoting digital skills through the acquisition of knowledge about AI and reflection on its social and ethical impacts.

8 Bughin, J., Seong, J., Manyika, J., Hämäläinen, L., Windhagen, E., & Hazan, E. (2019). Notes from the AI Frontier: Tackling Europe's Gap in Digital and AI. McKinsey: New York, NY, USA

9 Long, D., & Magerko, B. (2020). What is AI literacy? Competencies and design considerations. In Proceedings of the 2020 CHI conference on human factors in computing systems (pp. 1-16).

To ensure equal opportunities and representation of diverse perspectives, AI education should strive to create an accessible and inclusive learning environment for all learners and educators, irrespective of their background, identity, or prior experience.
Building upon these principles, DIG4Future has embarked on a mission to develop educational resources and training activities for educators in disadvantaged areas of Europe. Its objective is to provide access to AI education resources for educators and learners in such contexts.

This vision has proved to be particularly farsighted. In fact, the critical use of AI is of paramount importance, as highlighted in the European DigComp framework 2.2., still unpublished at the time the project was launched.

This framework includes examples of digital skills necessary for interacting with AI-based systems and emphasises AI literacy as an essential addition to the skills required for digital citizenship. However, due to the rapid evolution of AI and related disciplines, along with the limited availability of resources in languages other than English, the opportunity to promote AI education remains hindered.

The critical use of AI-based systems and a well-informed understanding of their usage are vital skills for all young people who will encounter AI-based technology throughout their lives.

From interacting with applications on their phones to engaging with AI-based technology in the workplace, these skills are essential.
Moreover, educators and adults, as guides and influencers in younger individuals' technology usage, also require these skills. They play a pivotal role in supporting practices that ensure positive digital well-being and enabling younger generations to navigate the implications of AI in terms of privacy, security, and equity.

THE IMPORTANCE OF CRITICAL USE OF TECHNOLOGY

AI literacy extends indeed beyond technical knowledge of how AI algorithms function. It also encompasses multidisciplinary discussions on the ethical implications of using AI technology in our society. This involves addressing values and cultural dimensions within the practice of employing AI technology and recognizing AI users as active participants rather than passive consumers. AI literacy enables individuals to understand the implications in terms of privacy, security, and equity when adopting any AI-based technological solutions. It also fosters awareness regarding the use of digital technologies and services, highlighting potential limitations and risks such as biases and fairness, as well as transparency and accountability of AI systems.

In this sense, the proposed approach captures how digital education and AI literacy must necessarily be posed in dialogue with the building of transversal, social or even global competences[10].

These are considered key by the 2030 Agenda or even the UNESCO Futures of Education project, being linked to the broader goal of equipping new generations to navigate an interconnected world. Starting especially in the second half of the 1990s, several countries have seen attempts to implement policies and practices inspired by intercultural education and education for democratic citizenship. However, the translation of these visions and policy directions into educational practices in European school systems is fraught with dilemmas and appears unaccomplished.

The convergence of these goals with those centred on digital competences and AI literacy appears to be an inevitable forefront. This importance is highlighted

10 Serban, Adina Marina, Stefan, Veronica, Potocnik, Dunja and Moxon, Dan. 2020. Social Inclusion, Digitalisation and Young People. EU Council of Europe Youth Partnership.

by the current increase in the prevalence and accessibility of generative AI algorithms. In an age where artificial intelligence is becoming an integral part of everyday life, it becomes crucial to nurture a population that not only understands but can also interact with these technologies knowledgeably and responsibly.

DIGITAL COMPETENCES AND GENERATIVE AI

In recent years, generative AI has indeed gained popularity due to its availability and improved precision. These AI tools showcase the capacity of artificial intelligence to automate tasks traditionally associated with human capabilities, albeit with varying degrees of accuracy. However, like any technology based on AI, they pose significant challenges related to privacy, social biases, and the overall quality of their outcomes. Indeed, AI technology raises crucial ethical concerns, especially as its usage becomes more widespread. Since these algorithms work with vast amounts of data, it is vital to address privacy and data safety concerns. This encompasses both the data used during their training and how they handle incoming data. Additionally, the emergence of biases in AI algorithms and their outputs is a critical issue that can be exacerbated by their increasing usage and dissemination of their outputs. Lastly, making these technologies transparent to users and establishing accountability for AI outputs remains of paramount importance.

Furthermore, generative AI technology has entered the educational sector, making its way into schools and encountering varying degrees of resistance or enthusiasm from educators and learners. Although these tools do not demand advanced competencies for basic usage (as seen, for instance, in the chat-based interface of many generative AI algorithms), comprehending their functioning and critically evaluating their results necessitates digital competencies. These competencies enable individuals to engage confidently, critically, and safely, as outlined in the new version of DigComp 2.2 [11].

This need is especially prominent in marginalised learning environments, where such technology may be readily accessible, but comprehensive education on digital competence may not be universally available to all students. Consequently, it is imperative to provide AI education to enhance children's digital skills, preparing them for the ever-evolving AI landscape in our society.

11 Vuorikari, R., Kluzer, S. and Punie, Y., DigComp 2.2: The Digital Competence Framework for Citizens - With new examples of knowledge, skills and attitudes, EUR 31006 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-48882-8, doi:10.2760/115376, JRC128415.

CHAPTER 2
THE FORMULA TESTED BY THE PROJECT - WHAT HAS BEEN DONE

THE "TRAIN-THE-TRAINERS" APPROACH

The project followed a "train-the-trainer" model and a reiterative approach, with the aim of training teachers and educators and co-creating flexible educational tools and pathways that could respond to the educational needs in disadvantaged contexts.

In particular, the approach consisted of a cascade process in which experts from Fondazione Bruno Kessler prepared and transmitted new materials on digital competences and AI concepts to 8 training operators (TOs) - two for each country - who, in turn, trained teachers and educators in the schools and youth centres involved in the project.

Trained teachers and educators, then, designed and implemented the new lesson plans in their classrooms and educational centres.
The teachers and educators were helped by TOs during the design of the lesson plans but they conducted the activities in class autonomously.
The project aimed to empower teachers and give them the freedom to tailor their lessons according to their students' needs.
The training operators were not directly involved in the implementation phase but they remained behind the scene to regularly support teachers and educators, moreover they observed a few lessons to take note of the reaction of students and to assess the method used by teachers.

The choice of this approach was functional to the project's proposed focus on highly innovative topic for schools, such as artificial intelligence, and to the educational context in question.

The "train the trainer" model has, in this regard, allowed for an in-depth and flexible exploration of the topics, with the identification of consistent paths between the focus on artificial intelligence and the elements of the European Digital Competence Framework, DigComp, in different training stages.

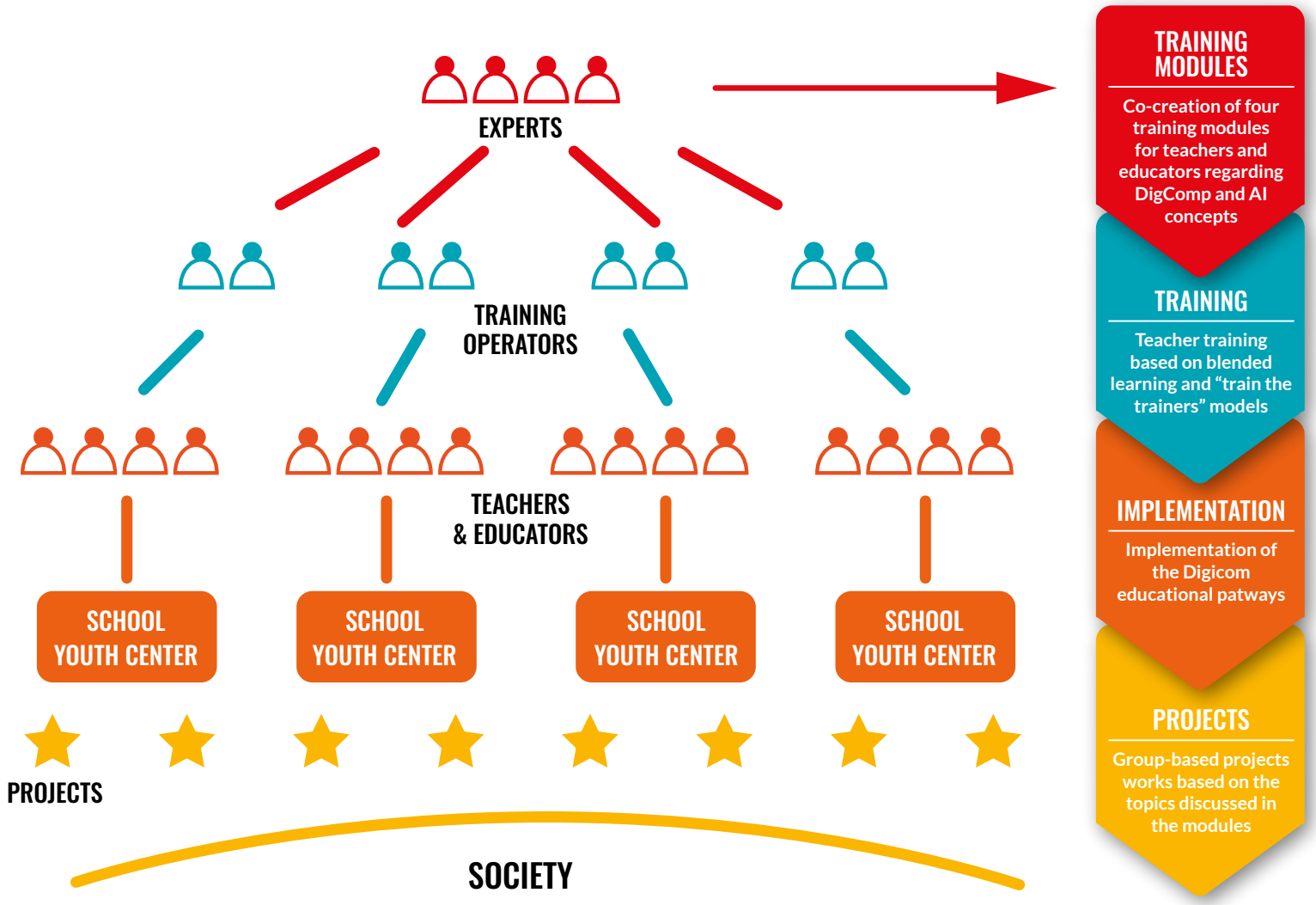
Furthermore, the approach has supported teachers in the ability to personalise learning by designing adaptable content and activities tailored to the various national contexts and the different school curricula of the four countries involved.

Lastly, the “train the trainer” approach ensures the project’s high sustainability because the teachers trained in schools can continue to update themselves and propose the project’s contents in the years and in subsequent classes.

After the first year of testing, modules and materials were revised and adapted according to teachers and educators’ feedback. The second year followed the same approach but less hours were dedicated to the teachers' training sessions.

The approach in numbers:

- **Operators training:**
  37 hours between 2021 and 2022
- **Teachers training:**
  22 hours between 2021 and 2022
- **In class implementation:**
  40 hours between school years 2021/22 and 2022/23
- **Project work:**
  8 hours between school years 2021/22 and 2022/23



THE SELECTION OF SCHOOLS AND TEACHERS AND THE WORK CONDUCTED IN CLASS

In order to foster digital skills and competences of digitally excluded children, the project has managed to involve schools and youth centres in disadvantaged areas in both urban and rural contexts where students have very limited opportunities to develop their digital skills and competencies and participate in European projects. In countries like Greece we worked with schools in very remote areas, In Italy, Bulgaria and Romania we involved kids coming from low income families living in both villages or big cities. There have been cases of students coming from Roma disadvantaged communities in Samokov, Bulgaria, or schools in Turin, Italy, with a large presence of students with a migratory background.

The teachers selected for the project, with few exceptions, did not have progressive knowledge of AI-based technology and their digital skills were quite basic. The consortium decided to involve both STEM and NON-STEM teachers who demonstrated a very strong interest towards the subject. It was important to have highly involved and motivated people as the training, the preparatory phase for the implementation of the activities and the actual work conducted in class were quite intense and demanding. Moreover, Training Operators used a personalised approach according to the needs of their teachers to make sure everyone understood how to use all the tools presented and were able to integrate them in the teaching sessions they would have with the children in class. The technical modules, in some contexts, were more challenging and the TOs supported educators and teachers who faced such difficulties by organising dedicated one-to-one sessions. During the first year of the project, due to the spreading of Covid-19, most of the activities were organised online, including the training of teachers.

Considering the teaching modality (online, in-person, or mixed/hybrid), all participating countries predominantly utilised in-person lectures, although few online lessons were organised in countries where Covid-19 restrictions were still in place. However, in the second implementation nearly all activities were conducted in person.

THE PROJECT IN NUMBERS

ROMANIA

- SCHOOLS 3
- TEACHERS 46
- CLASSES 9
- STUDENTS 191
- INFORMAL EDUCATION CENTRES 1
- EDUCATORS 2
- CHILDREN 20

BULGARIA

- SCHOOLS 4
- TEACHERS 28
- CLASSES 8
- STUDENTS 240

ITALY

- SCHOOLS 4
- TEACHERS 25
- CLASSES 12
- STUDENTS 216
- INFORMAL EDUCATION CENTRES 7
- EDUCATORS 11
- CHILDREN 49

GREECE

- SCHOOLS 16
- TEACHERS 34
- CLASSES 30
- STUDENTS 304
- INFORMAL EDUCATION CENTRES 4
- EDUCATORS 5
- CHILDREN 12

ROMANIA

The importance of teamwork and collaboration

What particularly resonated with the students in Romania was the informal nature of the activities. This laid-back atmosphere allowed them to connect with their regular teachers in a unique manner, cultivating a sense of camaraderie and ease. This distinctive setting fostered open discussions and nurtured creative thinking, ultimately contributing to a positive and dynamic learning environment.

A best practice that was put into action at Stefan Ispas Maglavit Gymnasium School involved the incorporation of AI projects into a variety of subjects across the curriculum, extending beyond the confines of computer science. As an illustration, students in biology classes harnessed AI to scrutinise data, while their peers in history classes delved into AI's potential for historical analysis.

This holistic approach not only underscored AI's adaptability but also encouraged students to recognize its relevance across a spectrum of academic disciplines.

Furthermore, the teachers actively fostered collaboration among students by orchestrating group AI projects within the school.

These initiatives not only cultivated teamwork but also nurtured critical thinking and innovation, providing students with the opportunity to apply their AI knowledge to practical, real-world challenges.

BULGARIA

Selecting the right teachers

Students in Bulgaria particularly appreciated the project work, they had the opportunity to learn about concepts like fake news and developed skills for a safer online behaviour. The first year of the project was the hardest one but it represented a solid foundation for the following year. During the first-year students were attracted by the dynamic content of the modules that was completely new for them, in the second year they were more confident in the use of tools and managed to master new content by working as a team. The time teachers could devote to working on the project was short, and this was their main difficulty. An activity that worked very well in the schools in Bulgaria was the creation and distribution of printed digital passports for each child participating in the project. This activity increased the commitment of the students who were encouraged to complete and collect points for each completed lesson. A good example of the importance of selecting the right teachers for this project could be the one related to Konstantin Fotinov High School. The history teacher, although had no previous knowledge of AI related technology, demonstrated exceptional ability in presenting information in a highly accessible and engaging manner. During her lessons, she included relevant examples and facilitated discussions, which played a pivotal role in attaining the defined learning objectives and expected outcomes. The students actively participated in the lessons, this ignited their curiosity for further knowledge.

ITALIA

Subgroups to prompt discussion

Dig4future project had a significant impact on the classes of the two schools involved in the city of Turin, with different effects determined by various factors such as: the composition of the class group, the teachers' knowledge of the topics covered and the subjects they teach, the continuity and preparation of the meetings.

The greatest effectiveness of the proposed model was found where students were able to interact with each other in subgroups, through workshop activities aimed at practical experimentation or the production of a text, a digital product, and research on a defined theme. In some cases, theoretical reflections on a theme were less adequate, due to the lack of capacity for abstract conceptualisation typical of the age group of students involved.

The teachers who were able to work in teams and who managed to have greater continuity in scheduling the meetings achieved more than satisfactory results, especially if they were able to delve deeper into the proposed topics and prepare the lessons by sharing the workload.

The project was enthusiastically welcomed by both students and teachers, who were able to see the development, dissemination and knowledge of AI, which suddenly went from being a niche topic to a mass phenomenon that was treated and discussed on a global level.

GRECIA

Outside-the-box and creative thinking

In Greece the project was welcomed with great engagement and enthusiasm by TOs, teachers and students.

The teachers involved in the project utilised the educational material, by overcoming the resistance that characterises the educational world in adopting innovative teaching techniques and subjects. Finally, the participating students acknowledged the usability and ease of use of the teaching material enhancing their knowledge and readiness to adopt a related culture (ICT, data, and AI culture) taking into account the ethical issues raised.

In the 2nd Gymnasium of Florina DIG4Future activities were combined with French language lessons and the results were quite creative: students designed a digital tourist guide, which welcomes Greek tourists at the Paris airport and guides them to the main monuments / sights of the city.

The AI was firstly used in the simultaneous translation from French to Greek (the guide speaks French and thanks to the AI the translation is done in Greek) and then in voice recognition (the students trained the model to recognize sounds - words, in this case words corresponding to the monuments of Paris).

The students worked together, exchanged information, practised problem solving and created high-value innovative products.

CHAPTER 3
TRAINING MODULES, INCLUDING GUIDELINES FOR TEACHERS

The AI curriculum was developed adopting an interdisciplinary and project-based approach and it consists of four different learning modules (available at www.dig4future.eu) for a total of 48 hours encompassing in-class lessons (40 hours) and project-based activities (8 hours).

The program's content covers a wide range of topics related to digital competencies and AI technology. These topics include an examination of individual perspectives on AI, a deep dive into the inner workings of AI algorithms, its widespread integration into our daily technologies, and an exploration of the ethical and societal implications it entails. At its core, this program takes an interdisciplinary approach that is central to shaping the entire curriculum, making it accessible to educators from diverse fields of expertise.

In addition to delving into technical aspects, this approach promotes a comprehensive discussion of AI technology, encompassing a multifaceted exploration of its various dimensions, including societal, ethical, and cultural considerations. By encouraging learners to engage in this holistic examination, the program aims to foster a more informed and nuanced understanding of AI.

The four modules cover:

1. INTRODUCTION TO AI ■ Introductory concepts and AI-related disciplines

This initial module serves as an introduction to the fundamental concepts of artificial intelligence, exploring the definition of AI and of its various related domains. Within this module, essential concepts, such as intelligence and depictions of AI, are examined. It dispels misconceptions and unrealistic notions surrounding AI technology through a critical discussion highlighting the multidisciplinary nature of AI technology and use.

Through this module educators can acquire the competencies needed to guide classroom discussions and activities centred on expectations and beliefs concerning AI, initiating a thoughtful examination of the challenges and opportunities presented by these emerging technologies.

2. HOW AI WORKS ■ Algorithms and machine learning

The second module includes activities for investigating how artificial intelligence operates, with a particular focus on introducing concepts such as algorithms and machine learning. Additionally, this module addresses the training and behaviour of AI systems, while introducing educators to programming concepts and presenting activities related to generative AI algorithms. The overarching objective of this module is to train educators and learners with fundamental computational skills and concepts relevant to AI systems.

3. ETHICS AND AI ■ Societal impact and ethical considerations for AI

The third module is directed towards the practical applications of AI and machine learning that are either currently available on the market (such as computer vision applications and web-search engines) or poised to emerge in the near future (including autonomous vehicles and humanoid robots). The activities within this module foster a critical discourse on the attainable possibilities through AI and machine learning, as well as the frontiers that remain beyond reach in this field. Furthermore, it establishes a connection between the applications of AI technology and Sustainable Development Objectives (SDOs). This module empowers educators to make informed decisions regarding their interactions with AI, enhancing their critical thinking and facilitating discussions on the ethical and responsible use of AI.

4. LIFE ON THE NET ■ The impact of AI in social media

The fourth module focuses on the characteristics of online human-to-human communication and information exchange within the context of social networks, while emphasising the pivotal roles played by AI in shaping these interactions. The primary objective of this module is to equip educators and learners with the requisite tools to cultivate digital well-being and promote healthy digital consumption practices. Topics such as privacy, anonymity, and confidentiality are explored, training skills for source verification and critical thinking exercises.

PROJECT WORK

As an additional set of activities, teachers also introduced class-based project works to their students in conjunction with the other four modules.The primary objective of these projects is to foster active engagement among students, encouraging them to participate in authentic and captivating tasks aimed at achieving shared goals through collaborative efforts and skill development. These supplementary activities are tailored to enhance creativity and digital proficiency in audio and video editing, as well as the creation of both digital and non-digital materials. Concurrently, they aim to deepen participants' understanding of the AI content covered in the program and generate outputs that can be shared with the entire school community to disseminate the knowledge acquired. The students embarked on various types of projects, including posters, presentations, videos, theatrical performances, coding activities, interactive books, and novels. Before implementing the activities in class, all the teachers underwent 16 hours of training on the modules and the related activities from professional teacher trainers. The constant monitoring, through specific focus groups, of each individual module and the project work proposed in the project has led to the definition of guidelines for training operators and teachers.

This document represents the natural completion of the "train the trainer" model at the core of the project, which allowed for active participation of teachers through a comparison and exchange of proposals among teachers and trainer operators. The initial version of the guidelines, from 2021, therefore offers tools to support the activities of Training Operators alongside best practices for teachers in developing classroom activities. It includes a significant section dedicated to child safeguarding in online environments, specific to each participating country.

The document, updated in 2022 based on the outcomes of new focus groups, can assist teachers with a series of methodological suggestions dedicated to the development of group activities in the classroom and tools to promote an inclusive and participatory discussion within the entire class. In addition to these methodological notes, the guidelines also provide teachers with specific references to connect the curriculum of individual subjects with the project's activities.

CHAPTER 4
THE EVALUATION: METHODOLOGY AND RESULTS

The Dig4Future project evaluation includes two complementary analyses: the analysis of the project implementation process and the analysis of effects (or impact) conducted in the four participating countries: Bulgaria, Italy, Greece and Romania.

The first, internal and coordinated by Fondazione Bruno Kessler, accompanied the project throughout its development and, using purely qualitative methods, made it possible: a) to correct and improve, in real time, its implementation; and b) to identify the factors that, more than others, contributed to positively orienting the implementation of the educational pathway towards the desired direction;

The second, the analysis of the effects - quantitative was assigned to an external evaluating body (Disamis) - was aimed at detecting the change - in terms of improvement in the digital skills of the students involved - and estimating its causal dependence on the project.

QUALITATIVE EVALUATION

Qualitative data were collected during the implementation of the DIG4Future modules through teachers' and educators' logbooks [12] and direct observations conducted by the trainer operators. [13]
Additionally, insights from dedicated focus groups [14] and monitoring activities involving training operators, teachers, and educators were gathered. The qualitative evaluation yielded several notable insights summarized in the following.

12 The teachers were provided with an ad-hoc logbook to monitor and document classroom activities. A total of 1.182 logbooks were collected during the first (N = 582) and the second implementation (N = 600)

13 A total of 74 observation grids, filled by the Training Operators during (or immediately after) their direct observations of the project activities in the classrooms, were completed (50 during the first year of implementation and 25 during the second year).

14 Each year of implementation, teachers' and educators' opinions have been collected through two rounds of focus groups. The focus groups aimed to assess the strengths and weaknesses of the project implementation from the perspective of the teachers and educators and to understand the challenges they encountered during their classroom work. Overall, 8 focus groups have been conducted, with the participation of about 200 teachers/educators from the four countries.

In general, teachers (both from STEM and non-STEM subjects) found the training useful to acquire new knowledge and develop teaching methods for engaging students at risk of exclusion or with special educational needs.

The training undertaken is also seen as an opportunity for their professional development. The inquiry also showed that the teaching material (modules and lesson plans) can also be used effectively by teachers of non-STEM subjects.
In this case, however, it becomes even more central to receive adequate training and more work is required to adapt the content and find connections with the curricular programme.

In the post-training test, both STEM and non-STEM teachers reported an increase in their overall level of digital competence, with no significant differences between the two groups. Additionally, they expressed feeling more confident in implementing the activities in their classrooms and noted a positive shift in their attitudes toward digital technologies due to the training.

After the training, the preparation of the educational pathways required teachers to make an effort sometimes resulting in a perceived workload overload.
At this stage, the main challenge the project encountered relates to the availability of materials (e.g. topical cases and examples) in the different languages of the countries involved.
Moreover, one of the most common remarks that have been made by teachers regards the insufficient or not constant availability of devices and technological support for the implementation of the activities.
Discrepancies at country level and within the different contexts shall be considered at this regard.

However, overall, compared to the first year of the project when time planning showed some difficulties and the effects of the pandemic still affected the teachings, in the second year the implementation showed a more fluid process and a better balanced distribution of time among the different modules.

Through the observation grids the TOs reported a high or very high level of understanding and acceptance regarding the purpose of the tasks among the classes involved. They also confirmed that the overall enthusiasm and willingness to participate among students was predominantly high.

> **“ At the beginning students though that the activities were about robots but then they developed a more mature and realistic view on AI, including a glimpse of their own future.**
>
> *(A TEACHER FROM BULGARIA, 09.03.23)*

In the second implementation, teachers observed an increase in student motivation, with 74% indicating high motivation, compared to the 69% reported in the previous year.

This suggests that the project team's revision of educational materials and reinforcement of specific concepts within the learning path, following the evaluation of the first implementation year, positively impacted student engagement.

Generally, most teachers acknowledge that the course has primarily enhanced students' understanding of AI's functionality in daily life and its potential implications for their futures.

As recalled by the teachers during the second round of focus groups, in the course of the project, moreover, even from the emergence of new tools such as Chat GPT, the urgency of reflection on AI became increasingly evident to both the students and the teachers themselves. During the focus groups a major engagement specially by the part of teachers in humanities and not-STEM subjects emerged. Some of them stated that, compared to the previous year, they were more able to adapt the modules contents and methods to their classes and even to include some topics and activities in the official curriculum.

However, the need for a strict collaboration between IT teachers and the other colleagues have been repeatedly underlined in the different countries.

The increase in the social attention towards AI was particularly emphasised by teachers also to explain the growing interest in the project activities shown by colleagues not directly involved.

> **The project was beneficial also for teachers and educators not in the target group. In the second year, more colleagues asked to participate in the project or to refer to some of the topics in their classes activities. I think there has been a positive contamination among teachers.**
>
> *(A TEACHER FROM ROMANIA, 06.03.23)*

However, there remains a perception among some teachers, especially in Italy, that in the school world, the work on digital competences is still considered to be secondary to learning related to core subjects.

The pupils' participation has been generally constant for each module.
However, both the TOs' observation and the teachers' responses indicated that contents referring to more abstract concepts revealed to be less engaging.
This particularly regards module 3 concerning the ethics of AI.
In this regard, a difficulty on the part of teachers in leading discussions on ethical and normative issues emerged.

The project has shown that this issue needs to be addressed in greater depth to avoid a prevalence of an abandonment of the educational method centred on dialogue and reasoned discussion.

While some teachers stated that ethics are not approachable by young students given their complexity, the majority of them were open to the possibility of reshaping the materials and activities in order to render them more approachable. In the second version of the module, which followed the first evaluation and revision, the ethics of AI have been referred to in the discourse on the Sustainable Developments Goals (SDGs). This thematic anchorage allowed teachers to show concrete examples of AI for goods and risks in the use of AI with respect to the achievement of goals and values that European countries firmly share and are therefore scarcely controversial.

> **The creation of fake news, which has become a popular topic of discussion in class.**
>
> *(A TEACHER FROM GREECE, 15.03.23).*

With references to the modules more devoted to the social implications of AI, many teachers have underlined the increasing awareness of students on topics like fake news and privacy, with which they were unfamiliar at the beginning of the project.

The feedback gathered among the teachers and the observation by the TOs also highlighted the potential of the course with regard to the inclusion of students with special educational needs and those at risk of dropping out.

Among the resources that the project has provided in this direction, it is interesting to note that, in the opinion of the teachers, it is primarily the reference to and use of technology that has proved to be effective.
This in fact functioned as a mediating element in the teacher-student educational relationship (a relationship that is also intergenerational) and as a driving factor in the motivation to learn.

As some teachers pointed out, moreover, by focusing on a field in which the new generations already move with a certain ease, albeit in the need for qualified skills, the project enabled students with greater difficulties in ordinary subjects to put their previous and informal skills into play and feel more gratified.

> **I have seen that children who often do not participate become an active part of the group; they come forward, raised their hands.**
>
> *(A TEACHER FROM ITALY, 28.06.23)*

Finally, in terms of innovation of the teacher's role, the project seems to have solicited a deep reflection.

It is worth reporting the words used by Greek teacher:

> **I learned the importance of being flexible during the program and adapting my methods when I felt that students were not interested in the topics. I reflected on what motivates students and found this activity to be crucial for my professional development.**

(A TEACHER FROM GREECE, 15.03.23)

A systematic and dedicated training is largely considered by teachers of all countries a necessary component to a professional development based on updated knowledge on technological innovation and its social and ethical implications. At the same time, as largely recognized by the respondents, any revisitation of the teacher's role inevitably requires innovation at the level of school institutional organization. The role of the school principal is key in this regard. However, the discourse has often been enlarged to the level of policies.

> **Through the project we are facing the challenge to include and adapt contents related to Ai in our teaching. School institutions, instead, take a long time to develop new solutions. It is important to exploit projects like this one beyond a single/spot initiative and integrate them into the regular school curriculum.**

(A TEACHER FROM GREECE, 15.03.23)

QUANTITATIVE EVALUATION

The overall evaluation of the project complemented the analysis of strengths and difficulties in implementation conducted using a qualitative method with a survey assessing the students' digital skills. The study employed a quasi-experimental design, evaluating both intervention and comparison groups at the outset of the project in spring 2021 and upon its conclusion in spring 2023 across all participating countries.

A test created by the University of Milano-Bicocca was used for this measurement. The test, comprising multiple-choice items set in realistic online scenarios, was designed as a tool for measuring the digital citizenship skills indicated by the European framework DigComp 2.1 (Information & Literacy, Communication, Creation, Safety and a transversal area of Problem Solving). The assessment tool was translated and adapted into Bulgarian, Romanian, and Greek in collaboration with the project partners.

Pre-test data were collected from 1310 valid responses. Among the variables analysed, both parents' education level and, most notably, the availability of study resources at home emerged as significant factors influencing test scores. The statistical analysis revealed a medium-large effect size, indicating a substantial impact of the availability of study resources at home on participants' digital skills. Furthermore, it is worth noting that the availability of study resources at home was positively correlated with higher parental education levels. This underscores the critical role of home-based support resources in fostering digital competence. These findings emphasise the importance of providing support not only within the school environment but also within family settings, encompassing access to equipment, dedicated time, and assistance to enhance digital competencies. This need is particularly pronounced in disadvantaged communities, highlighting the urgency of additional investments to aid educators and learners in compensating for the lack of support available at home.

Post-test data, gathered from 432 respondents, were compared with responses from a control group consisting of 247 individuals who were not involved in the project.

The results show a nuanced picture of the project's implementation since there were slight improvements in the post-test for both the intervention and comparison groups, with no statistically significant difference between the two groups.
This suggests that the project was not effective in improving students' digital competencies as measured by the test used.

In the following paragraph, we will attempt to explain the results of DIG4Future combined evaluation.

KEY FACTORS THAT MIGHT HAVE INFLUENCED OUR RESULTS

The two analyses, qualitative and quantitative, are complementary, since, in essence, the analysis of the effects gives evidence of the changes brought about by the project and the analysis of the implementation helps to understand the reasons for them.

This correspondence, in the Dig4Future project, emerges but it is not explicitly clear since, despite the prevalent return by teachers of strengths relating to the implementation process (including above all the perceived interest and involvement of the classes) in the analysis of the effects slight improvements in students' digital skills were observed for both the intervention and comparison groups.

In an attempt to explain this discrepancy - crucial, as this is a pilot project aiming at wider adoption - we have identified some factors that may have contributed to it:

1. **The tool:** the questionnaire used for the pre-post survey on digital competences was developed by the University of Milan-Bicocca; it has Dig. Comp 2.1 as its reference and, as such, does not include the topic of artificial intelligence, which was later integrated into Dig.Comp 2.2. Dig4Future was born, among other things, as an experimental project on the skills needed to interact in a conscious and responsible way with technologies that use artificial intelligence; in the second year of the project, Dig.Comp 2.2 became its reference framework for updating the teaching modules and teachers' assessment tools. This probably led to a discrepancy between what the students acted and learned during the project, especially in the second year, and what they were then asked to do during the assessment. The questionnaire, in the form in which it was used, is not fully calibrated to the type of skills solicited and it is therefore possible that it may not be able to bring them to light; however, the rigorous methodological approach of the counterfactual evaluation of effects did not allow for any changes, so the same questionnaire was also used at the end of the intervention. It is important to emphasise that the instrument was chosen in 2021 at the start of the project, as it was the only one, at that time, developed and tested (on DigComp 2.1) by a university and accredited by the Italian Ministry of Education.
2. **A further element to be taken into consideration is the duration of the teaching course implemented, which amounts to 48 hours including:** classroom lessons (40 hours) and project work activities (8 hours) spread over two school years. This time frame may not be adequate to manifest a tangible impact on the competences assessed through the questionnaire used in the counterfactual study.
3. **The drop-out of participants** (i.e. not repeating the test at the end of the project), particularly in the treated group, probably contributed to influencing the final result. The analysis of the quantitative results, in fact, [Ref. Questionnaires on digital competencies > Quasi-experimental results > Attrition rates and dropouts], showed that it mainly affected the most

deprived young people, who would probably have benefited more than others from the project in terms of skills improvement, contributing to slightly raising the average overall change found in the effects analysis.

4. **Not all schools completed the proposed educational pathway**. The 'train the trainer' model proposed by the project promoted a strong autonomy of the teachers in the construction of the activities and the implementation of the teaching modules, which, in some cases, led to the choice of deepening some of the proposed modules over others. From the analysis of the implementation [Ref. Qualitative evaluation of the educational intervention > Logbooks from teachers] it emerges that module 3 and, to some extent, also module 4 - where topics such as privacy and fake news are dealt with - were, in this sense, among the most penalised; the contents of these modules are more in line with those investigated in the follow-up questionnaire than others, however the lower confidence of the pupils with these modules translates into low scores in the final follow-up questionnaire.
5. **Lastly**, during the final review among the project partners, distortions and superficialities emerged in the administration of the final questionnaires in some classes, by the teachers, despite the guidance and support made available by the project trainers; this aspect too may have contributed, in part, to the discrepancies found.

The above considerations stem from the need to find one or more keys to understanding why a positive implementation is not fully reflected in a standardised increase in the digital competences of the students involved.

Each of the factors described helps in this understanding; nevertheless, for an overall analysis of the results achieved by the project, we consider it appropriate to go beyond the discrepancies that emerged from the two analyses, since it is evident that they focus and collect data on different aspects of the process of acquisition of digital competences, and to highlight the important results achieved in terms of an increase in understanding, knowledge and awareness, in essence, of a more mature outlook on the digital issue, on behalf of the boys and girls involved.

Taking into account the involvement of educators, the project successfully engaged teachers and learners in an educational path toward learning digital competences, especially focusing on the interaction with AI systems.

The project's outcomes include educational materials and guidelines translated into the target country's language, expanding its reach.

While the project encountered challenges, such as teacher turnover and difficulties in cross-disciplinary collaboration, it succeeded in nurturing multidisciplinary teamwork among educators, promoting the sharing of expertise.

The success of an approach involving teachers from different disciplines (STEM and non-STEM) is particularly noteworthy, considering the need for AI education to combine technical knowledge with reflective and critical perspectives.

The "train the trainers" model emerged as a significant resource in motivating trainers and teachers and enhancing their professional profiles during the implementation process analysis. This autonomy, however, might have led to a divergence between the module contents and the students' learning, a discrepancy challenging to detect through the standardised test.

This consideration underscores the importance of adopting an integrated approach that combines both qualitative and quantitative methods when evaluating the implementation of educational activities in the classroom, especially when a high level of adaptation in the different contexts is involved.

Such a mixed-method approach provides a more comprehensive understanding of the impact and effectiveness of educational initiatives.

CHAPTER 5
SOME RECOMMENDATIONS FOR POLICY MAKERS, STAKEHOLDERS AND SCHOOLS AT LOCAL, NATIONAL AND EUROPEAN LEVEL

RESULTS AND LESSONS LEARNT

The DIG4Future project addresses issues that are part of a broader and rapidly evolving debate at national, European and international level.

Systems based on artificial intelligence (including generative AI) are now part of our society: they can have a profound impact on education and shape the future of teaching/learning processes.

These new technologies may offer many opportunities in education, but they also raise several important questions: what will be the role of teachers in the future? How will the subject of assessment evolve? What knowledge, skills and competences should our educational systems promote? How will schools, teachers and educators be able to help students navigate such technological revolution? [15]

The project addresses some of these issues and seeks to provide some initial answers. In particular, it recognises the importance of artificial intelligence in the lives of young people and aims to support their basic skills to recognise, understand and critically use these technologies.

In the approach used in DIG4Future, teachers and educators are seen as the key players in reducing the gap between those who can keep up with technological change and those who risk being left on the sidelines (digital divide). Indeed, a key task of schools should be to leave no one behind because of artificial intelligence and its impact on the world and the future labour market.

15 UNESCO, 2023, "Generative AI and the Future of Education", S. Giannini, Programme and meeting document.

This process of inclusion also requires recognising the social and cultural diversity of students and thus defining content and approaches of digital and artificial intelligence education suited to each of them.

The pilot project focuses on four European countries where digital education is still only marginally integrated in the curriculum and the digital competence level of citizens (including young people) is low. In fact, according to the Digital Economy and Society Index [16], Bulgaria, Italy, Greece and Romania rank below the European average in terms of human capital and digital skills.
These countries also share common challenges in their education systems, characterised by significant regional disparities in terms of services and learning outcomes.

In all countries, the teachers and educators involved showed a strong interest in the topic of artificial intelligence and understanding how it works, emphasising the need for orientation and training programmes.

The results of the project therefore confirmed that the training provided to teachers met their needs and expectations. All the teachers (including those in the humanities) reported an increase in their overall level of digital skills, which is essential for effectively and independently developing artificial intelligence literacy activities in the classroom.

One of the most important lessons that emerged from the project is therefore the validation of the importance of providing teachers with continuous and in-depth training on topics related to artificial intelligence, through courses that provide content and guidance to support the effective development of classroom activities, the management of complex concepts related to artificial intelligence and the adaptation of teaching methods to different educational contexts.

The adoption of a project-based approach has been particularly appreciated by teachers and educators. This approach fosters a more engaging and hands-on learning experience for students, allowing them to apply their knowledge of artificial intelligence in real-world scenarios.

The reference to content related to digital technologies facilitated intergenerational exchange and connected to the interests and skills already existing in the younger generation. On the other hand, the technological artefact, as an intermediate object in the educational relationship, functioned in facilitating cooperative learning and collaboration in the classroom.

The results of the project evaluation reveal that there is still room to simplify and adapt the tested literacy modules to better suit different national contexts, schools and individual students' needs. This underlines the importance of tailoring educational content to specific needs and requirements, while maintaining a common perspective on AI education.

In conclusion, the DIG4Future project addresses the crucial need to initiate artificial intelligence literacy pathways in schools and educational settings and tries to provide students, teachers and educators with the necessary skills and knowledge to deal with this ongoing revolution.
Through the promotion of a project-based learning approach and the ongoing training of key adults, the project seeks to bridge the digital skills gap and promote inclusive education in the face of technological advances driven by artificial intelligence.

16 European Commission, The Digital Economy and Society Index - DESI (2022). https://digital-strategy.ec.europa.eu/en/policies/desi

FUTURE DIRECTIONS AND RECOMMENDATIONS FOR SCHOOLS

Below are some key recommendations addressed to the European community on how to develop an artificial intelligence literacy programme specifically designed for secondary schools (11-14 years old), especially in disadvantaged educational settings.

These guidelines are congruent with the Digcomp 2.2 framework, which emphasises the importance of digital competence, including artificial intelligence literacy, for all citizens.
Furthermore, they are aligned with the human-centred approach to artificial intelligence and the main policy recommendations put forward by UNESCO, which recognises the central role of artificial intelligence in education and promotes inclusive and future-oriented approaches to prepare students for the challenges to come.

This approach will enable students not only to be prepared to exploit the opportunities offered by artificial intelligence technologies, but also to develop the ability to recognise challenges and possible risks. These include, for example, understanding issues of bias and fairness, the importance of transparency and accountability in artificial intelligence systems.

By taking care of artificial intelligence literacy from an early age, students will be better prepared to participate responsibly, ethically and critically in a world increasingly influenced by technology.

This will help create a more informed and resilient society, able to face the challenges and opportunities arising from new technological developments and applications.

For these reasons, we recommend educational institutions to:

1. **Foster in-depth discussion and debate in educational communities**

   Digital literacy and artificial intelligence are central issues for the younger generations and require ongoing reflection by adults. In order to pursue this objective, it is necessary to cultivate a culture of sharing and continuous training among teachers, educators and the entire school community.
   It is crucial to involve the entire educational ecosystem in this endeavour by initiating training and refresher sessions, promoting open dialogue between parties, and encouraging interactions on these issues with families as well.
   This collaborative approach will help establish a clear and transparent discussion on the potential and limitations of artificial intelligence technology.

2. **Promoting a multidisciplinary and human-centred approach to AI**

   As part of each school's curriculum, provide for the cross-disciplinary dissemination of fundamental concepts, promoting a comprehensive and in-depth understanding of the impact of artificial intelligence on various aspects of life.
   This approach can support a human-centred idea of artificial intelligence, emphasising not only the technological capability, but the ethical, social and cultural implications, to ensure that artificial intelligence serves people.

3. **Foster an inclusive learning environment that considers the diverse needs and abilities of students**

   Artificial intelligence education must be inclusive and address the needs and abilities of all learners, regardless of their background or specific learning characteristics. This means providing differentiated teaching strategies according to need, accessible teaching materials (including non-technology-based lesson plans for schools with limited Internet access) and support for students with disabilities or special educational needs.

4. **Promoting creativity and problem-solving skills**

   As part of artificial intelligence literacy courses, provide methodologies that stimulate students' creativity and problem-solving skills.
   Students' active participation in designing applications and analysing data, using algorithms and imagining AI-based solutions to real-world challenges should be encouraged. The adoption of a hands-on and laboratory methodology can support students' full participation, as also suggested by Article 12 of the UN Convention on the Rights of the Child.

5. **Cultivating critical thinking**

   An artificial intelligence literacy programme must provide students with the tools to assess the ethical, social and economic implications of technologies. Students should be encouraged to critically examine both the potential benefits and risks of artificial intelligence, as well as its impact on privacy, employment and social justice.

6. **Raising students' awareness of ethical issues**

   Promote awareness of the possible biases of artificial intelligence to prevent the reproduction and perpetuation of discrimination and inequality (based on gender, ethnicity, religion, etc.).
   Students need to learn to recognise the possible distortions in artificial intelligence algorithms and understand their impact on the individual and societal level. By promoting greater awareness and understanding, students can become advocates for fairer and more ethical artificial intelligence systems.

FUTURE DIRECTIONS AND RECOMMENDATIONS FOR DECISION MAKERS AND STAKEHOLDERS:

The accelerated development of artificial intelligence is transforming the world of education and training, offering exciting potential for social improvement and the achievement of the Sustainable Development Goals. At the same time, however, it carries the risk of introducing significant dangers and threats, in particular putting the safety of children, adolescents and young people at risk.
Addressing this dual challenge requires the implementation of articulated policies, careful ethical oversight and effective global collaboration.

At the European level, the Parliament recently approved a key tool to measure the possible negative impacts of AI systems and identify levels of responsibility.

"The Parliament's priority is to ensure that AI systems used in the EU are safe, transparent, traceable, non-discriminatory and environmentally sustainable.
AI systems should be supervised by people, rather than automation, to prevent harmful outcomes"

(European Parliament News, 2023).

In light of the obligations introduced by the Artificial Intelligent Act - currently being approved at the European level with a view to implementation by individual states at the national level - European companies developing or using AI systems classified as high-risk will be required to ensure full compliance not only with the regulations and technologies involved, but also with ethical issues such as ensuring “high quality of the data feeding the system to minimise risks and discriminatory outcomes”.

In the context of this ongoing debate, *"education, given its function of protecting and facilitating development and learning, has a special obligation to be carefully sensitive to the risks of AI, both those known and those just ahead"*

(UNESCO, 2023).

In particular, the DIG4Future pilot project emphasises the importance of:

1. **Ensuring schools have adequate connection and technological infrastructure**

   Providing all schools with digital tools and fast connections is an essential prerequisite for reducing the digital divide, giving priority to schools located in particularly disadvantaged and remote areas, where material and educational poverty is more widespread.

2. **Ensuring artificial intelligence literacy paths for all students**

   In school curricula, artificial intelligence literacy must be guided by the fundamental principles of inclusion and equity, regardless of background and learning specificities and with respect for diversity. As is being pioneered in many European countries, artificial intelligence literacy needs to be incorporated into educational curricula, as part of digital curricula and/or civic education pathways.

3. **Training teachers and educators**

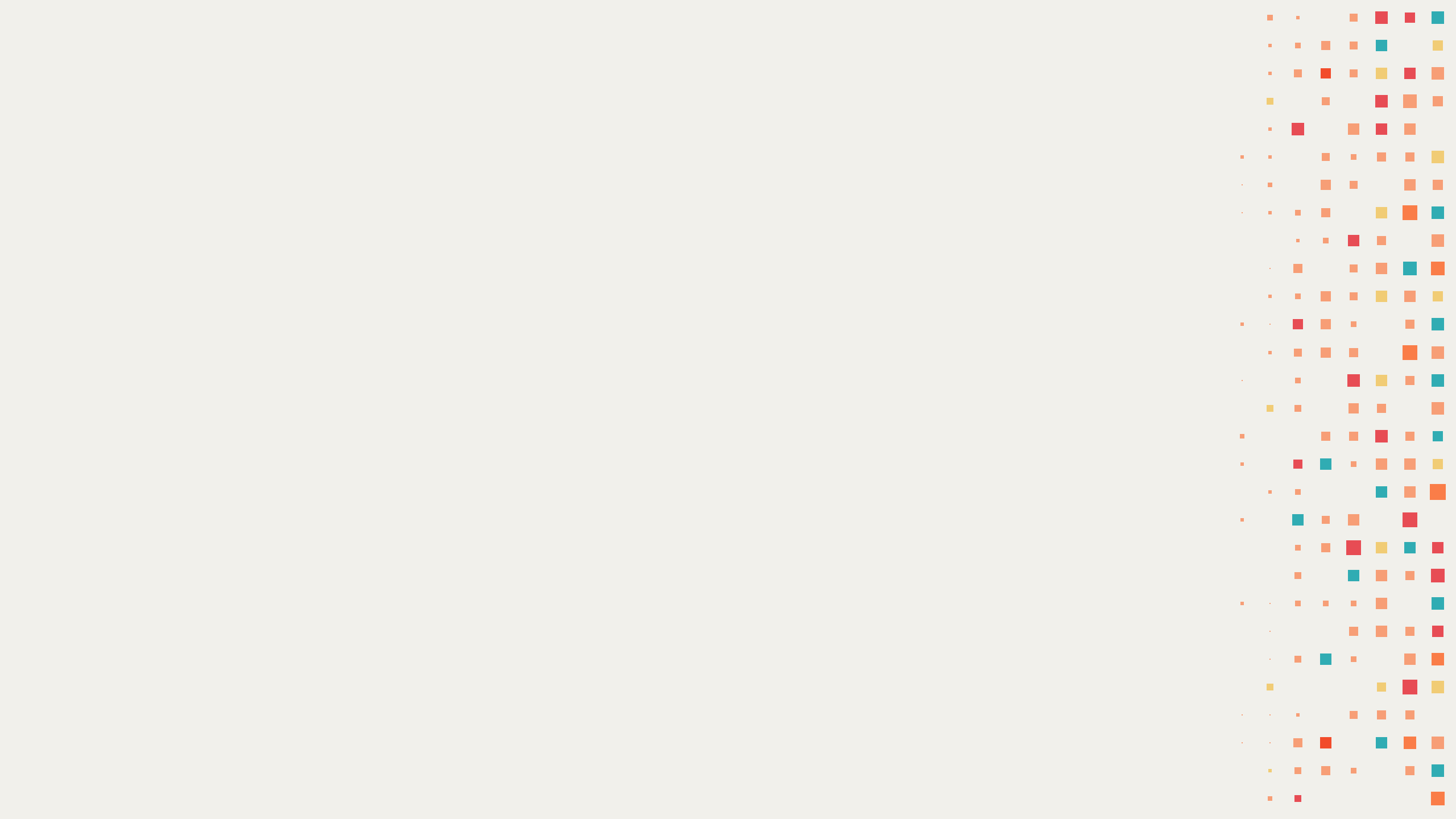
   Ensure training programmes for teachers and educators to improve their understanding of artificial intelligence, its applications and implications for education/education, giving priority to schools and educational centres in disadvantaged contexts. It would be useful to consider supplementing textbooks with specific and up-to-date sections on artificial intelligence technologies and their critical use, to further assist teachers in addressing these issues in the classroom.

4. **Developing assessment methods for digital competences related to the use of artificial intelligence**

   Further investigation and experimentation within school and educational contexts are essential to further explore this topic.

Although efforts exist at institutional, academic and field level to develop assessment methods for digital competences, there is a shortage of specific tools to assess skills related to understanding and using artificial intelligence technologies. It is recommended that national education systems activate synergies and forms of collaboration to create effective and shared methodologies for assessing digital competences related to artificial intelligence.

Teachers, educators and researchers should collaborate together in the identification of key competence areas and the creation of effective assessment methodologies that can measure students' abilities to deal confidently with the changing landscape of artificial intelligence and even contribute to its development.



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