AI PIONEERS

Artificial Intelligence in education & training

Guidelines to design your own AI projects and initiatives

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EXECUTIVE SUMMARY

Advances in Artificial Intelligence (AI) have been marking our era with ongoing revolutions in all the spheres of individuals' life, e.g., education. Beyond the social sphere, the constant exponential evolution has led academics and non-academics, teachers, trainers and practitioners in general in the area of education to experiment and imagine how AI can represent the means through which changing training and education. The present report aims to offer an understanding of the existing perspectives on the use of AI in Adult Education and Vocational Education and Training in order to understand how to integrate in the educational sector.

To achieve this aim, the present report comprises the results of two research activities conducted within the Working Package 4 of the AI Pioneers coordinated by the University of Verona and in collaboration with all the project partners. Understanding how AI can change the educational sector and in particular Adult Education and Vocational Education and Training requires a research approach that stands at the nexus between academic and practitioner perspective. This is why we undertook two main research activities, namely: a literature review of the use of AI in Education and a large cross-country qualitative study on teachers' uses and perspectives on AI in Education.

The present Report comprises the ultimate findings on the use of AI in Education in addition to reporting the two research activities undertaken. In the first chapter, the report comprises a) description of the project and Working Package 4 methodology, and b) highlights of the findings with short description of the main results of the two research activities. This chapter is meant to offer a practical guideline for teachers and trainers who are interested in understanding AI in Education and how to integrate AI in Education.

The second chapter contains the literature review, i.e., the first study conducted. In this study, we refer to existing reviews of the literature and perspectives of academics on the use of AI given the sparse empirical knowledge on the use AI in education. Moreover, given the small number of studies in Adult Education and Vocational Education and Training, we refer to the use of AI in Education in general.

The third chapter contains the qualitative study conducted, that is the second study realized for the Working Package n. 4. Partners collaborated in the realization of this study by conducting interviews

and focus groups with trainers and teachers in the area of VET and Adult Education in order to collect their perspectives on the use of AI and its integration.

Taken together, the chapters makes the document providing a comprehensive guide for incorporating AI in Adult Education and in Vocational Education and Training. The overreaching aim of the report is to support the preparation of trainers and teachers to harness the promise of AI in enhancing learning experiences while mitigating risks through ethical and thoughtful integration.

1. WHAT TO KNOW TO DESIGN YOUR AI PROJECT

1.1 AI PIONEERS

The AI Pioneers project, under the ERASMUS+ Forward Looking Project, is a multifaceted initiative aiming to integrate Artificial Intelligence (AI) into education, particularly in Adult Education and Vocational Education and Training (VET).

The project focuses on various aspects:

Impact of AI on Education: The project acknowledges the transformative power of AI across all economic and social sectors, including education. It is recognized that AI can accelerate the achievement of global education goals by reducing barriers to accessing learning, automating management processes, and optimizing methods to improve learning outcomes. The European Digital Education Action Plan's strategic priorities align with the project's objectives, which include developing a high-performing digital education ecosystem and enhancing digital competences for the digital transformation.

Reference Network of AI Pioneers: A central component of the project is to establish a reference network of AI Pioneers, consisting of trainers, stakeholders, policymakers, and educational planners. This network will serve as a hub for the promotion and teaching of AI in Adult Education and VET, and it will act as a point of reference for the design and implementation of future AI-related educational projects at various levels.

Supplement to the DigCompEDU Framework: Another objective is to develop a supplement to the DigCompEDU Framework, outlining the skills and competences of educators related to AI in education.

Development of Resources: The project aims to produce recommendations, toolkits, and implementation guidelines for AI Pioneers at both organizational and systemic levels. These resources will be disseminated to promote the use of AI in education and training.

Ethical Guidelines for AI Use: The project will also focus on developing guidelines for ethical and trustworthy AI use in education, in line with existing EU policies. This will include producing an evaluation schema and piloting these guidelines in practice.

Dissemination and Mainstreaming: The project includes a strong emphasis on disseminating its findings and mainstreaming its results into the wider educational landscape. This includes involving participants in project activities and disseminating project results to other education providers, organisations, policy makers and planners.

Project Management and Impact Analysis: The project consortium, composed of various organizations, will manage the project through a structured approach, ensuring smooth development and implementation. Impact analysis will measure the project's effects on target groups at local, national, and European levels.

Project partners

- ITB, University of Bremen, (Germany) Coordinator
- TecMinho (Portugal)
- Active Citizens Partnership (Greece)
- **CARVET, University of Verona (Italy) – Responsible for the Working Package n. 4**
- University of the Basque Country (Spain)
- Pontydysgu (Spain)
- European Distance and E-Learning Network (Estonia)
- Federal Institute for Vocational Education and Training (Germany)
- Centre for Social Innovation (Cyprus)
- CNOS-FAP Federation (Italy)

1.2 METHODOLOGY OF THE WORKING PACKAGE N. 4

The AI pioneers aims to develop tools and resources about AI in Adult Education and VET, not just to support AI Pioneers_but all those working in Adult Education and VET, including researchers, managers, policy makers and planners. Working Package n. 4 (WP4), led by the University of Verona, aims to identify and analyse best practices on a global level about use of AI in education in areas related to Professional Engagement. Digital Resources, Teaching and Learning, Assessment, Empowering Learners, Facilitating Learners' Digital Competence (T4.1). This includes a literature review on AI and education (Study 1, see Chapter 2) and Focus groups and interviews with target groups (teachers, trainers and schools/VET centre managers) (Study 2, see Chapter 3) to identify best practices about AI, education and project design. Project design is seen as key to increasing the use of AI in Adult Education and VET as a key step towards mainstreaming its implementation in practice. This initial work under the Work Package leads to the development of key resources: a toolkit (T4.2), Open educational resources (T4.3) and Scenarios (T4.4). These resources will be available in all partner languages.

1.3 HIGHLIGHTS & GUIDELINES

AI IN EDUCATION – TECHNOLOGIES

- AI is a transformative force in education, with significant impacts on several educational sectors, e.g., Adult Education & Vocational Education and Training;
- Technologies such as Intelligent Tutor Systems (ITS), Machine Learning (ML), Natural Language Processing (NLP), Virtual Reality (VR) and Augmented Reality (AR) offer possibilities for improving teaching and learning.

INTEGRATING AI IN EDUCATION

- To integrate AI in Education, teachers and trainers should follow the principles of personalisation, efficiency, accessibility, inclusiveness and the potential for improved learning outcomes.
- ITS, ML, NLP, VR and AR are the most widely used AI technologies today.
- Good practices include the creation of a hierarchical structure for the design of educational content and modules on AI.

BENEFITS

- Benefit for students are: customised tutoring systems; problem-solving skills, high cognitive skills and improves student motivation.
- Teacher and trainers play an important role to undergo significant changes, with a reduction in tasks due to the automation of assessments and more opportunity to focus on the explanation of concepts.
- AI can collect and analyse data on students, making it easier to monitor performance, emotional tendencies and quality of work.
- The implementation of AI in educational institutions would lead to significant cost reductions through the automation of administrative tasks, improving the quality of education.
- The increased accessibility and flexibility of education would lead to an increase in student numbers.

RISKS

- Need to provide adequate training on these new technologies to both students and teachers and to thoroughly address ethical and privacy issues is emphasised to ensure the success of these transformations.

GUIDELINES

The following guidelines have been developed based on data collected through literature review and analysis of interviews with practitioners. The aim is to establish a framework for the successful and ethical integration of AI in education, focusing on positive aspects while concurrently addressing potential challenges and concerns.

- **Prioritize Personalization and Student-Centric Approaches:**

  Leverage AI to provide personalized tutoring, customized instructional strategies, and activities tailored to individual learners. Focus on addressing the unique needs and characteristics of each student.

- **Promote Motivation and Engagement:**

  Implement AI tools that contribute to increased motivation and engagement, especially in subjects like STEM. Design educational experiences that capture students' interest and foster a positive learning environment.

- **Enhance Efficiency in Assessment for Educators:**

  Integrate AI tools to streamline and enhance the efficiency of assessment processes for teachers and trainers. This allows educators to spend more time to developing effective teaching strategies.

- **Leverage Data-Driven Insights:**

  Harness the power of AI's data collection and analysis capabilities to gain valuable insights into students' study habits and learning processes. Use this information to inform instructional approaches and interventions.

- **Implement Early Intervention Strategies:**

  Utilize AI for constant monitoring to identify students at risk of dropout. Develop early intervention strategies to address difficulties promptly and maintain high motivation among students.

- **Ensure Accessibility and Inclusivity:**

When implementing AI, focus on making education more accessible and inclusive. Provide study materials that are available at any time and place, ensuring that students, including those with disabilities, can participate in classes.

- **Address Technical and Training Challenges:**

  Proactively address challenges related to the availability of technical equipment, staffing, and the need for student training. Ensure that there is adequate support and resources for successful AI integration.

- **Promote Transparency and Ethical Considerations:**

  Prioritize transparency in the use of AI tools, especially those provided by private entities. Implement ethical considerations to address issues related to biases, cultural sensitivity, and data protection. Ensure that students and educators are informed about how AI tools operate and their impact.

- **Developing a Network of Collaborations:**

  Cultivate relationships with both public entities and autonomous initiatives by teachers to build a robust network of collaborations. This will foster greater flexibility in organizing training courses.

  Actively Engaging Administrative Bodies:

  Promote close collaboration with the administrative bodies of schools and institutions, especially concerning autonomous initiatives. This can facilitate the coordination and management of educational activities.

- **Seeking Support from State Programs:**

  Maintain sensitivity and attention to the guidelines of state programs, integrating educational objectives with national initiatives to ensure alignment with regulations.

- **Promoting Operational Flexibility:**

  Adopt a flexible and adaptable approach to the dynamics of the educational sector. This will enable a prompt response to the evolving needs of students and the educational environment.

2. STUDY 1 – LITERATURE REVIEW OF THE USE OF AI IN EDUCATION

2.1 Introduction

Artificial Intelligence (AI) is increasingly marking all the core areas of interests in education and training. Being at the nexus as an educational discipline (e.g., in digital engineering) and as a tool for education, the recent advancement in AI represents a reality for all the individual spheres that affects and shapes formal and informal ways for training. While this social endeavour is welcomed, it becomes also crucial to establish initial understanding on how AI in education can result in the near future, and how it can impact Adult Education and Vocational Education and Training (VET).

Historically, the human being has been continually intrigued by the idea to create intelligent artefacts. Following John McCharty (2007) AI is "the science and engineering of creating intelligent machines, especially intelligent computer programs. [It] relates to activities such as using computers to understand human intelligence, but AI should not be confined to methods that are biologically observable." Therefore, AI is a field of computer science interested in the development of mechanisms capable of performing tasks that routinely require human intelligence: namely the purpose of computer science stands in the creation of systems able to learn, reason, perceive, and understand human language, and make decisions accordingly. It results from the combination of algorithms, statistical models, machine learning techniques, neural networks and other methodologies to simulate or reproduce some of the human cognitive capabilities. Unsurprisingly, AI easily applies to every branch of social life, e.g., education, extending the mere nature of an ideal of the human being or the wish of a specific disciplinary field. AI tools relate to specific areas of application (e.g., generative artificial intelligence for conversations) which expand the scientific purpose of computer engineering.

The educational sector has been part of the many applications of AI with the first intelligent tutor system, used by students in learning geography tracing back to the early 70s. Nowadays, education and training sector have been starting to include new AI robotic systems and chatbots to foster learning and training techniques leading to open new questions on the future of education itself (Luan et al., 2020). AI renovates the mere terms *training* and *education*, or at least gives impetus to reinterpret education and training. This is due to the fact that training and education follows the use of devices and strategies (teaching and training strategies) for the dissemination and construction of educational contents with the purpose of developing an individual's skills, knowledge and abilities

in a given field (Aguinis & Kraiger, 2009). Ultimately, the constant exponential development of open and easily accessible AI tools impacts the education as new (digital) devices and strategies for disseminating and constructing educational contents.

In the literature, scholars and practitioners have been taking into account such a reinterpretation of the educational sector. Scholars have conducted different research studies (e.g., empirical studies, literature reviews and conceptual contributions) to investigate the impact of specific AI tools in specific disciplinary areas (e.g., medical sector). For example, the literature is fulled by reviews of the literature discussing the role of specific AI robotic system–for medical education, while conceptual contributions have been discussing the role of AI for the future of education. Despite the valuable effort present in the literature, questions on how AI is changing education in general remain unanswered. For example, the understanding of a) the way education is chaining and being renovated by AI, b) the types of technologies used in education, and c) which evidence is there about best practices remains limited to specific sectors.

The present article seeks to improve the understanding of the effects of AI in Adult Education and VET by undertaking a synthesis of the existing perspectives on the use of AI in education. Our overreaching aim is to realize a map of the impact of AI in education in order to provide an initial basis for research and practice. By using the method of the systematic literature review, the present paper seeks to answer the following question: What knowledge and evidence base is there on the use of AI in training and education? Considering the large amount of literature reviews and conceptual papers, the present research limits to this specific type of research in order to offer an umbrella of the existing perspectives on AI in education. The synthesis serves to formulate a comprehensive and holistic perspective that can offer initial answers to questions on a) what AI technologies are being used in training and education, b) what uses and c) best practices are identified in the literature. Ultimately, the present paper aims to provide contributions on how to implement AI technologies in the field of Adult Education and VET. It is perhaps worth noting that the existing literature lacks extensive discussions about the use of AI technologies in these contexts. Accordingly, our synthesis will serve to offer indications for these fields.

In the rest of the paper, we proceed as follows. First, we describe the method used for undertaking our synthesis of the reviews of the literature. Second, we analyze and provide answers to each of our research questions (e.g., types of AI technologies, uses and good practices). To conclude, we

discuss our results by setting out future research perspectives and applied implications for education and training.

2.2 Method

In this literature review, we refer to the methodological lines proposed by Briner and Denyer (2012) for conducting systematic literature reviews. In sharp contrast to rigorous criteria of other methodological approaches, Briner and Denyer (2012) suggest that literature reviews in organization studies, social sciences and educational sciences should follow principles. Accordingly, a systematic literature review aims to "report as accurately as possible what is known and what is not known about the research questions addressed in the review" (Briner, Denyer, & Rousseau, 2009, p. 27). Briner and Denyer's approach appears as an effective approach in the field of education studies in which different disciplines and perspectives are intertwined. This approach allows for the collection of multiple data giving researchers the flexibility to understand issues with consistency. Rather than rigid criteria, Briner and Denyer propose adhering to four main principles that ensure a rigorous approach: a) organization, b) transparency, c) replicability, and d) quality. First, the review must be conducted according to a system or method specifically designed to address the review's research questions. For the sake of transparency, the method followed should be clearly stated to ensure that other researchers can effectively replicate the review. Finally, through synthesis, the findings in relation to the research question(s) can be summarized in a structured and organized manner to ensure replicability, credibility, and relevance.

Following Briner and Denyer's principles, a literature review has to follow concrete research phases. First, the researchers involved in the literature review plan the review (i.e., define the research question(s) and pilot search of the literature). Second, the researchers undertake a structured search using terms related to the research questions. Third, researchers evaluate the material collected and finally, they analyze and synthesize the information to present the results.

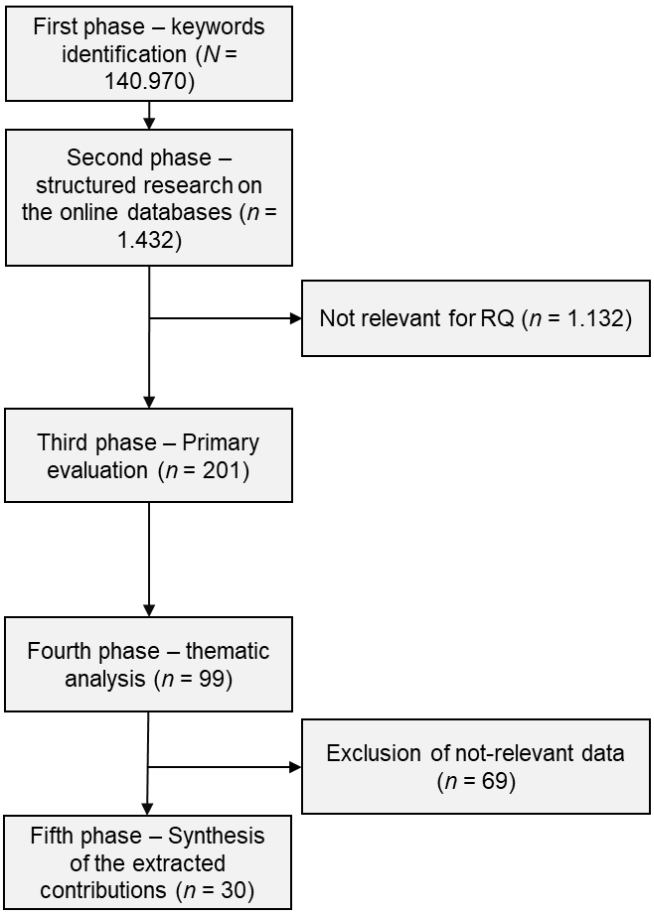
2.2.1 Data Collection Procedure

To collect data for our review, we undertook the first three phases of the literature review according to Briner and Denyer (2012)'s approach. In the first phase, the pilot search, keywords were defined related to the research question "What knowledge and evidence base is there on the use of AI in training and education?" and the sub-questions on AI tools, uses and best practices. Then, we grouped keywords relating to "education" and "training" with keywords on "artificial intelligence" by using Boolean system AND, OR, AND NOT. These were then tested in two scientific search

databases, Scopus and Eirc. The result of our pilot search led to a total of *N* = 140,970 contributions (*n* = 4,444 on Scopus, *n* = 136,526 on Eric). To better define the focus of the search for bibliographic material, the second phase of the structured search, we used more structured extraction strings with a number of related keywords and synonyms used in the context of education: “education”, “training”, “school”, “Vocational education”, “Vocational Education and Training”, “School”, “Teaching”, “Teach*”, “VET”. Likewise, we identified specific terms for artificial terms such as “AI”, “technology”, “digital devices”, “generative artificial intelligence”, “chatbots”, “robotics”. Following the Boolean system, we considered all the terms by using “AND”, “OR” and “AND NOT” commands to guide the search by creating specific categories of analysis and data extraction. In addition, we used specific criteria for inclusion and exclusion of items provided by the scientific databases. We limited our search to contributions in English. Moreover, given the sparse presence of empirical studies and a large amount of literature reviews and conceptual papers, we limited our search to these types of items, namely reviews and conceptual papers. For date range, we considered only recent contributions by limiting to studies that have been published between 2019 and May 2023. At the end of the second phase, we collected *n* = 1,432 items, which were first screened for the presence of articles not relevant to the research question and duplicates, yielding a total of *n* = 1,132.

To conclude the data collection, the third phase involved a primary evaluation based on title, abstract and discipline. We considered only contributions referring to education and artificial intelligence (*n* = 201). During this phase, we noted that a large number of contributions referred to the medical areas in which AI tools are applied. We decided to not consider these contributions as representing to not bias the review and realize a broader perspective on AI in education. At the end of the evaluation phase, we obtained a total of *n* = 99 items (see Figure 1).

Figure 1, data collection and extraction according.



2.2.2 Data extraction

In the fourth phase, we begin the data extraction by conducting a thematic analysis of the items collected. To conduct this phase, we realize a specific evaluation ~~from~~ (see Appendix A) which has been filled in by the researchers involved in the study. The evaluation form comprised questions on the quality of the study in addition to specific aspects relating to a) types of AI technologies, b) uses and best practices identified. The use of the evaluation form allowed to have an initial basis for the synthesis beyond refining data collected. Each researcher worked individually to conduct the thematic analysis and submitted the material to Author 1 who reviewed the material collected and approved the analysis. After this stage, three researchers compared the extracted documents and re-evaluated each scorecard by excluding irrelevant data, resulting in a total of n = 29 items for phase five, i.e., the final stage of synthesis of the extracted contributions.

2.3 Results

2.3.1 Overview of the extracted items

Within the 29 items collected, we identified *n* = 1 bibliometric analysis, *n* = 1 historical review, *n* = 1 systematic-bibliometric literature review, *n* = 1 case study, while the rest literature or narrative reviews. Studies have been conducted largely in general education and the application of Artificial Intelligence. Other contributions focused on higher education, inclusive education, and only education while *n* = 1 on dental education, *n* = 1 on mathematics and *n* = 1 on STEM education. According to a general view, the various items highlighted the speed of the global changes claiming the need for rapid adaptation to the new conditions in higher education (Reis-Marques et al., 2021) with the use of artificial intelligence in teaching is currently not totally widespread, but destined to become one of the main tools to be used (González-Calatayud et al., 2021).

Overviewing the contributions, the main uses of AI applied to education are related to tutoring and assessment, the intelligent tutoring systems (ITS) developed at the moment show more effectiveness than traditional methods and are beneficial tools for teaching and learning activities by supporting learners and human tutors in their activities (Alfaro et al., 2020). General perspectives discuss artificial intelligence has the potential to improve efficiency and accuracy in research, personalize learning experiences, and make education more accessible and inclusive. with the help of AI, teaching and learning become more exciting and creative by making it easier for students to understand a subject, in addition, the increasing use of extended reality (XR) also makes online education more attainable, useful, engaging, collaborative, and self-learning (Rangel-de Lázaro & Duart, 2023). One of the greatest merits of AI is to enable personalized instruction; conventional teaching requires many more resources than online teaching in terms of teaching spaces, scheduling and human resources (Maghsudi et al., 2021). Moreover, there is a large agreement within the collected items that most applications of artificial intelligence have favorable outcomes on students' academic performance, from the technological point of view, the studies reported good efficiency and accuracy of algorithms in the application of AI in STEM (Science, Technology, Engineering and Mathematics) education (Xu & Ouyang, 2022).

Finally, most of the authors agree that there are some gaps in this field of research which can bring possible complications in the inclusion of AI in education. Large consensus suggests that it is necessary for schools that intend to use them to promote specific training courses for teachers so that they can better control the activities and compensate for deficiencies (Zanettia et al., 2020).

Assisting teachers to develop the digital skills and abilities needed to use AIED (artificial intelligence in education) applications and tools in an ethical and informed manner is critical to improving the student learning experience and achievement of learning outcomes (Lameras & Arnab, 2021).

Table 1, descriptives of the items included.

Author/s (year)	Contribution to	Type of AI and digital tools
Alkhatlan & Jugal Kalita (2018)	Education (general)	Intelligence Tutoring Systems
Bozkurt et al. (2021)	Education (general)	Blended/hybrid learning
Bressame et al. (2022)	High education	The fuzzy AI-based model
Deng & Yu (2022)	Education (general)	Machine translation (MT)
Gamage et al. (2022)	Education (general)	Moodle Learning Management System (LMS)
González-Calatayud et al. (2021)	Education (general)	The use of AI for student assessment in online and face-to-face subjects.
Humble & Mozelius (2022)	Education (general)	SWOT-framework, Google scholar
Kooli (2023)	Education (general)	Chatbot, ChatGPT
Lameras & Arnab, (2021)	Education (general)	Artificial Intelligence
Maghsudi et al. (2021)	Education (general)	Machine Learning (ML)
Mallik & Gangopadhyay (2023)	Education (general)	Machine learning & deep learning methods
Mohamed et al. (2022)	Education (general)	Robotics, systems, tools, teachable agent, autonomous agent, and a comprehensive approach.
Okonkwo & Ade-Ibijola (2021)	Education (general)	Chatbots
Ramesh & Sanampudi (2022)	Education (general)	AI and machine learning used for automated essay scoring.
Rangel-de Lázaro & Duart (2023)	High Education	Extended Reality & Artificial Intelligence
Reis-Marques et al. (2021)	High education	Blockchain technologies
Saghiri et al. (2021)	Education (general)	Virtual reality & augmented reality
Salas-Pilco et al. (2022a)	Education (general)	AI machine learning, NLP (Natural Language Process), VMAR (augmented

		reality), LA (Language Analytics) dashboard
Salas-Pilco et al. (2022b)	Education (general)	AI & LA, Mobile learning & technology, Game-based, VR, Robotics
Shaik et al. (2022).	Education (general)	Machine learning, deep learning, and natural language processing (NLP)
Shenkoya & Kim (2023)	Education (general)	Digital transformation in general
Soofi et al. (2019)	Education (general)	Information Technology System
Tahiru (2021)	Education (general)	Artificial Intelligence
Tan et al. (2022)	Education (general)	Computer-supported collaborative learning (CSCL)
Wang-Kin. C. (2021)	Education (general)	Robotics, virtual reality (VR), and augmented reality (AR)
Xu & Ouyang (2022)	Education (general)	Automated AI technologies, e.g., intelligence tutoring, automated assessment, data mining and learning analytics.
Yue et al. (2022)	Education (general)	Machine Learning
Zanettia et al. (2020)	Education (general)	ITS, content creation and the augmented and interactive virtual reality.
Zheqian Su et al. (2019)	Education (general)	AI assessment system

2.3.2 Artificial intelligence tools & uses

Diverse AI tools are present in the literature. The most widely used are intelligent tutoring systems (ITS), machine learning (ML), natural language processing (NLP), virtual reality (VR) and augmented reality (AR). *Intelligent tutoring systems* are integrated and complex systems, designed and developed using artificial intelligence approaches and methods, for solving problems and requirements of teaching/learning activities in education and training of students and the workforce, based on computers and emerging web-based resources (Alfaro et al., 2020). *Machine learning* is a branch of artificial intelligence that focuses on creating algorithms and statistical models that enable computers to improve performance on a specific task through experience and learning

from data. In other words, machine learning allows computers to learn from data and autonomously improve over time without being explicitly programmed to perform a specific task (Zhi-Hua, 2021). Instead, *natural language processing* is a branch of artificial intelligence that focuses on the relationship between computers and human language. The main goal of NLP is to enable computers to understand, interpret, and generate human language naturally. This field addresses the challenge of enabling computers to interact more meaningfully and usefully with humans through language (Shaik et al., 2022). Finally, virtual reality and augmented reality are technological tools used for visual education. *Virtual reality* is a technology that creates a simulated environment, often three-dimensional and interactive, that can be explored and manipulated by a person through the use of devices such as VR viewers, sensory gloves, or controllers. This virtual environment can be designed to represent a completely imaginary world or can be a simulation of a real-world environment (Riva & Gaggioli, 2019). *Augmented reality* is a technology that superimposes digital elements, such as images, sounds or information, on a real-world environment in real time. In essence, AR enriches the perception of the real world by adding virtual elements, often through devices such as smartphones, AR glasses or AR visors (De Paolis, 2012).

The use of AI follows the idea that it can improve teaching and learning, with positive effect on students who can personalize feedback and evaluate their performance (González-Calatayud et al., 2021). Students can also become more critical and responsible in facing daily challenges, learn and improve interpersonal skills and social interactions (Mohamed et al., 2022). For example, intelligent tutoring systems, developed as tools to help in education and training, include affective tutoring systems, a mechanism that monitors the emotional state of students and generates a response in the form of encouragement and feedback, or by changing the difficulty of the task, and game-based tutoring systems so that children learn better while having fun (Alkhatlan & Jugal Kalita, 2019).

Examples of the use of AI in education appear in facilitating the learning process by the application of AI in tutoring, assessment, personalization, gamification, data analysis, and content generation. However, authors discussed how AI is certainly supportive in learning, but it cannot completely replace human interaction and experience-based learning since AI can only provide personalized feedback and support (Di Tore, 2023). Anyways, while formal education requires more resources, such as teaching spaces and planning, AI technologies and tools hold the potential for revolutionary change in traditional education (Maghsudi et al., 2021).

Considering their uses, differences appear in respect to the subject of training and education. In most of the selected articles, artificial intelligence was employed in the general educational context. However, some of them investigated precise areas of education, namely: primary school education, mathematics education, STEM education, inclusive education, and dental education. In primary school education, artificial intelligence is mainly used to develop personalized pathways and innovative solutions, such as using intelligent tutoring systems to support students in learning (Alfaro, et al., 2020). Experimental uses of AI are present in pedagogical reflections on education and how to design more effective teaching methodologies (Yue et al., 2022). STEM (Science, Technology, Engineering and Mathematics) Education benefits from AI to create interactive and stimulating learning environments, which can include simulations and virtual labs to address STEM disciplines in a more engaging way (Xu & Ouyang, 2022). Similarly, in dental education AI can be used for training dentists, particularly simulations of dental procedures are used (Saghiri et al., 2021). Finally, in the context of Inclusive Education, AI is used to promote accessibility to education for all, including students with disabilities (Salas-Pilco et al., 2022).

2.3.3 Best practices

The process of identification of best practices on the use of AI tools has required a thorough analysis of the contributions. On the surface, best practices are techniques, procedures or methodologies that are applied in specific context and demonstrate to be the best in reaching specific goal or target. Both implicit and scientific thinking understand best practices as essential given the proof of effectiveness when they are applied to specific context and yield positive results. In the scientific context, best practices have also the characteristics of being accepted and recognized by the scientific community, i.e., experts in the field, which should ensure a certain degree of reliability. However, these procedures are not always present within the scientific literature and are usually discussed in relation a specific context. In the educational context, for example, this is achieved by presenting a procedure or a technique in a specific educational setting with specific educational purposes. Moreover, these elements do not apply in general, but these procedures can change or depend on different factors, such as the individual, the relational level (e.g., teacher and student) or the institutional context.

In our literature review, a few specific procedures emerged as understandable as best practices per se according to the literature. First, the application of Intelligent Tutoring systems (ITS) was found to be very effective, as through the latest of them, it was possible to monitor students' emotional state,

provide more appropriate feedback, increase problem solving skills through the management of automatically generated problems that students had to solve and implement personalized interventions. To use ITS, scholars discussed how teachers and trainers should take care about the introduction of the ITS by presenting the tool, explaining its potential and motivating students in their use. This applies effectively in respect to the realization of game-based training, i.e., game-based ITS, which acts as booster of (for) student engagement (Alfaro, et al., 2020; Alkhatlan & Jugal Kalita, 2019).

Second, authors emphasized how the use of translation technology (MT) and generative AI in education can be effective. However, to pursue such effectiveness, trainers and teachers must consider the importance of following a series of steps before their involvement. For example, the use of generative Ai must be a) introduced, b) explained and demonstrated as a useful tool before c) assigning tasks and d) supporting reflection on it within students. The core idea is to maintain a critical approach to the use of AI but also to tailor the use of AI based on the different competencies of students (Deng & Yu, 2022).

Last but not least, there is a large agreement that one of best practices for the inclusion of AI in education involves the creation of a hierarchical structure in which designing and presenting AI tools in general or specific devices. This occurs with the design of educational content and modules on AI with modules in classified into beginner, intermediate and advanced levels. Such a procedure allows for flexibility in content selection and definition and provides the student with a pathway for skill development (Yue, et al, 2022).

2.3.4 Strengths & Weaknesses of the use of AI in Education

Defining the use and the best practices in the area of AI applied to the educational and training context means identifying a technique, method, or procedure that, when applied, can effectively integrate artificial intelligence within the educational environment. This integration should result in tangible improvements in student performance, motivation, and the learning process, as well as provide significant benefits to the educational figures involved. Within the 29 items extracted and analyzed we noted that there was not a predominant best practice, but multiple aspects emerged (e.g., points of strength or weaknesses). Given the presence of few examples, in our analysis aimed at proposing an initial understanding of the best practices associated with the implementation of AI in education, we identified a) weakness and strengths and b) the different positive or negative effects which AI tools can have.

Strengths of the use of AI

Among the items, there is a large consensus on defining AI as a tool with a number of benefits for students, teachers/trainers and educational institutions. The majority of the items report how the use of AI in educational settings results in a general improvement in the effectiveness and efficiency of teaching and learning. First, at the student level, a considerable benefit of AI in education is the possibility of addressing one of the most present educational issues which is the need for personal tutoring. Within the contemporary educational landscape, the most common educational relational dynamic involves a teacher, trainer or educator and numerous students. The quality of learning would improve if there was a teacher for every pupil (Zanettia et al, 2020), but because the cost is an option that is very often unaffordable, AI integration would not only allow students to be personally tutored. Moreover, AI systems can also customize instructional strategies and activities to the needs and characteristics of the learner, and provide appropriate feedback to the individual student (Lameras & Arnab, 2021; Alkhatlan, & Jugal Kalita, 2019; Ramesh & Sanampudi, 2022). This would entail a significant shift in perspective, in which it is no longer the student's responsibility to adapt to the educational system but the educational system becomes responsible for the student's adaptation. Moreover, the value of AI tutoring can result in improved learner performance (Wang-Kin, 2021), enhanced development of higher-order thinking (Xu & Ouyang, 2022), and increased problem solving skills through the creation of specific problems tailored to the student's skills (Mallik & Gangopadhyay, 2023). Notably, the use of AI tools in education contributed to increase the motivation and engagement of learners, particularly encouraging interest in STEM subjects (Salas-Pilco et al, 2022).

Second, at the level of *teacher/trainer*, the application of AI in educational settings offers them numerous advantages. Thanks to the use of AI tools, the assessment of tests and tasks can be carried out much more quickly and efficiently. This means that AI tools can greatly lighten the workload of teachers and gives them the opportunity to focus primarily on the creation of teaching strategies to improve student learning (Bozkurt et al, 2022; Ramesh & Sanampudi, 2022). Artificial intelligence's ability to collect and analyse data makes it possible to gain insights into students' study and learning habits, providing an opportunity for teachers to deeply understand their pupils' learning processes and adopt more suitable approaches in order to maximize results (Lameras & Arnab, 2021). In addition to this, artificial intelligence can also prove effective in preventing and counteracting school dropout, as it allows for constant monitoring of each student's performance. This constant monitoring gives the ability to do predictive analysis and identify students at risk of not completing

a course. Identifying these students allows teachers to intervene early to help them overcome difficulties and maintain high motivation (Bressame et al., 2022; Mallik & Gangopadhyay, 2023).

Lastly, at the *institutional,* the application of AI in education can lead to a digital transformation that would innovate several areas of educational institutions. The inclusion of AI in education can lead to a significant reduction of costs by enabling the automation of administrative tasks while personal tutoring systems would allow teachers to invest more time in explaining more complex concepts (Tahiru, 2021). Taken together, these elements would result in improved effectiveness of educational institutions in general. Moreover, some authors highlighted how AI can make education more accessible to more learners and make it easier for students with disabilities to attend classes (Shenkoya & Kim, 2023; Okonkwo & Ade-Ibijola, 2021). Study materials being available at any place and time would allow students the time they need to best learn the concepts.

Weaknesses of the use of AI

To make a comprehensive analysis of the implications of artificial intelligence applied to the educational context, it is essential to consider not only its undeniable advantages but also its weaknesses and challenges. Some of the main issues raised in the various items relate to the availability of the various technical equipment, the lack of adequate staff to handle the technological tools, and the need to train pupils in their use (Wang-Kin, 2021; Mallik & Gangopadhyay, 2023). Other articles, however, have pointed out problems related to the possibility of equitable treatment among students. For example, ITS is not always efficient because the provision of personalized instruction for all may be hindered by differing technological and economic development among states (Zanettia et al., 2020).

In addition, it is important to note that these technological tools are mainly provided by private entities, resulting in a lack of transparency in how they operate and how they are used. For this reason, it is not always possible to know how data are protected, except on the basis of general privacy laws (Zanettia et al., 2020). With the advent of AI, we are also faced with critical ethical and cultural issues, which entail an additional obstacle for equality of opportunity among learners; in fact, the creation of content in intelligent tutoring systems may be affected by the difference in programming and teaching that any culture might produce, with possible biases favouring learners belonging to the culture of the producer of the said system. AIED systems also may be affected not only by cultural biases but also by students' performance and abilities (Zanettia et al., 2020; Salas-

Pilco et al., 2022). Finally, there are also two empirical studies that found no significant improvement in student learning outcomes (Xu & Ouyang, 2022).

2.4 Discussion

The purpose of this literature review was to identify the implications of using artificial intelligence in training and education contexts. We used the method of systematic literature review to address our question on what are the current perspectives on the use of AI in education and training. Given the paucity of empirical studies and the large presence of literature reviews and perspective contributions, we undertook a synthesis of these last type of contributions in order to offer a comprehensive and holistic view of the use of AI. We followed the guidelines proposed by Briner and Denyer (2012), and after the data collection and data extraction, we analyzed *n* = 29 items to map the existing perspectives on tools, uses and best practices of AI in education. On the surface, it appears that AI as an educational device can provide a series of advantages as well as disadvantages. On the one hand, artificial intelligence improves the efficiency, accuracy of learning by making it more accessible, inclusive, and easy to understand (Mohamed et al., 2022). It requires fewer resources both in terms of space and in human terms, intelligent tutoring systems possess the same behavior as a real teacher, students learn and interact with learning materials, and receive personalized feedback (Alkhatlan, & Jugal Kalita, 2019). On the other hand, ethical and transparency issues can hinder their uses but also possible costs associated with these tools and their maintenance, and lastly the need for training to use AI devices (Kooli, 2023; Alfaro et al., 2020).

2.4.1 Insights for the use of AI in Adult Education and VET

Surprisingly, we have not been able to find contributions that directly cover the topic AI in education in the context of Adult Education and VET. In order to advance initial propositions, it's important to note the absence of direct coverage in the literature may be attributed to the limitations of our research. However, the results obtained in the existing literature review can still offer valuable insights for the implementation of AI in Adult Education and VET. Artificial Intelligence has emerged as a transformative force in education, with a significant impact on various educational sectors. While the literature primarily focuses on AI in general educational contexts, the principles and practices discussed therein can be extrapolated to the realms of Adult Education and VET.

AI technologies, including Intelligent Tutoring Systems (ITS), Machine Learning (ML), Natural Language Processing (NLP), Virtual Reality (VR), and Augmented Reality (AR), offer a wide array of possibilities for enhancing teaching and learning experiences. The insights gained from the broader

educational context can guide the implementation of AI technologies in these specific sectors. The principles of personalization, efficiency, accessibility, inclusivity and the potential for improved learning outcomes, are equally applicable in the context of Adult Education and VET.

Our literature review, of the existing reviews and conceptual papers, shows that the AI technologies most used at present are intelligent tutoring systems (ITS), machine learning (ML), natural language processing (NLP), virtual reality (VR) and augmented reality (AR). One of the most effective AI tools appear(s) to be the use of ITS and the use of generative AI and translation technology. With respect to the best practices, we found that the creation of a hierarchical structure for the design of educational content and modules on artificial intelligence is crucial for the implementation of AI tools in educational settings. As previously described, Artificial Intelligence applied to the educational sector would imply a revolutionary change that would counter the predominant paradigm to date. Instead of students having to adapt to the educational system, playing their role as learners in a passive way, without having the opportunity to be able to express themselves in choosing an educational methodology that is more congruent with their person, with the application of AI a transformation would take place that would reverse this relationship, in fact it would become the burden of the educational institution to adapt to the needs of the individual learner (Lameras & Arnab, 2021; Alkhatlan, & Jugal Kalita, 2019 ; Ramesh & Sanampudi, 2022). This shift is not limited to traditional education; it extends to the domains of Vocational Education and Training (VET) and Adult Education as well.

In this scenario, students can benefit from intelligent personal tutoring system that offers the opportunity to enjoy personalized instruction that respects the individual's learning time. In addition, the use of artificial intelligence has been shown to contribute to the development of higher-order and problem solving skills, as well as improved performance and increased student motivation (Xu & Ouyang, 2022; Mallik & Gangopadhyay, 2023). The role of the teacher in a context in which artificial intelligence has become an integral part of the educational system would undergo significant changes. First, a reduction in his or her duties would take place; in fact, the evaluation of tests and assignments would be fully automated, significantly reducing his or her workload while allowing him or her to devote more time to explaining concepts (Bozkurt et al, 2022; Ramesh & Sanampudi, 2022). Second, AI’s ability to collect and analyze data on students would allow the teacher to get feedback on students' emotional state, performance trends, and the quality of his or

her work, so that it would be easier to identify struggling students. (Lameras & Arnab, 2021; Bressame et al., 2022; Mallik & Gangopadhyay, 2023).

With respect to educational institutions, the implementation of AI in VET and Adult Education would benefit with huge cost reduction due to automation of administrative tasks and higher quality of education (Tahiru, 2021). Educational institutions would also deal with an increase in students caused by the increased accessibility and flexibility of education (Shenkoya & Kim, 2023; Okonkwo & Ade-Ibijola, 2021). Finally, it should be emphasized that in order for these transformations to materialize, it is imperative to provide adequate training on the use of these new technologies to both students and teachers, as well as to address ethical and privacy issues in depth (Zanettia et al., 2020; Salas-Pilco et al., 2022).

2.4.2 Limitations and future research

To conclude, these initial perspective about (on) the use of AI in education for Adult Education and VET presents a number of limitations which can be addressed in future research. This is due to the fact that these limitations appear as general limitations of the existing literature. This is the case of the low presence of contributions investigating general use of AI in education by taking into account student, teacher and institutional levels of analysis. Such an investigation requires resources and time, but it is perhaps worth noting that the mere analysis of a specific tool cannot be sufficient for understanding the impact of AI in education.

In our review of the literature, we explicitly limited to synthetize previous literature review*s in order to* integrate the existing perspectives. To do so, we limited to publications from 2019, we excluded non-English language papers, (as well as publications from other sources than scientific literature. We took these decisions to follow our purposes, but future research could consider the potential of considering different sources and focus on specific AI tools (e.g., ITS). In light of our results that have emerged from this literature review, it is possible to expect a gradual and steady change in the traditional educational and teaching approach known to date. A future is desirable in which the welfare of all involved is promoted, but in which special attention will be paid to students, as AI will enable them to take advantage of a personal teaching method, tailored to the individual's skills and abilities. Teachers will enjoy continuous support suitable for decreasing their workload and easily identifying at-risk students while enabling them to increase the quality of teaching. In this not-so-distant scenario in which technology will be the leading actor, both teachers and students will inevitably need to acquire computer skills. Despite the fear of the change that AI will entail, it is

necessary to foster progress and not limit it, since its potential, if harnessed ethically and transparently, will significantly improve the quality of education, including Adult Education and VET, creating people increasingly qualified to deal with the transformations that have become an everyday occurrence in the contemporary world.

3. STUDY 2 – QUALITATIVE STUDY

3.1 Introduction

Existing contributions in the literature on education and training represent the initial path to address possible opportunities and challenges of the use of AI in Education. For example, Study 1 of the present report identifies technologies and recommendations for understanding the impact of AI and how to integrate AI in education and training.

Nevertheless, there are still seminal questions that remain unanswered. Current knowledge on the core competencies and skills is limited by the perspective of scientific analysis whereby stakeholders' and practitioners' perspectives are still rare or in their infancy. That is, what are the competences needed by teachers and trainers to implement AI in their training and educational activities? Likewise, there are no existing precise cases on how to use AI in education, namely specific indications on how to implement AI in education.

The current understanding of education and training within the AI revolution lacks field knowledge by which to integrate the seminal contributions proposed about the prospects and conditions for AI integration in Adult Education and Vocational Education and Training. Additionally, questions on training strategies and educational tools for boosting and promoting students' development remain open. In brief, what are possible uses of AI in Education that can be effective in terms of student development? What are the risks of using AI in Education? What are the main skills and competencs for implementing AI in education? What are the practitioners' views about the future of education and training? Which are the main specific educational updates? What kind of sustainable practices can be promoted in order to address the risk of technological disruption?

In the present study, we aim to address training and educational challenges for AI implementation by taking into account such questions. We propose a field understanding of the education and training prospects in current transformations by reporting a cross-cultural qualitative study conducted within a sample of education and training practitioners from different European countries. Then, we suggest an integrated view by coupling our findings with the current state of the art (study 1) in order to promote the understanding ~~on~~ of the use of AI in education.

3.2 Methodology

We devised a field study by involving a mix of qualitative data collection and analysis methods; coupling semi-structured interviews with the grounded theory approach (Charmaz, 2008; Glaser et al., 1968). On the one hand, qualitative data collection has been considered to conduct an exploratory investigation from the standpoint of the experiences and views of the participants, i.e., education and training practitioners and stakeholders. On the other hand, the grounded theory approach allowed us to generate new knowledge by valuing the experiences and narratives of participants. This method has been used in similar research contexts already (Perini and Pentassuglia, 2018; Perini and Tacconi, 2017; Tacconi, 2011; Tacconi et al., 2019; Tommasi et al., 2022) since it also helps considering unexpected elements that may occur in qualitative data. We collected data via semi-structured interviews to keep the focus on the research object, without a strict structure of questions. As such, this method helped to let participants tell and present their opinions and link episodes and situations that may be relevant for them (Charmaz, 2008).

We instructed project partners about type of participants we wanted to include in our study, how to conduct semi-structured interviews and report data. Participants were invited by presenting brief description of the study accompanied by the invitation. In this way, 13 adult education and vocational education and training experts were involved in the study. Interviews were conducted both in person and electronically via Skype, GoogleMeet, Zoom or telephone according to the interviews possibilities. The collected data were analyzed following the principles of grounded theory to identify the emerged macro topics. However, given the variety and richness of the collected information, the interviews were also synthesized on a case-by-case basis in the form of summary sheets.

3.3 Results

As previously mentioned, the data was collected through 10 interviews and a focus group composed of 3 individuals, resulting in a total of 13 participants in the research. The primary information gleaned from the analysis falls into the following 5 macro-topics, partially reflecting the macro-argumentative areas of the interview track:

- Project Development Status and Objectives
- Initiative Origins
- Disciplinary Sectors Involved
- Utilized Technologies and Technical Requirements

- Educational Methodologies

The first relevant information from the analysis is that the examined projects are largely still in the embryonic phase or under development. In all cases, teachers and students/trainees are actively involved, sometimes accompanied by public education entities promoting the initiative and training companies engaged in the project. Some projects are even supported by companies specializing in the development of AI-based technologies, providing their solutions for testing.

The objectives of these projects are diverse: teaching new AI technologies to students and teachers, experimenting with new AI-based hardware technologies, seeking strategies to collect data from various sources to predict student dropout risks, and teaching apprentices to create the correct prompts for effective use of AI. Attention has also been given to ethical issues, integrated into several projects (e.g., case 4) or even placed at the center of the educational intervention (as in case 6). Another objective is to teach students to use prompts effectively, especially when interacting with assistants like ChatGPT or services for image generation. Often, integrating new AI-related skills into curricula is a key element of these projects, with particular emphasis in some cases (e.g., case 1, case 8).

The predominantly involved disciplinary sectors relate to specific professional fields such as robotics engineering, graphics, gaming, and business. However, some projects take a cross-disciplinary approach, embracing diverse disciplines and referencing digital skills (cases 6 and 7).

Regarding the technologies used, these include AI assistants like ChatGPT, Microsoft's Copilot, Perplexity, technologies for generating slides like slides.ai, and intelligent tutoring systems. Additionally, technologies for image generation from platforms such as deepai.org, Adobe Firefly, and Midjounery are employed. Tools for plagiarism detection, image recognition software for robotics, and AI-based hardware technologies, such as collaborative robots, are also integral parts of these projects.

In terms of technical requirements, in some cases (e.g., case 4), especially for projects related to robotics, it is necessary to use equipment and computers with high computing capabilities. Conversely, for most projects, specific AI-based software or services and an adequately efficient internet connection are sufficient.

The employed educational methodologies vary widely, ranging from group work to practical activities, lectures to workshops. Finally, it should be noted that the initiative in many cases originates from state programs, while in others, such as in the case of San Zeno, it arises directly from spontaneous initiatives by teachers, involving later the administrative bodies of schools and institutions.

From the analysis, cross-referencing the above-summarized information, some targeted operational indications have been identified to provide a clear framework for the design and implementation of AI-related training projects in the context of VET:

- Building a Network of Collaborations
- Actively Engaging Administrative Bodies
- Promoting Operational Flexibility
- Seeking Support from State Programs

These indications, along with other information gathered from this qualitative analysis, have been integrated with the results of the literature review and reported in the form of guidelines in the initial part of the report.

Case-by-case summary

CASE 1	
Title	**The use of robotics at the Birkenstraße vocational school in Osnabrück, Germany.**
Actors involved	• Vocational school Osnabrück (teachers and students) • Companies • Federal Government There is cooperation between the vocational school in Osnabrück and companies. Some of the companies provide robotics on loan or as a gift. In addition, funds are accessed through public funding programs, e.g. Digital Pact for Schools in german "Digitalpakt".
AI technologies used	Collaborative industrial robots (industrial robots with which humans work together without protective equipment in the production process); AI software e.g. ChatGPT
Planned activities	Innovation and Future Center for Collaborative Robotics opened. Students in vocational education and training have the opportunity to work with 13 collaborative robots.
Expected results	After participating in the working group, the students receive a certificate. According to the interviewees, it is to be expected that AI as learning content will not only

	change vocational schools as teaching content in the future, but will also influence lesson design through tools such as the AI software ChatGPT.
Project origin	The vocational school in Osnabrück has been addressing the topic of AI for six years in the form of an additional service.
Lesson planning	So far, the subject of AI has mainly been offered in the dual system in the form of a working group. Originally planned for higher-achieving pupils, there is growing interest among many lower-achieving pupils. Once every six months, the results of the working groups are presented by the students at a trade fair at the vocational school.
Technical requirements	Computers with high computing power must be procured and software must be procured.
External stakeholders	Federal Ministry of Education and Research: Financial support from the Digital Pact for Schools.
Issues encountered	Integration into the existing curriculum.
About Results	On the one hand, the results make it clear that the topic of AI is present in vocational schools in Germany. At the same time, various funding opportunities are available at federal level. Some of these funds are not being fully utilized. One reason for this may be that vocational schools are not sufficiently informed about federal support measures. On the other hand, this result leaves open the question of the extent to which teachers have the time resources available to submit funding applications. Furthermore, it is assumed that the existing curriculum and the framework curricula of the training occupations will be adapted. The results were discussed with the students and among the teachers. The results are also disseminated via the school's website and presented at school events.

CASE 2	
Title	**The use of ChatGPT to create teaching materials**
Actors involved	Teachers and students
AI technologies used	AI software e.g. ChatGPT and deepai.org
Planned activities	The interviewee presents a worksheet that he has created himself using ChatGPT. The difficulty lies in formulating the right prompts. It is also important to keep the prompts as short as possible and use as few technical terms as possible ChatGPT is only as good as the prompts you enter. The time required to generate worksheets is determined on the one hand by constantly trying out and improving the prompts until the generated worksheet comes close to your own ideas. The worksheet never achieves 100% of your own ideas, and on the other hand the workload consists of manual adjustments to the generated result. The worksheet often contains technical

	errors that need to be corrected. The interviewee rates ChatGPT as an auxiliary tool that is particularly good at solving the time-consuming task of devising numerical relations for arithmetic problems.
Expected results	Specifically, the interviewee estimates that the time required for a worksheet can be reduced from over a day to a few hours. ChatGPT cannot insert photos, these can be generated using other software. Longer tasks can also be generated, but the more complex and specialized the construct becomes, the worse the result of ChatGPT will be. The worse the result, the greater the subsequent revision effort. For precise results, it is advisable to let ChatGPT create small sections that are then assembled manually.
Project origin	In class, a German teacher introduced ChatGPT to the students and showed, for example, that the AI software can be used to correct exercise sheets. The pupils also showed interest in ChatGPT. However, the teacher also pointed out the incorrect information provided by ChatGPT due to the wrong prompts.
Lesson planning	Topic of AI as part of teaching units. The topic of AI is not integrated into the current curriculum.
Technical requirements	Laptops Tablets for using AI software e.g. ChatGPT.
External stakeholders	None for now
Issues encountered	The problems relate to the use and operation of ChatGPT
About Results	The results were discussed with the students and among the teachers. The results are also disseminated via the school's website and presented at school events

CASE 3	
Title	The use of AI at vocational schools in Germany. An insight into the vocational schools 2 in Emden, Germany
Actors involved	• Vocational school teachers and students; companies in the mechanical sector; regional VET institutions.
AI technologies used	• 12 collaborative robots (cobots)
Planned activities	The subject of AI has so far been offered to students as an additional qualification to their vocational qualification as part of their dual vocational training. The additional qualification is supervised by teachers from the electrical engineering and information technology departments. In the future, the topic of AI could be integrated into the existing curriculum.
Results	Students' basic understanding of the use of AI in robotics and image recognition.
Project origin	Cobots was provided with funding as part of the digitalization master plan of a Regional initiative.

Lesson planning	Teaching units for students from the subjects of electrical engineering and mechatronics that integrate the topic of AI into the existing curriculum. Participation on the part of the students is voluntary. A maximum of 15 students take part. The students program the cobots together with a team of vocational school teachers specializing in subject didactics and IT.
Technical requirements	A total of 12 collaborative robots (cobots) are used in three laboratories. Learning stations are each equipped with cobot where students can practise teaching an AI with images as training data.
External stakeholders	Robotics manufacturers offer cooperation, e.g. in the training of teachers in the use of robots.
Issues encountered	Applying for public funding is a challenge for teachers. In addition to a lack of time resources, there is a lack of knowledge about how applications should be written and what content is relevant for funding. At this point, the teachers mention the need for support measures and further training opportunities. The topic of AI is currently offered as part of an additional qualification and is offered by teachers alongside the regular curriculum. Teachers deal with the topic of AI outside of their regular working hours. Additional knowledge on the topic of AI is provided through train-the-trainer measures.
About Results	The results were discussed with the students and among the teachers. The results are also disseminated via the school's website and presented at school events.

CASE 4	
Title	AI workshop for image recognition software
Actors involved	Teachers, Students and AI developers
AI technologies used	Image recognition software for robotics.
Planned activities	The image recognition software was used to develop an example for students of how a roll of adhesive tape can be identified by image recognition, regardless of its position. The roll of adhesive tape is then placed on an unwinding reel by a robot.
Results	There is no standardized system for the use of AI that could be taught to trainees for use in their companies. As a result, all companies have so far had to rely on a few AI pioneer companies as external service providers for AI applications, which, however, pursue a pricing policy that makes AI applications uneconomical for most companies from the outset due to their individual position. Application software would have to be developed for trainees that makes it possible to use AI for operational applications universally with little programming effort as a low-code or no-code application and that establishes itself as a quasi-standard in industry and trade or is also supported by a standards body.

Project origin	The software developed for teaching at vocational schools was developed by vocational school teachers as a very simplified example to demonstrate and teach students the basic function of AI. No public funding from the federal government is involved in this example.
Lesson planning	The existing offer is integrated into teaching sequences on robotics.
Technical requirements	Smart Factory from Festo - provides an example of how AI can work in principle.
External stakeholders	The teachers approached well-known AI developers to talk about their solutions and methods and to further develop their learning software, but the companies cited confidentiality as trade secrets and showed no interest in developing a user-friendly tool.
Issues encountered	In addition to software, correspondingly powerful hardware must be procured. Image recognition in this didactic-technical context was classified as ethically uncritical, as no personal data is processed, but only sample components were photographed.
About Results	The results were discussed with the students and among the teachers. The results are also disseminated via the school's website and presented at school events.

CASE 5	
Title	AI deployment to predict student drop-out (project implemented in the institution) & AI used to teach how to deploy AI to automate processes.
Actors involved	Vocational teachers, IT specialists, students, administration.
AI technologies used	• Tool created for project purposes • Microsoft's Copilot AI assistant ; ChatGPT ; tool for detecting plagiarism.
Planned activities	• Searching for strategies to collect data from different sources for predicting drop-out risks. • It focuses not on theoretical teaching and learning about AI but on deploying AI in practice. One of the activities aimed to establish the sequence of actions but was less successful than expected.
Results	• To analyse how and if AI can predict learners' dropout and assess if this solution suits the institution. The most significant benefit is that the warning signal comes before the staff member notices it, allowing them to make data-informed decisions on actions to avoid dropouts. • To suggest and apply solutions on how to predict students' dropout rates.
Project origin	• The head of the institution initiated the project idea several years ago based on the experiences of other institutions that were presented at international conferences. The project's initial idea was to apply DI in some way, and then

	they looked for ways to make it more relevant to the issues that the institution encounters. • The teacher gives classes about new technologies, so allowing students to experiment with AI corresponds to technological innovations, enabling learners to practice the skills and awareness about the possibilities and risks of the AI tool Copilot.
Lesson planning	AI is a motivational tool in classes as learners are curious to explore new tools and innovations. Students want to see more possibilities of AI applications that are more than just for chatting and text generating, but even for preparing templates of instructions that might be a reasonable basis for the result. The teacher assesses whether the deployment of AI makes it easier to find the right solutions to create a suitable sequence of action. The teacher also teaches learners to create the correct prompts. AI is also used for detecting plagiarism.
Technical requirements	Institution has licensed Microsoft 365; Copilot is integrated into Microsoft 365. Apart from this, no other technical requirements were needed.
External stakeholders	In the beginning, they mainly learned independently from the digital resources available, but now, many different courses are available, so they choose what they need at the time. Next to this, teachers share their experiences among themselves.
Issues encountered	• More issues encountered from the technical perspective: AI for predicting learner attrition requires data to be collected from different sources, e.g., Moodle, e-journals, and other databases, which immediately leads to the problem of data protection and different data formats. Then, it becomes apparent that artificial intelligence is less strong on this issue than it seems. • There's a lack of tools that would fit the specific needs of vocational schools. The ones that exist are expensive or have restricted access.
About Results	• To suggest and apply solutions on how to predict students' dropout rates. • The aim is straightforward: as a teacher teaches about new technologies, he wants students to practice these technologies immediately. Learners value the possibility of practicing the proper use of AI to find solutions, create instructions, and critically assess them, as well as the relevance and real-world application of this experience. The generated instructions also allow the detection of errors when instructions are generated not clearly. In this case, students must rethink how to make it better.

CASE 6	
Title	Critical use of AI for text and image generating

Actors involved	Adult learners, adult educators
AI technologies used	Canva, ChatGPT, SlidesAI
Planned activities	To introduce learners to AI, to disclose the ethical issues, to raise critical awareness of using AI for text or image generating; to foster discussion with learners on ethical issues.
Results [expected]	Raised awareness about the use of AI in text and image generating. Raised awareness of ethical dilemmas, authorship, citation, and data protection.
Project origin	The idea for this topic to be presented for adult learners was suggested by the teacher who is an expert in educational technologies. She designed a 25-hour training material for blended learning.
Lesson planning	Since the aim was to raise awareness and critically assess the use and potential of AI, 2 learning outcomes were designed, then learning resources and activities planned. Learners were introduced to the international documents and reports regarding the use of AI in learning, discussed existing practices, and had debates themed “AI image wins art content” and similar. Learners used ChatGPT to summarize the documents, highlight main aspects, concerns, and recommendations. Generated results were visualized using CANVA and then discussed in a group.
Technical requirements	Free versions of AI technologies were used so no other technical requirements were needed.
External stakeholders	
Issues encountered	It was difficult to explain why use of AI should be seen as a risk as much as the potential. Data protection (that learners might upload too much of personal information when ‘experimenting’ with ChatGPT).
About Results	Learners were happy to learn how to create prompts, to see how text is generated. Learners raised awareness regarding issues like data protection, transmission of data to third parties, and other ethical dilemmas.

CASE 7	
Title	Introducing AI Chatbot in Continuous training Learning Management System
Actors involved	Training and Development Office, IT project manager, employee
AI technologies used	Learning management system, AI chatbot
Planned activities	1. Meeting with IT figures involved 2. Identification and involvement of the test group 3. Definition of AI test times on the platform 4. Meeting and feedback through satisfaction survey

Results [expected]	• To implement an Intelligent Tutoring System in the LMS that assists users in selecting and accessing available courses on the platform. • Autonomous development of workers' skills
Project origin	initiative of the training and development office
Lesson planning	-------
Technical requirements	The LMS must be able to implement the AI chatbot functionality
External stakeholders	The suppliers of the LMS platform
Issues encountered	• The employees and workers receiving the training have difficulty accessing the platform • Lack of digital skills and poor or absent digital mindset among operators
About Results	

CASE 8	
Title	Introducing the use of AI in initial VET graphic design curriculum
Actors involved	Teachers and students
AI technologies used	Adobe Firefly, Perplexity, Chat GPT, Midjounery
Planned activities	AI tools are shown to students as working tools during practical graphic design activities
Results	• Students learning how to use the new AI tools for graphics and research/information generation even if these topics have not yet been included in the curriculum • Insert update curriculum with skills related to the use of AI in graphic design, but not only
Project origin	Free initiative of VET teachers of graphic design disciplines
Lesson planning	Work deliveries also involve the use of image generation software
Technical requirements	Access to AI services for image generation and a stable internet connection are required
External stakeholders	Experts in copyright were involved to train teachers on issues related to the copyright of images generated with AI.
Issues encountered	Many colleagues have shown resistance, being reluctant to the use of innovative technologies and expressing a desire to maintain the current curriculum.
About Results	The school management has considered the curriculum update.

CASE 9

Title	AI & Business Automation Workshop
Actors involved	Workshop facilitator, training agency, event sponsors
AI technologies used	OpenAI ChatGPT, GPT Plugins, Complementary AI tools, Zapier, Excel & Google Sheet
Planned activities	• What is Artificial Intelligence (AI)? • The Evolution of AI • What is AI Prompting? • Examples AI Prompting • What is ChatGPT? • Using ChatGPT efficiently • What are ChatGPT plugins? • Using ChatGPT plugins efficiently • Generating Images with DALL-E in ChatGPT4 • Complementary AI Tools • What is Zapier? • Using Zapier efficiently • - Advanced: Let's use Zapier with ChatGPT!
Results	This workshop is meticulously crafted for absolute beginners, ensuring a comprehensive understanding of how AI can revolutionize both business and personal productivity. This hands-on exercise, curated by industry-leading experts, offers a practical approach to understanding and implementing AI strategies. The exercise is not just theoretical; it promises tangible outcomes that participants can immediately apply to their businesses, boosting both operational and personal productivity. Moreover, in an ever-evolving business landscape, staying ahead of the curve is crucial. This workshop not only equips the participants with current best practices but also prepares them for the future of business operations, ensuring that they and their business remain at the forefront of innovation. By the end of the session, the participants will have a clear roadmap on how to integrate AI and automation into their personal life and business strategies, ensuring efficiency, growth, and a competitive edge.
Project origin	The workshop was developed by the Unity Growth team to address the increasing demand in understanding and using efficiently and effectively the power of AI tools in completing daily tasks.
Lesson planning	The facilitator makes an introduction to the concept of AI, then introduction to AI prompting with examples. Then, the tools to be used during the workshop. The attendees use their laptops to replicate what the facilitator presents and also does while presenting.

Technical requirements	Laptop and internet connection
External stakeholders	
Issues encountered	Need to have enough provision of power plugs and extension chords in order to keep attendees' laptops powered long enough until the workshop is done.
About Results	More results out of this workshop: • The basics of AI and its role in modern business. • Hands-on "Learning by Doing" practices: Bring your laptop and dive right in! • Mastering prompt generating techniques for effective AI communication. • Streamlining and automating your daily personal and professional workflows. • Practical ways to integrate AI seamlessly into your everyday life. • Preparing for the future of automated business operations. • Strategies to achieve a 10x boost in your productivity. • Harnessing the power of AI for efficient and in-depth research. • Exploring and utilizing AI plugins and extensions for enhanced capabilities. • Real-life examples showcasing the transformative impact of AI in various scenarios. • - Insights from industry experts on AI trends and innovations.

CASE 10	
Title	Smart AI Innovators
Actors involved	Teachers and students
AI technologies used	LOBE (Microsoft)
Planned activities	The project aims to design, develop and pilot-test a comprehensive and ready-to-implement smart AI innovators toolkit which will support VET trainers/leaders to introduce the eco-system of AI technologies supported with advanced digital skills such as coding and Video Game Development using unity engine in school curricula based on a multi-disciplinary STEAM oriented approach on real-life scenarios which focuses on the use of DIGITAL INNOVATION for SOCIAL CHANGE. Now they ARE starting the pilot phase with two courses, telecommunications and computer systems, and computer systems administration, and the result of the pilot will be the design of an application (Python or Javascript) for object recognition. They work based on challenges/projects and in teams (they follow the Ethazi methodology) and the team that does the best will have the opportunity to collaborate with students from other participating schools for a week.

Results	The result of the pilot will be the design of an application (Python or Javascript) for object recognition. Ideally, according to them, the application could be extended to other uses. The team that does the best will have the opportunity to collaborate with students from other participating schools for a week.
Project origin	According to the aim of the project: to thrive in a technology-driven economy, VET trainers, educators, workers, but perhaps above all 'the lockdown generation' whose education and employment prospects have been affected due to the pandemic, will need to be digitally skilled and confident to succeed in a rapidly changing environment and adapt to new and emerging technologies. In the case of this vocational training centre, the idea came from the innovation department and some teachers, because they were concerned about starting to use and familiarize themselves with the use of AI.
Lesson planning	1 course of both, the two groups get together. mixed teams are formed and work a few hours each week to develop an application that recognizes objects in an image.
Technical requirements	Microsoft LOBE Pyton
External stakeholders	Sector companies
Issues encountered	Not yet
About Results	Not yet

CASE 11	
Title	AI4FEMALES: Artificial Intelligence (AI) and Internet of Things (IoT) as digital tools inspiring females to choose fields of study related to science, technology, engineering and mathematics (STEM).
Actors involved	Teacher and students
AI technologies used	
Planned activities	AI4Females seeks to promote gender equality in science by creating motivated demonstrators based on Artificial Intelligence of Things. The axes of the project will be focused on: • Improving school curricula, including new content regulated and approved that adapts to the competences of professional training. • Developing training material for the future that allows students to acquire new knowledge connected with Artificial Intelligence and that can be applied in their future jobs and in the industry. • Bringing out the significant role of women in STEM VET schools. • Inspiring young girls through role-model education to follow STEM VET schools.

	• Enhancing teachers' and students' skills in Internet of Things and Artificial Intelligence. The planned IA-related activities are: • Create documentation on technical aspects of IA. • -Create three IoT and IA projects that may be attractive to women.
Results	Create: • Documentation on IA (in this case on IA theory and APIs). • Create three projects for each of the 4 VET centers. • Receive a course on IA • Travel with the students to Portugal and Poland • Receive students from Portugal
Project origin	They were invited to participate in an Erasmus+ KA2 project. The project was already IA oriented. The school already had a member of the department working part-time on IA in Tknika and they were already doing some small IA projects with the students (AI embebida: ESP32-Cam and Edge-impulse). In the Electronics and Telecommunications department they have a group of teachers oriented to Erasmus+ projects. When the invitation was received, the amount of work and personnel resources available were assessed and it was decided to accept the invitation to be part of the call (at that point it is not known whether the project will go ahead or not).
Lesson planning	That there are manuals, practical examples and videos is very useful to understand and practice with IA. They do not keep a count of the hours dedicated to the project, but they are many. It could easily be about 8 hours a week, for two years it adds up to 800 hours.
Technical requirements	To realize the projects related to this Erasmus+KA2 they had to buy hardware, especially two Jetson nano The project itself provides money to realize the demonstrators.
External stakeholders	No, but the Erasmus+KA2 project itself included a training course on IA.
Issues encountered	Not particularly. There are times when projects progress slowly, but they consider it a regular occurrence.
About Results	The students had the opportunity to travel to Poland and see all the projects in progress. In total there are three projects for each of the four participating VET centers, making a total of 12 projects. The students were able to exchange their impressions about each of the projects with each of the VET centers. There is a day at the school to show this type of work. It was explained to all the teachers what the Erasmus+KA2 project was about and they could see the projects in progress.

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