WP2a2 - Integrative Report

Title: 'Implications of Artificial Intelligence in teaching and learning in Portugal: Opportunities and Challenges'

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Introduction

The teacher training centre "Centro de Formação Dr. Rui Grácio" (Lagos, Portugal) is part of the European team of the ERASMUS+ project "Teacher Education Regenerated (TE_REG) Beyond Competencies. Rethinking and redesigning teacher education curricula in the GenAI era» - Reference no. KA220-HED-CF9D94FC.
Within the scope of this European partnership, we have research in Portugal to try to understand how digital transformations and IA in recent years have had an impact on Teaching and Learning, leading to a new role of the teacher.
As the spirit of the Erasmus+ TE-REG project is also one of questioning and reflection, we have adopted an attitude of constant openness to the unpredictability and complexity of systems as our starting point as a Training Centre of School Association in Portugal (CFAE), on the assumption that integrating AI into the educational context will expand the frontiers of research into the construction of knowledge. Dialogical learning processes between human beings and AI are at an early stage of research. Increasingly sophisticated AI systems take part in complex dialogical interactions, influencing the learning processes and knowledge construction of both teachers and students. We therefore set out to discover not only the main emerging problems, but also the innovative perspectives that the effects of AI may have on teaching and learning.
In the current context, of a complex, globalized society marked by social transformations and technological-digital advances, it is essential to understand to what extent AI has become more and more crucial to understand the need for new processes of teaching and learning.
To re-examine the implications of this complexity in prospecting a new role of the teacher, congruent with the current times, the following report objectives were designed.

Objectives

1. Analyse the impacts of AI on education in Portugal, considering recent studies and practices in the field of initial and in-service teacher education.
2. Analyse the results of two Focus Groups and discuss the opinions on AI effects in education.
3. Reflect about the impact of AI on different dimensions: on learning, on teaching, on the teacher, on the student, on the curriculum, on school organization, on teacher training and on society in general.
4. Systematise a set of conclusions and recommendations for the present and future of education, to develop the discussion about teaching and learning in the era of AI.

Strategy

In the context of the development of the TE-REG Erasmus+ project, previous research was carried out on the impacts of GenAI on national strategies, policies, decisions and framework for education in Portugal (Work Package 2 - GenAI - WP2a1: "Artificial Intelligence: The Portuguese context, policies and strategy on AI and Education". In this first report, which was more descriptive and exploratory, we have tried to understand how digital transformations and IA in recent years have had an impact on national decisions and framework for education and teachers professional practice. The conclusions of this previous work tell us that Portugal seems to be well positioned to develop the integration of AI in education, thanks to a robust national strategy, investment in infrastructure and teacher training, and a critical and ethical approach. However, to ensure that AI is a benefit for all, it is crucial to deepen digital literacy, strengthen continuous training, promote inclusion, and ensure sustained curricular and ethical integration.

In the present report, more reflective and sustained from a conceptual point of view, we have researched for a theoretical and critical framework, referring to publications by some Portuguese researchers. To

complement this conceptual framework and reinforce the reflection, two Focus Group were organised, one with forty-four in-service teachers and another with five Education and AI Portuguese experts, which contributed to the analysis of the AI impacts on teaching and learning in Portugal, discussing its effects on teacher training and articulating the discussion with the impacts of current AI in several educational domains.

Structure of the report

This report is divided into three parts: a **first part** in which the discussion on the Impacts of AI on Education was made as conceptual frame, in light of some studies and practices on teacher education; a **second part** in which the methodology is explained and where the impacts of the two Focus Groups are analysed; and a **third part**, in which the challenges of AI transformations are foreseen, revealing the impacts in various dimensions of education: impact on learning, on teaching, on the teacher, on the student, on the curriculum, on the school organization, on teacher training and on society in general. Finally, the report concludes with a set of reflections/recommendations envisioning possible adjustments on educational conceptions and teaching and learning practices.

1.Theoretical framework

1.1. Publications and articles on AI on Education

In a report carried out by Lucas and Bem-Haja (2021), the results of a study on the level of digital competences of primary and secondary school teachers in public schools in Portugal are presented. The study was operationalised through the application of a questionnaire, the main component of which includes the Check-In self-assessment tool, developed based on the European Digital Competence Framework for Educators (DigCompEdu). The study's main conclusion is that teachers' level of proficiency in digital competence can be considered low, given that DigCompEdu places the B2 Expert level as the foundation for digital transformation and the critical, effective and innovative use of digital technologies. The average level achieved corresponds to B1 Integrator, which describes an inconsistent use and integration of digital technologies. At this level, teachers need support to improve their understanding of which tools work best in which professional situations and how digital technologies fit into teaching methods and strategies.

In a report by Dorotea, Pedro and Piedade (2021), the aim was to understand teachers' competence and confidence as decisive factors in the implementation of digital innovation in educational practices. The aim was to analyse the degree of teachers' confidence in using digital technologies after the transition to distance learning. 99,760 responses from teachers were analysed. The results showed ‘high levels of teachers’ perception of their confidence in using technology in their teaching practices’ (pp.12). This data is most evident in the items related to the frequency of training in the digital dimension and the use of digital tools and applications in their pedagogical and didactic activities, which leads us to believe that the national programme and the teacher training provided by the CFAEs have managed to have an impact on changing educational practices in terms of integrating digital into the classroom.

Brazão and Tinoca (2024) carried out an investigation into the evolution of critical questioning in a dialogical relationship between artificial intelligence (AI) and a group of students in a curricular unit of a higher education course in Educational Sciences. Based on the students' class records, the study tries to understand the evolution of critical thinking in the context of formal education. The students' interaction with the AI allowed them to see: the diversity of levels of questioning, the progression of critical thinking, the areas for improvement in each working group, the encouragement of reflexivity and metacognition, an understanding of complex concepts, the visualisation of the practical application of concepts, and the broadening of interdisciplinary thinking. This study thus contributes to the literature on education and AI technology, offering insights into how to structure effective dialogical interactions between students and AI systems.
Tinoca (2023) explores two theories articulated with the digital age: the Rhizomatic Learning theory (Cormier, 2008) and the Connectivism Learning theory (Siemens, 2005).
The Rhizomatic Learning Theory (Cormier, 2008) proposes ‘a shift from traditional, hierarchical models of knowledge acquisition to a more collaborative and adaptive approach’. This theory is inspired by the concept of rhizomes, plants that grow underground without a centralised system of roots or stems, and which have a decentralised and interconnected network of roots and nodes that grow and adapt according to their environment. In rhizomatic learning, the emphasis is on creating an environment that students can explore by connecting to multiple sources of information, and where they are encouraged to take ownership of their learning path by differentiating their trajectories according to their needs and interests.

Connectivism or Connectivism Learning theory (Siemens, 2005) also emphasises the idea that ‘learning, in addition to being the result of individual effort, is structured around processes of connection and

involvement with various sources of information, people and resources, through the formation and reinforcement of links between various sources of knowledge. These sources can include individuals, websites, online communities, social networks and even non-human sources such as databases and information systems. This theory argues that the ability to navigate and establish meaningful connections within these networks is crucial for effective learning.'
In connectivism learning, artificial intelligence can be used to help students build and manage their own learning network, connecting with other people and relevant resources. Artificial intelligence can be used to create recommendation systems for contacts and resources that can help students expand their learning network and find new sources of information. Artificial intelligence can also be used to create information management systems that can help students organise and process large amounts of data efficiently.

A question has arisen on the AI scene: Can machines be intelligent, think and even feel, just like human beings? In his recent essay 'Generative Artificial Intelligence', Arlindo Oliveira (2025) discusses the evolution and impact of artificial intelligence (AI) technologies, with a particular focus on generative artificial intelligence.
One of the central points of the essay is the ability of machines to perform tasks that were previously considered exclusively human, such as generating text, images and solving complex problems. This ability raises questions about the automation of various functions and the impact this will have on the labour market and society in general. The author also discusses the risks associated with the use of artificial intelligence, including privacy issues, disinformation and the possibility of discrimination by systems trained on biased data. The author speculates on the future of artificial intelligence and its relationship with human intelligence and mentions dystopian scenarios where humanity could lose control over the technologies it has developed.

According to Jorge Silva (2024), the Internet and associated technologies have become omnipresent in our lives and jeopardise citizens' fundamental rights. Created more than two centuries ago to protect human dignity in the physical world, these rights have evolved and today need to be adapted to the demands and threats felt by people in the digital universe.
Access to networks, the protection of personal data, browsing security, the prohibition of malicious artificial intelligence applications and freedom of expression on social networks are the main faces of a brand-new generation of fundamental rights. This essay analyses how these rights have been implemented at European and national level, with the aim of legally safeguarding citizens in this new world, which is both admirable and dangerous.

In a study published in the Journal Of Humanities And Social Science, Farias, Oliveira, Sousa and Silva (2024) analysed the impact of Artificial Intelligence (AI) on education and its ethical implications, with the aim of understanding how these technologies transform teaching. Using a bibliographic research methodology, information from various academic sources was collected and analysed to identify trends, gaps and theoretical foundations on the subject. The results indicate that AI offers significant opportunities to personalise learning, optimise administrative processes and support students with virtual assistants and tutors. However, important ethical questions arise, such as data privacy, the transparency of algorithms and bias in systems, as well as the impact on the role of teachers. The analysis concludes that while AI can enrich teaching, it is essential to address ethical concerns responsibly to ensure integration that respects teacher autonomy and promotes equitable and effective education. Critical reflection and adequate teacher training are key to maximising the benefits of AI in education.

Lima and Serrano (2024) present a literature review exploring the impacts of the ChatGPT chatbot in the educational context. The guiding question of this study is: what are the potentialities and limitations of the application of Artificial Intelligence (ChatGPT) in Education? To answer this question, a systematic search was carried out in databases for recent articles on ChatGPT and Education, and 10 studies were selected based on criteria such as relevance and quality. The results and discussion highlighted the potential of ChatGPT as a valuable complementary tool in the automated generation of personalised content and assessments. However, they also revealed crucial limitations, such as flaws in logic, inaccurate responses and bias. Ethical issues, such as encouraging plagiarism and inhibiting student creativity, are latent concerns that require careful pedagogical strategies. It is concluded that there is still much to be researched before ChatGPT can be safely and effectively integrated into educational practice. The research highlights the need for a balanced and critical approach when integrating ChatGPT and similar technologies into the educational curriculum, ensuring that the technology benefits students and society. It concludes that while more is known about the implications and opportunities of ChatGPT in Education, there are still many issues to be explored and discovered.

In this sense, in the article 'Generative AI - The new challenge in and for Education', Marco Neves (2023) discusses the growing influence of generative artificial intelligence (AI), especially after the launch of ChatGPT, and the challenges this poses for the field of education. Generative AI, unlike previous technologies, is not passive; it could create original and interactive content, which raises questions about authenticity and authorship in learning. The author emphasises that the use of AI in schools must ensure equity, as it can result in an 'AI Divide', where only some students have access to these technologies, while others are left on the sidelines. Instead, the responsible and meaningful integration of generative AI should be promoted, preparing students for the future and encouraging a critical attitude towards the information generated by these tools.
The same author regularly publishes a newsletter on AI. In a recent edition 'Unlock AI: Shape the Future - AI in 5 Minutes', Neves (2025) suggests that AI can be seen from a collaborative rather than instrumental perspective: 'we explore how we should approach Generative AI more as a "collaborator" rather than just another "tool."'. To find out more about the Newsletter:
https://www.linkedin.com/pulse/unlock-aishape-future-ai-5-minutes-marco-neves-jk2uf/?trackingId=Ce64UZbhQTG65IXKGmMI9Q%3D%3D

In conclusion, all the authors suggest that education must evolve to include greater AI literacy, enabling students and teachers to use these technologies effectively and ethically, maximising their potential for learning and minimising the associated risks.

1.2. National Survey on the use of AI in Education

On 'National Trainer's Day', celebrated on 18 November 2024, at the 12th online meeting on the thematic of AI in Education, a questionnaire was administered to 1134 participants by ISLA of Instituto Politécnico de Santarém. The results were based on the answers of the 8 questions below:

Questions on AI: Transforming the way we learn

- 1. How often do you use AI tools in your teaching practice? (37% - occasionally; 25% - rarely; 24.5% - frequently).
- 2. How do you rate the reliability of the answers generated by AI assistants such as ChatGPT? (60.5% - Moderate; 27.5% - High credibility; 8.6% - Low credibility.
- 3. What impact does AI have on improving students' learning outcomes? (54% - positive; 35% - neutral)
- 4. Do you believe that AI can transform the way students learn? (55% - partially agree; 31.2% - totally agree)

The following conclusions emerged from this set of questions:

- **Teacher training:** Most respondents emphasise the need for education and regulation for teachers.
- **Acceptance:** Most respondents believe in the transformative potential of AI, highlighting personalised learning as a key benefit.
- **Divergent views:** Responses reflect a split between enthusiasm for the benefits and scepticism about its implementation.
- **Balance between opportunities and challenges:** Despite optimism, there is concern about ethical and practical issues that need to be resolved.

AI issues: Transforming the way we teach

5. Do you believe that AI can transform the way teachers teach? (53% - Partially agree; 39% - Completely agree)

The following conclusions emerged from this question. It turns out that:

- **Scepticism -** There are doubts about the transformative potential of AI. Excessive dependence on technology and the difficulty of replacing human interaction.
- **Ethical impacts -** The need for responsible use of AI is revealed, with concerns about the ethical impact and possible risks of depersonalising teaching.
- **Support and innovation** - Developing the personalisation of teaching, using innovative tools and facilitating educational strategies.
- **Practical challenges** - Practical limitations, such as lack of resources, the need for adequate training for teachers and insufficient infrastructure.

AI issues: The vision of AI transformations in education and training

6. How do you rate the preparedness of teachers/trainers to use AI in their pedagogical practices? (51.4% - Poorly prepared; 22.9% - Moderately prepared; 23.3% - Very poorly prepared).
7. How necessary is additional training in AI for teachers/trainers? (60.7% - Extremely necessary; 33.8% - Necessary).
8. How do you see the changes that AI will bring to education and training in the coming years? 50.1% - Promising; 21.7% - Worrying; 13.1% - Very promising and 11.6% - Very worrying).

The following conclusions emerged from this set of questions:

Enthusiasm and scepticism - AI changes are seen as inevitable and having a significant impact, but opinions oscillate between enthusiasm and scepticism.
Fears - The greatest fears centre on ethical issues, unequal access and lack of training.
Positive aspects - The most prominent include innovation, ease of access to new resources and the potential for personalising learning.
Cautious optimism - This is the dominant position that emphasises the need for a responsible and informed approach to AI integration.

For more information about this survey, follow the link:
https://drive.google.com/file/d/18rL8bQ4YJIlHOtINTuaZHtWC9EY96lk2/view?usp=drive_link

2. Methodology and Focus Groups analysis

This report used a qualitative methodology, based on the realisation of two Focus Groups with the aim of collecting perspectives from different actors involved in teacher training and education. This approach allowed an in-depth analysis of the AI impacts on teaching and learning, through the active listening of experiences and opinions of professionals and experts in direct contact with the educational reality.

2.1 Framework of the methodological strategy

The methodology adopted aimed to complement the literature review with the focus groups contributions, with empirical data collected directly from stakeholders in the educational field. The Focus Groups technique was chosen due to its ability to promote discussion and the collective construction of knowledge.

2.2 Constitution and profile of the participants

The Focus Group 1 was made with 44 teachers from all levels of education

The Focus Group 2 was made with 5 experts on AI and Education:

- 2 university professors, experts in Education and ICT.
- 1 researcher, expert in AI in Education.
- 2 teacher trainers of in-service teacher training, experienced on AI programs.

The diversity of the participants allowed us to collect a multiplicity of views on AI and Teacher Education, enriching the reflection with contributions from research, training and professional practice.

2.3. Focus Group 1 with Teachers

A focus group with 44 teachers from all levels of education was organised by the “Centro de Formação Dr. Rui Grácio” on January 27, 2025, at the Júlio Dantas Secondary School, in Lagos Portugal. The session aimed to establish a broad discussion on the impacts of AI on Teaching and Learning. We organised the discussion around 15 questions, adapted from the TE-REG Project Coordinator proposal, which are explained below. A summary of the main conclusions was made.

1. What was your first experience with Artificial Intelligence (GenAI)?
Most of the participants have already used ChatGPT for various purposes. They have done online research, searched for information out of curiosity or to try out the tool. They have used it to prepare work materials and administrative tasks. They have learnt about it in informal contexts, such as conversations

with friends, and through platforms like Facebook and virtual assistants like Alexa. They tested it with basic questions, poem requests and lesson plans. They took part in teacher training where they planned the application of assessment criteria. They also used Canva and Copilot. They consider the interactions to have been varied and useful in different contexts.

2. How did you feel when you realised you were working with AI?
3. Did you find the experience special in any way?
4. Do you consciously use AI?
5. For what purposes do you use AI and in what way?
Most of the participants found the experience fascinating, but some still show apprehension and concern about using AI, although most consciously use it for professional purposes (planning teaching resources, summarising, multimedia).

6. Are your students authorised to use AI in class or at home?
7. Do your students use AI unconditionally and everywhere?
8. How do you know if your students use AI or not?
Although most participants perceive that their students use AI, they don't know whether they are allowed to use it at home or unconditionally. Most commented that this perception comes from the students' reports in class and from work they have submitted.

9. Do you discuss the use of AI with your colleagues?
10. Do you talk about AI with your students?
11. If you answered yes to the previous question, in what way?
12. If you do, what impact does the use of AI have on your students' learning?
Most teachers say that they talk about AI with colleagues and students. Now, only those teachers who use AI in the classroom consider that it has an impact on their students' learning.

13. Do you think that AI can help promote your students' deliberate learning?
14. Do you think it's important for students to learn about AI and how to deal with it at school?
Almost all the teachers considered it important for students to learn about AI, saying that it could promote their learning if they learnt how to use it.

15. Do you feel you have a role to play in teaching AI as an individual teacher or as a member of a teaching team?
16. What initiatives are taken in your school to integrate AI into teaching and learning practices?
Although the vast majority feel that they play an important role, either individually or as part of a pedagogical team, in teacher training and practices at school, the answers are varied, with many not being aware of any formal initiatives. The discussion showed that they don't know if there are any established measures in their school, but some mention ongoing teacher training and the use of digital platforms. There is a recognition that few steps have been taken in AI training practices, and some participants consider that training has been made available, but there is not yet widespread implementation or awareness. Discussion among colleagues is still limited and there is a need for more awareness-raising and training.

Synthesis of the Focus Group 1 with teachers:

We see that teachers are positioned in a space-time of transition, in which there are, on the one hand, fears and concerns about the consequences of AI, due to a possible lack of training and control over AI systems, and, on the other hand, the existence of innovative pedagogical practices that are the result of curiosity, innovation, initiatives by teacher learning communities and continuous training that is beginning to gain some expression, but still very insufficient, in the field of AI.

2.4. Focus Group 2 with Experts on Education and AI

On 21st of February of 2025, the Centro de Formação Dr. Rui Grácio held an online Focus Group via Zoom with five education experts: two professors from two universities / Faculty of Education / Institute of Education; a researcher expert on AI in Education; a director of a school cluster, also a teacher trainer in

ICT and AI; and a pedagogical coordinator from a professional and scientific association in educational telematics, also a teacher trainer in ICT and AI.

The results of the Focus Group 2 discussion were analysed and organised in six domains: A. The Role of AI in Education; B. AI in Teacher Training; C. The Role of Teachers in AI Education; D. The Role of AI in Pedagogical Assessment; E. AI Initiatives in the Participants' Educational Institutions; and F. New needs and new scenarios.

A. The Role of AI in Education

The group discussed the role of AI in education and its potential impact on teachers. They agreed that AI cannot replace teachers, but those who use AI effectively will have an advantage over others. It was considered that AI can complement teachers in situations such as personalised tutoring, when human resources are limited. However, they emphasised the importance of teachers adapting and integrating AI tools into their practice, rather than being replaced by them.

Highlighting the following citations:

> "The school is different. It is constantly changing and we, as professionals, also must adapt to the changes in society. I think teachers seek this a lot in continuing education, an updating of knowledge, but we also work a lot on empathy and ethical issues." (Participant 1)

> "As trainers, we feel that there is a great need for the scientific competence component to have an impact on children and young people. The interconnection between scientific knowledge, pedagogical and didactic knowledge, and soft skills is fundamental for teachers to improve. This is very important and should be included in teacher training, obviously." (Participant 2)

> "The essence of teaching, in my opinion, has always focused on the human relationship between teachers and students. There must be pedagogical adaptation." (Participant 1)

> "Those teachers who become proficient and competent in the use of generative artificial intelligence will have an advantage. They will be able to better personalise their students' educational experiences and even have advantages in bureaucratic areas." (Participant 3)

> "The partnership between AI and teachers is fundamental. There must be new and many teachers for this to gain real strength in schools." (Participant 2)

B. AI in Teacher Training

The participants discussed the role of generative AI in initial and in-service teacher training curricula/programmes. They agreed that AI can personalise differentiated curricula and create more diverse learning experiences but expressed concerns about the need for teacher training and the potential of AI. They also discussed the challenges of diversifying training programmes and the need for better preparation for the future job market. They concluded that AI should be used in complementarity with teachers' pedagogical action. The role of AI in designing curricula and supporting students was discussed. The discussion reached a consensus that scientific and pedagogical knowledge will remain central to initial teacher training programmes, despite the evolution of AI.

Highlighting the following citations:

> "I would like to see teachers not only using AI in their teaching but also integrating it into the dynamics of their subjects, so that future teachers can use AI in their professional practice, even in the contexts of initial professional practice." (Participant 3)

> "The school curriculum cannot be left to the discretion of AI without some kind of higher guidance or strategy. AI can be a very valid support tool, but it should not be totally autonomous." (Participant 2)

> "It is up to teachers, in their daily lives, to adapt what is in the curriculum, which is global, to the specificities of their social context or, within a class, to the context of the students they have." (Participant 4)

> "The range of proposals that can arise from the use of generative AI is vast, as it is possible to adapt proposals to each student, provided there is a good prompt. The teacher's professional competence here seems fundamental." (Participant 3)

> "There should be a continuity and balance between real, face-to-face pedagogical practice and the scenarios worked on in training. This balance is fundamental." (Participant 2)

The biggest challenge for teacher training programmes is to strengthen teachers' critical capacity to evaluate technologies, use them ethically, and safeguard the human dimension in the educational process.

C. The Role of Teachers in AI Education

There was a consensus that AI cannot replace teachers, highlighting the importance of professional competence and the physical presence of teachers. AI can support specialised tutoring and the completion of tasks but cannot replace teachers. Teachers' actions will need to be complemented by AI. The importance of teachers' scientific knowledge in validating AI-generated information was discussed. The consensus was that AI should enhance the capacity of teachers. The need to develop critical thinking skills in teachers to use AI effectively was emphasised, as well as the importance of teachers' pedagogical skills in the effective integration of AI. The need for digital literacy and the development of critical thinking skills in students was also discussed, as well as the potential and concerns about the transformative power of AI.

Highlighting the following citations:

> "There are situations where generative artificial intelligence makes very interesting contributions, but let's not forget its mistakes and hallucinations. For now, I cannot conceive of a situation where students work with AI without some form of supervision or special attention from the teacher." (Participant 5)

> "AI should not be responsible for creating curricula without national or local intervention. These tools can be a valid support, but not totally autonomous." (Participant 2)

> "AI is a very useful tool that helps to diversify, enrich, and adjust, but there must always be a human intelligence capable of critically assessing what makes sense." (Participant 5)

> "The teacher's professional competence here seems fundamental, just as with a doctor: I see AI as an excellent assistant, but I do not want it to be the one making the diagnosis." (Participant 3)

> "Teachers must know how to use the tool strategically, not rely entirely on what the tools generate. There must be critical thinking and adaptation to the strategies we use." (Participant 1)

D. The Role of AI in Pedagogical Assessment

Participants discussed the role of AI in pedagogical assessment and in monitoring results. They agreed that AI can analyse student patterns and difficulties and produce progress reports but emphasised the crucial importance of teacher intervention in interpretation and critical analysis. AI can automate tasks such as correcting exercises, but teachers must guarantee the quality of the results. There was concern about the potential for AI to control the assessment process and a call for a holistic approach to assessment. The group agreed that AI could monitor learning outcomes, but with the necessary validation of its reliability by teachers. The need for multiple assessment methods, including more continuous assessment and oral communication, was discussed.

Highlighting the following citations:

> "I do not believe that artificial intelligence will soon be fully responsible for controlling results. It can help us analyse results, but it is not responsible. Human intervention is still necessary to ensure quality." (Participant 4)

> "Monitoring data through AI can be useful for analysing patterns and student difficulties, but teachers should not lose their responsibility in assessment. There must be a more holistic approach, not centred only on GenAI." (Participant 1)

> "Automating certain assessment routines can be an added value: correcting exercises, analysing performance data, generating progress reports. However, the use of this data must be interpreted very carefully. AI often has biases, gaps, and lacks relational knowledge about students. The teacher's role remains essential for critically interpreting the information generated by AI." (Participant 3)

> "There are aspects of assessment that cannot be scrutinised just from a written answer. The question itself is layered, and the teacher's involvement is necessary to help identify which elements are relevant from an assessment point of view." (Participant 5)

E. AI Initiatives in the Participants' Educational Institutions

The focus group highlighted a growing number of AI-related initiatives in their institutions, including regular sharing sessions, workshops, and the creation of communities of practice. However, they also pointed out the high demand for training and the shortage of trainers for in-service training.

Highlighting the following citations:

> "There are already specific courses to introduce artificial intelligence. It will go to the scientific council next week, but I think we are not yet doing it, especially in that more transversal vision of it appearing as a relevant competence in various courses." (Participant 3)

> "At the school where I am, we are holding monthly sharing sessions, where we address various issues, many of them related to the use of generative artificial intelligence, but also with AI platforms in schools. Essentially, we are doing this: pedagogical sharing sessions and discussions around the topic. One session per month." (Participant 4)

> "There have already been workshops on this for two years. The university's pedagogical days with the theme of artificial intelligence, events in various faculties and schools focused on AI, even training offers organised by the rectorate on integrating AI into higher education classes, which have been in high demand. Therefore, there has been a lot of supply. And now, of course, specific courses with AI are also emerging in more programmes, beyond engineering, which was already a pioneer in this area." (Participant 3)

> "What the training centres also feel is that many of the usual trainers, as they have extra hours at school, cannot take on more hours at the centres. This ends up being a growing problem, because we will have more and more shortage of people in schools. And this means that the training centres are left with fewer trainers, which is not a good situation given the lack of information and training for teachers. We have a gap here that I am not sure how to solve in the short term." (Participant 2)

> "We are working on this at a very early stage, because we have a set of regulations, codes of conduct that we are working on for various areas, some of them legislated and to which we must respond, so we are setting priorities. We are already working on a code of conduct for the use of artificial intelligence, not only AI but also digital media in general, because there is often some lack of awareness about the impact that sharing information can have without being aware of what is being done." (Participant 4)

F. New needs and new scenarios

The group discussed the need for ethical codes and frameworks for AI in education. They also noted the lack of pedagogical training for higher education teachers in Portugal.

Highlighting the following citations:

> "Developing solid pedagogical skills that allow me to be with students and solve situations, because artificial intelligence will not yet be able to predict everything." (Participant 1)

> "Unfortunately, we still do not have teachers leaving initial training who are empowered in this area, also due to initial training itself, which is not doing it." (Participant 3)

> "There should be continuity and balance between real, face-to-face pedagogical practice and the scenarios worked on in training. This balance is fundamental." (Participant 2)

> "We, teachers, are very concerned about this topic and I feel that colleagues are very eager for training, because they feel that students know more than they do and they are uncomfortable. I think a lot of the discomfort comes from this." (Participant 1)

> "There is an enormous demand for training in this area of artificial intelligence, and the shortage of trainers is such that it is very difficult to find a solution for so many people wanting to do training." (Participant 2)

Synthesis

The participants discussed the potential of AI in education and agreed that AI is underexploited and underused but has the potential to revolutionise teaching and learning. They emphasised the importance of understanding and implementing AI in a practical and reflective way. They addressed the need for ongoing training for teachers to effectively integrate AI into practice. The discussion ended with a sense of optimism, but also with an acknowledgement of the challenges and uncertainties in integrating AI into education. Finally, AI was seen as an opportunity to catalyse pedagogical transformation at all levels of education, in the face of the predominance of traditional master pedagogy. It was suggested that AI could help teachers change their practices if they were supported in its implementation. They agreed that AI can diversify pedagogical approaches, create motivating activities and apply Universal Design principles in education. They emphasised the need for training and support for teachers to effectively integrate AI into their practice.

In conclusion, the focus group 2 participants provided a nuanced and critical perspective on the integration of AI in education in Portugal. Across the six domains, several key themes emerged:

AI as a Complement, not a Substitute: There was consensus that AI cannot and should not replace teachers. Instead, it should serve as a powerful tool to support and enhance teachers' work, especially in personalising learning and automating routine tasks. The human dimension, pedagogical adaptation, and critical thinking remain irreplaceable.

Professional Development and Training Needs: The rapid evolution of AI in education has resulted in high demand for teacher training, but there is a shortage of qualified trainers. Teachers are eager to learn, often feeling that students are more digitally literate than they are. This highlights the urgent need for continuous professional development and institutional support.

Ethics, Regulation, and Policy: Institutions are beginning to develop codes of conduct and ethical frameworks for the use of AI and digital media. National policies are evolving, with the Ministry of Education and DGE playing a key role in sharing good practices and developing new frameworks that integrate AI into digital competence areas.

Institutional and Systemic Challenges: While there are many promising initiatives - such as sharing sessions, workshops, and curricular innovation - the implementation is uneven, and there are gaps in both initial and continuing teacher education. The lack of pedagogical training for higher education teachers is a particular concern.

Optimism and Caution: Participants see AI as an opportunity to catalyse pedagogical transformation, diversify teaching approaches, and apply principles like Universal Design. However, they stress the need for careful, critical, and ethical integration, with ongoing evaluation of its impact on teaching and learning.

Challenge for teacher training: In general, the participants emphasised the importance of critical thinking and ethics in the use of digital AI tools and agreed that the biggest challenge for teacher training programmes is to strengthen teachers' critical capacity to evaluate technologies, use them ethically and safeguard the human dimension in the educational process.

In summary, the integration of AI in education in Portugal is progressing, but requires a balanced approach that values human expertise, ethical considerations, and robust professional development. AI is seen as a catalyst for innovation, but its successful adoption depends on empowering teachers, updating curricula, and ensuring that national policies keep pace with technological change.

3. Reflection on domains of impact of AI on education

3.1. Impact on Learning

In Focus Group 2, AI is seen as a powerful tool to personalise and diversify learning experiences. Participants highlighted that generative AI enables the adaptation of learning materials to individual students' needs, allowing for differentiated instruction and more engaging activities. On Focus Group 2 of Experts, some participants noted that AI can personalise learning, adapt content, and foster critical thinking, but stressed the need for human guidance.

> "The range of proposals that can arise from the use of generative AI is vast, as it is possible to adapt proposals to each student, provided there is a good prompt. The teacher's professional competence here seems fundamental." (Participant 3)

AI can help identify learning patterns and difficulties, offering more targeted support and feedback. However, the group stressed that the human dimension - empathy, motivation, and holistic understanding - remains essential for meaningful learning.

In fact, according to Brazão & Tinoca (2024, p.6), AI can enhance learning by enabling greater personalisation, formative feedback, and access to resources, but its effectiveness depends on critical human mediation and ethical use: “AI can enhance the personalization of learning, promoting the development of critical questioning and student autonomy in dialogical processes”. This implies, according to the Council of Europe (2022, p. 10), that it is needed “a holistic view to help ensure that AI empowers and not overpowers educators and learners, and that future developments and practices are genuinely for the common good.”

3.2. Impact on Teaching

Teaching is undergoing transformation, with AI automating routine tasks (e.g., grading, progress reports) and supporting lesson planning. Teachers who master AI tools gain significant advantages in personalising instruction and managing workloads.

Farias et al. (2024, p. 33) emphasises that “AI can support the teacher by freeing them from routine and administrative tasks, allowing them to devote more time to activities of greater pedagogical value.”. According to Brazão e Tinoca (2024, p. 8), AI augments teaching, allowing teachers to focus more on creative and relational aspects, but requires new pedagogical strategies and critical adaptation to avoid over-reliance on automation: “e role of the teacher, when interacting with AI systems, is transformed, requiring new skills to guide, supervise and validate the students' learning process.”

The same ideas were exploited by some participants on the Focus Group 2:

> “Teachers who become proficient and competent in the use of generative artificial intelligence will have an advantage. They will be able to better personalise their students’ educational experiences and even have advantages in bureaucratic areas.” (Participant 3)

> “The essence of teaching, in my opinion, has always focused on the human relationship between teachers and students. There must be pedagogical adaptation.” (Participant 1)

3.3. Impact on the Teacher

AI is not a replacement for teachers but a complement. The role of the teacher is evolving towards that of a facilitator, critical evaluator, and ethical guide. Professional competence, especially in digital literacy and critical assessment of AI outputs, is increasingly valued.

Teachers are empowered to innovate but must continuously update their skills. There is a growing need for resilience, adaptability, ethical awareness and confidence. According to Dorotea, Pedro e Piedade (2021, p. 13) “Teachers' confidence in the use of digital is strongly linked to their previous experience and continuous training, and is essential for the effective integration of new technologies such as AI.” and also critical literacy is needed: “Teachers need to develop critical digital literacy to act as mediators and not mere consumers of AI-generated content.” (Neves, 2023, p. 12).

The same ideas were discussed by the participants on the Focus Group 2:

> “Teachers must know how to use the tool strategically, not rely entirely on what the tools generate. There must be critical thinking and adaptation to the strategies we use.” (Participant 1)

> “The partnership between AI and teachers is fundamental.” (Participant 2)

Teachers who become proficient in AI will have an advantage. AI can support teachers by automating routine tasks and enabling more innovative pedagogy.

3.4. Impact on the Student

Students benefit from more personalised, motivating, and inclusive learning experiences. However, there is concern that students may become overly reliant on AI tools, potentially undermining the development of critical thinking and autonomy. Lima e Serrano (2024, p. 8) emphasises this topic “Generative AI can promote students' autonomy and creativity, but it requires ethical and critical monitoring to avoid dependencies and biases.” and it is evidence for Silva (2024, p. 15) that “Education should ensure that students develop critical thinking, ethics, and digital responsibility when interacting with AI systems”.

These ideas were confirmed by some participants on the Focus Group 2:

> "I think a lot of the discomfort comes from this: students know more than teachers and they are uncomfortable." (Participant 1)

> "AI can help analyse student patterns and difficulties, but teachers should not lose their responsibility in assessment." (Participant 1)

AI can support student engagement and success, but its positive impact depends on fostering digital literacy, critical thinking, and responsible use.

3.5. Impact on the Curriculum

AI enables the diversification and personalisation of curricular content, but participants caution against allowing AI to autonomously design curricula without human oversight: "The curricular integration of AI should be guided by clear ethical and pedagogical principles, ensuring that the technology serves educational objectives and does not replace them." (INCoDe.2030, 2020, p. 14)

Cormier (2008, p. 3) defends that the curriculum is based on the concept of "Community as curriculum: the learning network is the curriculum, and AI can be a node in this rhizomatic structure". These ideas are complemented by some opinions shared on the Focus Group 2:

> "The school curriculum cannot be left to the discretion of AI without some kind of higher guidance or strategy." (Participant 2)

> "It is up to teachers, in their daily lives, to adapt what is in the curriculum, which is global, to the specificities of their social context or, within a class, to the context of the students they have." (Participant 4)

Curricula can become more flexible and relevant, but human judgement and alignment with broader educational goals remain indispensable.

3.6. Impact on School Organisation

AI is prompting schools to implement new practices, such as regular sharing sessions, workshops, and the development of ethical codes. However, organisational challenges persist, including the shortage of trainers and uneven implementation across institutions.

These ideas were discussed by the participants on Focus Group 2:

> "At the school where I am, we are holding monthly sharing sessions, where we address various issues, many of them related to the use of generative artificial intelligence." (Participant 4)

> "There is an enormous demand for training in this area of artificial intelligence, and the shortage of trainers is such that it is very difficult to find a solution for so many people wanting to do training." (Participant 2)

In fact, school organisation is becoming more collaborative and innovative but faces capacity and resource challenges in scaling up AI integration. In this sense, the legal framework in Portugal defends that "The digital transformation of schools requires institutional reorganization, collaboration between teachers and continuous teacher training." (Diário da República, Resolução n.º 30/2020, 2020, p. 4) and an important national survey refers that "The creation of learning and sharing communities is key to the sustainable integration of AI into school practices." (ISLA, 2024, p. 7).

7. Impact on Teacher Training

There is a strong demand for both initial and continuing teacher training on AI, but a shortage of experienced trainers and insufficient integration of AI in initial teacher education. In the Focus Group 2, some opinions prove these ideas:

> "We, teachers, are very concerned about this topic and I feel that colleagues are very eager for training, because they feel that students know more than they do and they are uncomfortable." (Participant 1)

> "Unfortunately, we still do not have teachers leaving initial training who are empowered in this area, also due to initial training itself, which is not doing it." (Participant 3)

In the same way, from researchers' opinions, teacher training must be urgently updated to include AI literacy, ethical considerations, and practical applications, ensuring teachers are prepared for evolving classroom realities: "Teacher training should include technical, ethical and critical skills for the use of AI, promoting teacher trust and autonomy." (Lucas & Bem-Haja, 2021, p. 18) and also Brazão e Tinoca (2024, p. 10) emphasise that "Teacher education must be rethought in the GenAI era, focusing on critical questioning and dialogic processes with AI." (Brazão & Tinoca, 2024, p. 10)."

So, Teacher Education must be rethought in the GenAI era, focusing on critical questioning and dialogic processes with AI.

8. Impact on Society in General

AI in education is seen as a catalyst for broader social transformation, preparing students for future job markets and digital citizenship. There is optimism about AI's potential to democratise access to knowledge, but also concern about ethical, social, and equity issues. The Focus Group 2 discussion ends with some needs:

> "We are already working on a code of conduct for the use of artificial intelligence, not only AI but also digital media in general, because there is often some lack of awareness about the impact that sharing information can have." (Participant 4)

> "A new framework will be released, where, in addition to the six areas of the current framework, areas of artificial intelligence will also be integrated. The DGE is also involved." (Participant 2)

Integrating these contributions, AI seems to have potential to foster greater social inclusion and innovation, but requires robust ethical frameworks, public awareness, and policy support to mitigate risks and ensure equitable benefits. It is needed that "The spread of AI in education raises ethical and social challenges, requiring critical reflection and the involvement of the entire educational community." (Oliveira, 2025, p. 22) and the Council of Europe anticipates that "AI in education must be regulated to safeguard fundamental rights, democracy and the rule of law." (2022, p. 18).

Synthesis

The Focus Group results reveal that AI is already reshaping education across multiple dimensions in Portugal, also referred to by important researchers quoted in this report. While AI brings significant opportunities for personalisation, efficiency, and innovation, its transformative potential is contingent on the continued centrality of human agency - teachers' critical, ethical, and relational roles cannot be replaced. The main challenges lie in updating teacher training, ensuring equitable access, and developing ethical and regulatory frameworks. Ultimately, AI is a catalyst for pedagogical and social transformation, but its success depends on strategic, reflective, and inclusive implementation.

Conclusions

The integration of Artificial Intelligence (AI) into teaching and learning in Portugal is advancing step by step, driven by national strategies, investments in infrastructure, and a growing awareness of the opportunities and challenges AI brings to education. The research and Focus Groups conducted as part of the TE-REG project reveal that AI is not only reshaping the representations of pedagogical practices but also seems to be challenging traditional conceptions of what it means to teach and learn.

AI's influence is visible in the increasing personalisation of learning experiences, the automation of administrative and assessment tasks, and - slowly - the emergence of new forms of dialogical interaction between students, teachers, and intelligent systems. Teachers are called to develop new digital and critical skills, moving from transmitters of knowledge to facilitators, mediators, and ethical guides in a complex, interconnected learning ecosystem. At the same time, students are expected to become more autonomous, critical, and responsible in their use of digital resources and AI-powered tools.

However, the report also highlights significant challenges: persistent gaps in teachers' digital competences, the risk of deepening educational inequalities (the so-called "AI Divide"), and the urgent need to address ethical, legal, and social implications of AI in education. Issues such as data privacy, algorithmic transparency, bias, and the safeguarding of fundamental rights must be at the centre of any strategy for AI integration.

Furthermore, the findings emphasise the importance of continuous teacher training, the co-construction of knowledge in dialogical processes with AI, and the need for a critical and reflective approach to the use

of technology in education. There is a consensus that AI should empower and not replace teachers, and that human agency, creativity, and ethical judgement remain irreplaceable.

Recommendations for Teaching and Learning in Portugal in the Age of AI

1. Promote ongoing digital and AI literacy for all teachers and students, ensuring that everyone develops the skills to use, evaluate, and create with AI critically and ethically.
2. Foster critical thinking and questioning in all educational levels, encouraging students to reflect on, interrogate, and co-construct knowledge in collaboration with AI systems.
3. Integrate AI into the curriculum in a balanced and inclusive way, ensuring that technology serves pedagogical goals and does not replace human judgement or creativity.
4. Invest in continuous, high-quality teacher training focused on digital competences, AI ethics, and pedagogical innovation, supporting teachers as facilitators and mediators in the digital age.
5. Develop clear ethical and legal frameworks for the use of AI in education, safeguarding data privacy, transparency, and fundamental rights for all educational actors.
6. Encourage collaborative school cultures and professional learning communities, where teachers, students, and school leaders share experiences and co-develop best practices for AI integration.
7. Promote equity in access to AI resources and infrastructure, actively addressing the risk of an “AI Divide” and ensuring that all students benefit from technological advances.
8. Support research and innovation in dialogical and personalised learning with AI, exploring new models of co-construction of knowledge and assessment that leverage the potential of intelligent systems.
9. Engage students, teachers, families, and the wider community in ongoing dialogue about the opportunities and risks of AI, fostering digital citizenship and shared responsibility.
10. Continuously monitor, evaluate, and update policies and practices related to AI in education, ensuring that integration remains aligned with democratic values, social inclusion, and the well-being of all learners.

These recommendations aim to ensure that AI becomes a catalyst for pedagogical transformation and social inclusion in Portugal, empowering teachers and students to thrive in a complex and rapidly changing world. Integrating AI into teaching and learning has practical limitations, such as a lack of resources, inadequate infrastructure and the need for specific training for teachers. The paradigm shift in the act of teaching is the main challenge, and AI is seen as an opportunity to catalyse pedagogical transformation at all levels of education. We highlight the importance of addressing these challenges to maximise the benefits of AI in education. Finally, we emphasise the need for a balanced and critical approach to the introduction of AI in educational institutions, prioritising the adequate preparation of the school organisations for the protection of students' rights.

Bibliography

Brazão, P., & Tinoca, L. (2024). A Evolução do Questionamento Crítico nos processos dialógicos com IA: uma perspetiva em contexto universitário. In *SciELO Preprints*. https://doi.org/10.1590/SciELOPreprints.9566

Cormier, D. (2008). Rhizomatic education: Community as curriculum. *Innovate. 4* (5). https://davecormier.com/edblog/2008/06/03/rhizomatic-education-community-as-curriculum/

Council of Europe (2022). Artificial Intelligence and Education. A critical view through the lens of human rights, democracy and the rule of law. Council of Europe Publishing. https://rm.coe.int/artificial-intelligence-and-education-a-critical-view-through-the-lens/1680a886bd

Diário da República. Resolução do Conselho de Ministros n.º 30/2020, de 21 de abril. https://files.dre.pt/1s/2020/04/07800/0000600032.pdf

Dorotea, N., Pedro, A., & Piedade, J. (2021). Confiança dos docentes na utilização do digital na transição para o Ensino a Distância. Ministério da Educação - Direção-Geral da Educação.(Portugal).https://www.dge.mec.pt/sites/default/files/Noticias_documentos/confianca_dos_docentes_na_utilizacao_do_digital_na_transicao_para_o_ensino_a_distancia.pdf

Farias, S., Oliveira, A., Sousa, E., & Silva, F. (2024). O uso de Inteligência Artificial (IA) na educação e as suas implicações sobre a ética docente. IOSR Journal Of Humanities And Social Science (IOSR-JHSS) Volume 29, Issue 9, Series1 (September, 2024) 31-35 e-ISSN: 2279-0837, p-ISSN: 2279-0845. DOI:10.9790/0837-2909013135

INCoDe. 2030 (2020). AI Portugal 2030. An innovation and growth strategy to foster Artificial Intelligence in Portugal in the European context.
https://observatorio.incode2030.gov.pt/wp-content/uploads/2022/05/Estrat%C3%A9giaAI2030-1.pdf

ISLA, Instituto Politécnico de Santarém. (2024). FORMA-TE. Portal dos Formadores e Formação.
https://www.forma-te.com/mediateca-de-formacao/viewdownload/114-forma-te/54417-documentos-do-xi-encontro-nacional-de-formadores-2024

Downloads - Forma-te - Documentos do XI Encontro Nacional de Formadores 2024

Lima, C. B.; Serrano, A. (2024). Inteligência Artificial Generativa e ChatGPT: uma investigação sobre seu potencial na Educação. *Transinformação*, v. 36, e2410839.
https://doi.org/10.1590/2318-0889202436e2410839

Lucas, M. & Bem-Haja, P. (2021). Estudo sobre o nível de competências digitais dos docentes do ensino básico e secundário dos Agrupamentos de Escolas e das Escolas Não Agrupadas da rede pública de Portugal Continental. Universidade de Aveiro / Ministério da Educação - Direção-Geral da Educação.
https://www.dge.mec.pt/sites/default/files/Noticias_documentos/estudo_sobre_o_nivel_de_competencias_digitais_dos_docentes_do_ensino_basico_e_secundario_dos_agrupamentos_de_escolas_e_das_escolas_nao_agrupadas_da_rede_publica_de_portugal_continental.pdf

Neves, M. (2023). *A IA generativa - o novo desafio na e para a educação*, Direção Geral da Educação, revista Noesis. 80. julho 2023.
https://www.dge.mec.pt/sites/default/files/boletim/boletim_dge_n80_apoio_as_escolas_julho2023.html

Neves, M. (2025). Newsletter «Unlock AI:Shape the Future - AI in 5 Minutes». January 26, 2025. Linkedin.
https://www.linkedin.com/pulse/unlock-aishape-future-ai-5-minutes-marco-neves-jk2uf/?trackingId=Ce64UZbhQTG65IXKGmMI9Q%3D%3D

Oliveira, A. (2025). A Inteligência Artificial Generativa. Fundação Francisco Manuel dos Santos. Ensaios. 143.

Portugal Digital. Estratégia Nacional de Inteligência Artificial.
https://portugaldigital.gov.pt/acelerar-a-transicao-digital-em-portugal/conhecer-as-estrategias-para-a-transicao-digital/estrategia-nacional-de-inteligencia-artificial/

Siemens, G. (2005). Connectivism: A Learning Theory for the Digital Age. *International Journal of Instructional Technology and Distance Learning. 2*(1). http://www.itdl.org/Journal/Jan_05/article01.htm

Silva, J. P. (2024). *Direitos Fundamentais para o Universo Digital*, Fundação Francisco Manuel dos Santos. Ensaios.

Tinoca, L. (2023). A inteligência artificial e a pedagogia no ensino superior. Jornal Público, 12/07/2023.
https://www.publico.pt/2023/07/12/ciencia/opiniao/inteligencia-artificial-pedagogia-ensino-superior-2055874