

Artificial intelligence in secondary education: perspectives and perceptions of Uruguayan teachers

Inteligencia artificial en secundaria: perspectivas y percepciones de docentes uruguayos

Inteligência artificial no ensino médio: perspectivas e percepções de professores uriguaiois

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Abstract

This study explores the perceptions of secondary education teachers in Uruguay regarding the integration of Artificial Intelligence (AI) in the classroom—a particularly relevant topic in a country recognized as a pioneer in digital inclusion in education. Through three interviews and a focus group, the study examines teaching practices, levels of AI appropriation, attitudes toward this technology, and the obstacles and facilitators influencing its adoption. The findings reveal that, while there is enthusiasm for AI's potential, significant challenges remain in terms of teachers' digital competencies, access to resources, and curricular design. A diversity of perspectives on AI is identified, ranging from a focus on opportunities to ethical and social concerns. Peer collaboration and context-specific teacher training emerge as key factors in fostering the effective and responsible integration of AI. The study concludes that addressing these challenges and promoting a reflective and critical approach to AI's role in education are essential to ensuring that this technology benefits all students. Based on these findings, recommendations are proposed for teacher training and educational policies, aiming to contribute to an educational transformation that leverages AI's potential to enhance both quality and equity in secondary education in contexts similar to the one studied.

Keywords:

artificial intelligence, secondary education, teacher attitudes, educational technology, digital competence.

Resumen

Este estudio explora las percepciones de docentes de educación secundaria en Uruguay sobre la integración de la Inteligencia Artificial (IA) en el aula, un tema de relevancia en un país pionero en inclusión digital educativa. A través de tres entrevistas y un grupo de discusión se analizan las prácticas docentes, los grados de apropiación de la IA, los posicionamientos frente a esta tecnología, así como los obstáculos y facilitadores para su adopción. Los resultados revelan que, si bien existe entusiasmo por el potencial de la IA, también persisten desafíos en términos de competencias digitales docentes, acceso a recursos y de diseño curricular. Se identifica una diversidad de posturas frente a la IA, desde la visión de oportunidades hasta las preocupaciones éticas y sociales. La colaboración entre pares y la formación docente contextualizada emergen como factores clave para promover una integración efectiva y responsable de la IA. Se concluye que es necesario abordar los desafíos identificados y promover un enfoque reflexivo y crítico sobre el papel de la IA en la educación, con el fin de garantizar que esta tecnología beneficie a todos los estudiantes. A partir de estos hallazgos, se proponen recomendaciones para la formación docente y las políticas educativas, buscando contribuir a una transformación educativa que aproveche el potencial de la IA para mejorar la calidad y la equidad en la educación secundaria en contextos similares al estudiado.

Palabras clave:

inteligencia artificial, educación secundaria, actitudes del profesorado, tecnología educativa, competencia digital.

Resumo

Este estudo explora as percepções de professores do ensino médio no Uruguai sobre a integração da Inteligência Artificial (IA) na sala de aula, um tema particularmente relevante em um país reconhecido como pioneiro na inclusão digital na educação. Por meio de três entrevistas e um grupo focal, o estudo analisa as práticas docentes, os níveis de apropriação da IA, as atitudes em relação a essa tecnologia e os obstáculos e facilitadores que influenciam sua adoção. Os resultados revelam que, embora haja entusiasmo pelo potencial da IA, ainda existem desafios em termos de competências digitais dos professores, acesso a recursos e desenho curricular. Identifica-se uma diversidade de perspectivas sobre a IA, que vão desde uma visão otimista, voltada às oportunidades, até preocupações éticas e sociais. A colaboração entre pares e a formação docente contextualizada emergem como fatores-chave para promover uma integração eficaz e responsável da IA. O estudo conclui que é essencial enfrentar esses desafios e promover uma abordagem reflexiva e crítica sobre o papel da IA na educação, a fim de garantir que essa tecnologia beneficie todos os alunos. Com base nesses achados, são propostas recomendações para a formação docente e para as políticas educacionais, visando contribuir para uma transformação da educação que aproveite o potencial da IA para melhorar a qualidade e promover equidade no ensino secundário em contextos similares ao estudado.

Palavras-chave:

inteligência artificial,
ensino médio,
atitudes do professor,
tecnologia educacional,
competência digital.

Introduction

Artificial Intelligence (AI) has emerged forcefully in contemporary society, permeating industries, economies, and education systems worldwide. In the field of education, this technology presents opportunities for personalized learning, the automation of administrative tasks, and the expansion of pedagogical possibilities (Holmes *et al.*, 2021). In this sense, AI is positioned as a tool with the potential to transform education (Luckin *et al.*, 2016). However, its adoption entails complex challenges, ranging from the digital divide to the need for clear ethical frameworks (Gallent-Torres *et al.*, 2024), which must be translated into solid digital competencies and updated pedagogical knowledge. This demands teacher-training initiatives that ensure the appropriate use of digital technologies (García Pérez, 2024; Silva & Miranda, 2020).

Uruguay represents a particularly relevant case study in this context. The country has made significant investments in infrastructure and technological resources, positioning itself as a pioneer in digital inclusion in education through Plan Ceibal (Ceibal, 2020). Furthermore, there is a perceived gap between the availability of time and technological resources and their effective pedagogical use. This suggests that training programs must address the specific needs of teachers (Vaillant, 2023), particularly to ensure that they have the time and tools to meaningfully integrate AI into their practice (Ceibal, 2024; Mels *et al.*, 2024).

Despite efforts to foster digital inclusion, research in Uruguay indicates that teachers' digital competencies (TDC) still face significant challenges (Cabrera Borges *et al.*, 2018; Coitinho & González, 2024; Gómez, 2023; Mels *et al.*, 2023; Questa-Tortero *et al.*, 2024). Recent studies show that many teachers are still at basic or intermediate levels of digital competence, limiting their ability to fully leverage the potential of AI in teaching (Cabello *et al.*, 2021; Coitinho & González, 2024; Gómez, 2023; Morales *et al.*, 2020). Furthermore, there is a perceived gap between the availability of time and technological resources and their effective pedagogical use. This suggests that training programs must address the specific needs of teachers (Vaillant, 2023), particularly to ensure that they have the time and tools to meaningfully integrate AI into their practice (Ceibal, 2024; Mels *et al.*, 2024).

This situation is not exclusive to Uruguay. Across Latin America, the effective integration of digital technologies (DTs) in education faces similar challenges. Regional studies have revealed varying levels of teachers' digital competence (TDC) and persistent difficulties in translating technological investment into concrete pedagogical outcomes (Cabello *et al.*, 2021; Castillo *et al.*, 2023; Chamoli *et al.*, 2024; Granados, 2024; López *et al.*, 2025; Pinto *et al.*, 2024). Common barriers include a lack of specific training, resistance to change, inadequate infrastructure, and insufficient institutional support, all of which hinder the adoption of AI and other DTs in classrooms (Cabello *et al.*, 2021; Patiño *et al.*, 2021).

Background

At the international level, UNESCO has developed guidelines for the use of AI in education, highlighting key principles such as equity, inclusion, and data protection (Miao & Holmes, 2024). These guidelines aim to ensure that AI does not widen technological gaps or deepen existing inequalities. For example, the report “Artificial Intelligence and Education” emphasizes a human-centered approach, promoting universal access to AI benefits and addressing challenges such as algorithmic bias and the protection of the rights of vulnerable students (Holmes *et al.*, 2021). Additionally, UNESCO has launched AI competency frameworks for students and teachers to prepare educational communities to understand both the opportunities and risks associated with this technology (Miao & Shiohira, 2024; Miao & Cukurova, 2024).

In Latin America, studies have focused on TDC, emphasizing the need to adapt teacher training to specific contexts (Segovia *et al.*, 2025). A noteworthy example is the joint project between UNESCO and the Chilean Ministry of Education, which aims to strengthen TDC through personalized diagnostics and adaptive learning platforms (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2023). This initiative responds to the challenges that emerged during the pandemic in Chile and other countries in the region, particularly the inequalities in access to educational technologies (Vaillant *et al.*, 2022). Other research, such as that by Mancebo and Vaillant (2022), analyzes learning recovery programs in the region, highlighting initiatives such as *Aula Global* in Colombia, which combine personalized tutoring with professional development to reduce learning poverty and improve basic skills in mathematics and literacy.

In Uruguay, previous research has explored TDC more broadly (Cabrera Borges *et al.*, 2018; Gómez, 2023; Morales *et al.*, 2020), but there is a scarcity of specific studies on the use of AI in secondary education. While initiatives to promote this technology exist in other sectors—such as health and agriculture—its application in education remains incipient (Questa-Tortero *et al.*, 2025). This study therefore seeks to fill this gap in the literature by providing empirical evidence through the exploration of teachers’ perceptions regarding the use of AI in secondary school classrooms within the Uruguayan context.

This contribution focuses on reporting part of the qualitative findings from a broader pilot study and seeks to answer the following research questions:

1. How is the inclusion of digital technologies (DTs) manifested in the teaching practices of secondary education in a school in Uruguay, and how is AI integrated into this context?
2. What are the perspectives of teachers at the studied school regarding the degree of appropriation of DTs and AI?
3. What positions do teachers assume regarding AI, and how do these positions influence their practices and their perceptions of the opportunities and challenges related to AI in education?
4. What factors do teachers at this school identify as determinants for the effective and ethical inclusion of AI in their educational practices?

By addressing these questions, this study aims to generate knowledge about the opportunities identified by teachers and the barriers that hinder the adoption of AI, with the goal of deriving recommendations for its effective and ethical integration into secondary school classrooms.

Theoretical framework

To understand the integration of AI in Uruguayan secondary education, this study is based on three interrelated theoretical pillars: (1) teachers' digital competencies; (2) diffusion of innovations theory; and (3) a socio-critical approach to technologies. These concepts provide the analytical structure for examining AI use in education.

1. Teachers' digital competencies

In the context of a digitizing society, teachers' ability to effectively integrate technologies into their pedagogical practices has become an essential competency (UNESCO, 2019). Teachers' digital competencies (TDC) refer to the set of knowledge, skills, and attitudes that enable educators to use digital technologies creatively, critically, and responsibly to improve teaching and learning (Redecker & Punie, 2017).

Teachers must not only use digital technologies but also understand how these tools can transform instruction and learning. Digital competencies allow educators to design innovative activities, adapt materials to students' needs, assess learning effectively, and provide personalized feedback (Córdova *et al.*, 2024; Maier & Klotz, 2022; Ng *et al.*, 2023). Moreover, TDC can promote inclusion by ensuring that students have access to the opportunities offered by digital technologies (García Tartera, 2023).

This study draws on the DigCompEdu framework (Redecker & Punie, 2017), which offers a comprehensive structure for understanding and evaluating TDC and integrates the perspective of AI use. DigCompEdu defines 22 competencies organized into six interrelated areas: professional engagement through reflection and networking; the management of high-quality digital resources; the enhancement of teaching and learning through digital technologies; the use of technologies for assessment and formative feedback; the empowerment of learners through digital means; and the development of students' digital competence.

TDC are a prerequisite for teachers to effectively integrate AI into their pedagogical practices. For AI to become a useful pedagogical tool, educators must develop AI literacy (Ng *et al.*, 2023). This competency involves understanding the potential and risks of AI, selecting appropriate tools, integrating them meaningfully into learning processes, evaluating their impact using data, and promoting ethical and responsible use to enhance the quality and equity of education (Kim *et al.*, 2022).

2. Theory of diffusion of innovations

The integration of AI in the educational field should not be viewed as an isolated event. It is a dynamic and complex process that unfolds over time, involving various stakeholders and influenced by social, cultural, and institutional factors. To understand this process of change, this study draws on the theory of diffusion of innovations (Rogers, 2003), which offers a conceptual framework to analyze how new ideas and technologies spread and are either adopted or rejected within a society.

This theory is based on key concepts such as the characteristics of the innovation, the adoption process, and adopter categories. The likelihood of adopting an innovation depends on how its characteristics are perceived, including its relative advantage compared to what it replaces, its compatibility with existing values and experiences, the complexity of understanding and use, the ability to try it on a limited basis, and the observability of results by others.

The adoption process is divided into five stages: knowledge (the individual becomes aware of the innovation), persuasion (the individual forms a favorable or unfavorable attitude), decision (the individual engages in activities leading to adoption or rejection), implementation (the individual puts the innovation into practice), and confirmation (the individual seeks reinforcement for the decision but may reverse it if exposed to conflicting messages). Moreover, individuals adopt innovations at different rates, which allows them to be categorized as innovators, early adopters, early majority, late majority, and laggards.

The adoption of an innovation is not an individual process alone but is influenced by social interactions and group dynamics. In this regard, communities of practice (CoPs) can play a key role in the diffusion of AI among teachers (Cambridge *et al.*, 2024; Wenger *et al.*, 2023). CoPs are groups of people who share a concern, a set of problems, or a common interest in a topic, deepening their knowledge and expertise in the area through regular interaction. By participating in CoPs, teachers can share their experiences with AI, learn from colleagues, overcome resistance to change, and develop a sense of belonging and mutual support.

While communities of practice help to understand teacher interactions within an educational center, it is also useful to consider the concept of professional practice fields, as the adoption of technologies like AI varies according to the traditions, values, and structures specific to each profession. For example, ways of incorporating AI differ among doctors, lawyers, journalists, or teachers—even within each of these fields. This perspective does not invalidate the CoP approach but complements it by recognizing that technological innovation practices are shaped both in everyday interactions and within broader institutional and professional frameworks (Wenger *et al.*, 2023; Williamson *et al.*, 2023).

The theory of diffusion of innovations and the CoP perspective provide a useful framework for analyzing factors influencing AI adoption and better understanding the barriers and facilitators for its adoption within the scope of this study.

3. Critical sociological approach to technologies

As previously mentioned, the integration of AI in education cannot be considered a neutral or purely technical process. The adoption of digital technologies (DT) is intrinsically influenced by values, interests, and power relations that shape their development, implementation, and consequences (Feenberg, 2002; Winner, 2020). In this sense, the critical sociological approach to DT questions uncritical assumptions about technological progress and invites examination of how technologies may reproduce or even exacerbate existing social inequalities rather than solve problems (Winner, 2020). Adopting a critical sociological approach involves considering key principles such as participation, transparency, accountability, and social justice in the design and implementation of AI in education (Questa-Tortero & Pérez, 2024).

From this perspective, it is necessary to analyze how AI can generate risks in the educational field, such as creating or perpetuating biases that harm certain groups of students; increasing surveillance and control over students' activities, thereby eroding their privacy and autonomy; and contributing to the deprofessionalization of teachers by delegating key pedagogical functions to automated systems (O'Neil, 2016; Zuboff, 2019). Added to these challenges are the ecological and environmental costs associated with data- and device-intensive forms of AI, which also call for reflection at the educational level (Selwyn, 2024).

In contrast to these risks, the critical sociological approach also seeks to promote the ethical and responsible use of AI that benefits all students, especially those in vulnerable situations (Miao & Holmes, 2024). This implies designing policies and practices that ensure algorithmic transparency, the participation of students and teachers in AI development, the accountability of developers, and the protection of students' rights (Artopoulos & Lliteras, 2024). In this vein, Williamson *et al.* (2023) emphasize the importance of interdisciplinary approaches that integrate knowledge from various educational, technological, and social fields to critically design and evaluate the outcomes and implications of AI in education.

Within this context, Communities of Practice (CoP) can serve as spaces for critical reflection on the social, ethical, and political implications of AI in education. In these spaces, teachers can analyze how AI might reproduce social inequalities, question assumptions about technological progress, and promote a fairer and more equitable use of technology (Mera, 2025). From this perspective, it is essential to recover key questions — “why” and “for whom” — which then lead to thinking about the “what” and the “how” (Tuomi, 2024). However, the consolidation of these communities requires available spaces, which contrasts with teachers' limited time and the evident workload burden (National Institute of Educational Evaluation [INEEd], 2020; Mels *et al.*, 2024; Trillo & Questa-Tortero, 2023).

Methodology

This instrumental case study (Stake, 1995) explores the perceptions of secondary education teachers from a public Uruguayan school regarding the integration of Artificial Intelligence (AI) in the classroom, using an exploratory sequential mixed-methods approach (Creswell & Plano Clark, 2017). The purposive selection of the school was based on its track record in digital inclusion and educational innovation. This report focuses on the qualitative phase, aimed at deepening the experiences and perspectives of the participants (Teddlie & Tashakkori, 2009).

For qualitative data collection, semi-structured interviews were conducted with the school principal and two technology advisor teachers, as well as a focus group with six teachers. Participant selection sought to represent diversity in disciplinary areas, levels of experience, and digital teaching competencies (DTC). The interview guides and the focus group protocol were designed to explore teaching practices involving digital technologies and AI, the degree of appropriation, attitudes toward AI, and barriers and facilitators to its adoption, linking these aspects with the study's theoretical framework.

Data analysis was performed using thematic analysis (Braun & Clarke, 2006), identifying recurring patterns through a coding and review process conducted by the research team to ensure validity and reliability. The study adhered to ethical principles relevant to research with human subjects, guaranteeing informed consent, confidentiality, and anonymity of participants (British Educational Research Association [BERA], 2024). The dataset is openly available in the Redata repository, where the data collection instruments from this phase can also be consulted (Cabrera Borges & Questa-Tortero, 2025).

Results and Discussion

This section presents and discusses the results obtained from the qualitative analysis of the semi-structured interviews and focus group conducted. As outlined in the theoretical framework, the adoption of AI in education is a complex phenomenon influenced by various factors, ranging from digital teaching competencies (Redecker & Punie, 2017) to innovation diffusion dynamics (Rogers, 2003) and the power relations shaping technology use (Feenberg, 2002; Winner, 2020).

Considering these theoretical references, the results are organized around three main axes: (1) the inclusion of digital technologies in general, and AI in particular, within teaching practices; (2) the appropriation of digital technologies and AI to promote meaningful learning; and (3) teachers' positioning toward AI and its educational consequences. For each axis, key findings are presented, interpreted through the lens of theory, and some implications are discussed.

On the inclusion of technologies

Regarding the management of digital technologies in education (Mancebo & Vaillant, 2022), the teachers consulted perceive themselves as having a moderate level of integration of these technologies in their practices. This self-perception is a relevant factor in the process of adoption and implementation of technological innovations in the classroom (Jing *et al.*, 2024).

Although Ceibal's commitment to digital inclusion has sought to democratize access to technology at all educational levels (Ceibal, 2020), factors persist among this group of teachers that hinder the effective use of these tools for pedagogical purposes. At this point, the research by Cabrera Borges *et al.* (2018) highlights the need to promote situated and contextualized professional development that considers the particularities of each educational center and the specific needs of the teachers, which still does not seem to have been achieved.

Regarding the inclusion of technologies, the school principal commented:

Everyone uses technology... but the use of technology for pedagogical or didactic purposes, there (...) I estimate that between 60–70% of teachers take the initiative to work with it, and I would say that 40 or 50% work very well with technology, using it as a permanent tool and as a tool that encourages learning. (ED)

This view is complemented by the teachers who participated in the focus group, who stated that they incorporate digital technologies (DT) into their practices but also acknowledged there is still room for improvement: "I handle it well for what it is—teaching class, no problem." (FG)

I use CREA a lot [Ceibal's educational platform], and beyond just setting up a quiz and giving feedback, there are forums. So, in that continuity of the class, I open a forum for them to upload the activity, I give feedback, they have the possibility to improve that activity, and everything is recorded. (FG)

However, in the words of one of the technology support teachers, there are still colleagues who do not incorporate technologies and even express fear of using them, which could indicate resistance to change (Rogers, 2003): "There are people who already incorporate technology into their practices and others who see it with great fear." (EP1)

These observations are consistent with what Patiño *et al.* (2021) reported, highlighting the importance of generating support and training strategies to address these needs and fears.

Regarding how they incorporate DT into their practices, differences also seem to exist. In the following quote, a teacher describes their use and emphasizes the importance of promoting metacognition through the inclusion of these technologies, suggesting an attempt to go beyond the mere instrumental use of the tools (Selwyn, 2021):

I use various tools and create resources for my classes, and above all something to highlight, which I always try to bring to students, that part of metacognition: What can I do with technology that I cannot do with paper? (FG)

This reflection on the added value of DT compared to traditional methods is fundamental for achieving effective integration of technology in education, preventing it from becoming merely a replacement for existing practices (Selwyn, 2021). As proposed by Artopoulos and Lliteras (2024), both in the classroom and in teacher training, "unpacking" AI critically as a form of literacy should be promoted to empower the educational community.

The data suggest that, although teachers are using digital tools, this does not necessarily translate into an effective appropriation of their pedagogical potential. There is a need to go beyond the instrumental use of technologies, promoting a reflective approach that drives the integration of AI into teaching practices, avoiding "technological determinism" (Selwyn, 2021) and aiming for meaningful learning. This approach must align with digital teaching competencies (DTC), such as those in the DigCompEdu framework (Redecker & Punie, 2017), which emphasizes teachers' ability to reflect on their own digital practice and adapt technologies to students' needs (Miao & Holmes, 2024; Miao & Cukurova, 2024; Miao & Shiohira, 2024).

On the appropriation of technologies

The degree of appropriation of digital technologies (DT) by teachers is diverse, as is the extent to which they are able to leverage these tools. This reflects the existence of different categories of adopters among teachers (Rogers, 2003). In the words of one of the technology support teachers: "You get everything—people who don't know how to open an email, for example, and colleagues who already received training during their studies." (EP1)

The diversity in technology appropriation levels may be related to the digital literacy and training teachers have received, as proposed by Cabrera Borges *et al.* (2018), Silva and Miranda (2020), or Vaillant (2023). In initial teacher education, there are differences between those who had specific courses on this subject and those who did not.

According to the school principal, training spaces are created within the school, while external training offers are also shared as part of the teacher professionalization process: "We have provided courses through the groups we have with teachers, courses offered by different universities in our country and also courses here in this school." (ED)

Although training is identified as a need, not all teachers have specific preparation in technology—much less in AI—as noted by a teacher in the focus group: "Today's world demands a lot in terms of feedback, ongoing training, and sharing with colleagues, with other colleagues and with the world." (FG)

From the teachers' perspective, the use of AI in education is below what they would like: "In my case, I've used artificial intelligence quite a lot—well, much less than I would like to." (FG)

Some teachers express interest in learning to use it, understanding that their students are already doing so: "Yes, I've used artificial intelligence. I will continue using it because I understand that students are already using it."

One teacher describes how students have used AI, reinforcing the need for educators to be prepared to guide authentic use: "I've used [AI] for audio, image recognition, to help those who acquire and absorb knowledge. The kids use artificial intelligence tools to teach a computer to recognize waste... I saw that last year at the Robotics Olympics." (FG)

It is worth noting that the use of AI by teachers, like DT in general, is also varied. Several teachers mention using it for lesson planning:

I also use [ChatGPT] for my lesson plans and for the creative part. For example, if I want a catchy title, I ask the chat for a title related to such and such, and it gives me a title and subtitle with a brief description. (FG)

Yes, I use it. I like it for planning; it helps me. (EP2)

I use it a lot (...) but mainly for planning, not so much in the classroom. (FG)

This finding suggests that teachers are exploring AI's potential to support their work but have not yet found effective ways to integrate it into the classroom. To achieve this, pedagogical approaches must be developed that promote digital literacy, encourage collaboration between teachers and students, and fully leverage AI's capabilities (García Pérez, 2024).

Furthermore, authors such as Pangrazio *et al.* (2024) propose analyzing AI integration from a data justice perspective, warning that algorithmic systems may reinforce dynamics of educational exclusion. Eynon (2023) highlights the importance of academic communities in educational AI defining their knowledge traditions through critical frameworks capable of challenging dominant narratives of innovation.

On the other hand, some participants refer to using AI with students in the classroom, with varying perceptions of success. Some mention that they have not had positive experiences:

I use it quite a bit, and I've tried to get the kids to use it, but I haven't managed to get them engaged. It hasn't reached the point where they use it for homework, so maybe we haven't tapped into its full potential or achieved widespread use. (EP2)

In my case, I haven't used it much in class, but in specific situations—like creating images or logos—things they could've done without AI, but now it's much richer and easier. (FG)

An interesting dilemma they raise is whether the focus should be on detecting uncritical use of AI by students or on teaching them to use it reflectively: "Instead of incorporating it [ChatGPT], the idea was to find ways to detect [its use], rather than teaching students how to use it properly." (EP1)

This debate highlights the need for a sociocritical approach to technology—one that allows for the ethical and social implications of AI in education to be analyzed and promotes the responsible and equitable use of these tools (Feenberg, 2002). The goal is not simply to control students' use of AI but to empower them to use it critically and creatively (Miao & Shiohira, 2024).

Positioning toward AI

According to one of the technology support teachers (EP2), the degree of appropriation of digital technologies (DT) by teachers is heterogeneous, as is the extent to which they leverage these tools. This highlights the existence of different categories of adopters among teachers (Rogers, 2003), ranging from those who do not use them or stick to basic applications to those who explore more advanced functionalities and even envision future uses, as emerged in the discussion group: "I didn't speak because I'm not using it yet" (FG), "Yes, I've used artificial intelligence, and I will continue to use it because I understand that students are already using it—and if we don't use it with them, well, we're missing a great opportunity." (FG)

This perception of AI as an opportunity reflects a favorable attitude toward innovation, which may be a key factor in promoting its adoption in classrooms, at least among an initial core group of teachers (Rogers, 2003). However, it is important to analyze how this "opportunity" is defined and understood to avoid falling into uncritical technological determinism (Selwyn, 2021).

The school principal mentioned that there are specific subjects in the new curriculum in which AI is addressed, along with the precautions necessary for its use. This suggests a concern aligned with UNESCO's (2021) recommendations to promote the responsible and ethical use of technology: "[Students] are working with computer science teachers on the proper and improper use of artificial intelligence. How to ask questions, how to compare the results obtained from AI with those from, for example, textbooks." (ED)

As UNESCO points out, integrating AI into the curriculum and fostering reflection on its ethical use are important to ensure that the technology is used responsibly and benefits all students (Miao & Holmes, 2024).

Closely related to this is the view that using AI involves a "tremendous commitment" (FG). This may reflect a lack of clarity about how to effectively integrate AI into pedagogical practice, as Selwyn (2021) warns: "Agreements [about AI use]? Not that I know of—there are no agreements... Surely many teachers, or at least some, still think that when a student uses AI, they're cheating." (EP2)

In this sense, the lack of specific training and limited knowledge of AI tools can lead to insecurity and resistance to change (Cabrera Borges *et al.*, 2018).

In contrast to those who see AI as an opportunity, others emphasize the ideological components underlying these technologies: "To me, it's still just another instrument of domination." (FG)

This perspective aligns with the sociocritical approach to technology, which invites us to examine the power relations and interests shaping the development and adoption of technologies (Feenberg, 2002; Winner, 2020). From this standpoint, it is essential to analyze how AI may reproduce or exacerbate social inequalities and how alternative, emancipatory uses of technology can be promoted.

Overall, there appears to be a generally positive perception of DT—and particularly of AI. The following quote from the principal summarizes this vision and underscores the need for educators to remain open to lifelong learning in the face of these changes:

We have to learn from artificial intelligence, understand it, so we can later bring that understanding into the school. It's clearly a tool that we're all already aware of. Not everyone is actively using it, but we do know it's here to stay—and that it will keep advancing and undoubtedly continue to provide tools we can use in the best possible way. (ED)

This analysis reveals a diversity of positions toward AI, ranging from enthusiasm and the perception of opportunities (Rogers, 2003) to caution and concern about its ethical and social implications (Feenberg, 2002; Winner, 2020). While there is broad recognition of AI's potential to enhance the quality of teaching (Holmes *et al.*, 2021), there are also evident tensions and challenges related to the lack of training (Vaillant, 2023), the need for responsible and equitable use of technology (UNESCO, 2021), and uncertainty about how to effectively integrate AI into pedagogical practice (Selwyn, 2021).

Barriers and enablers for the inclusion of AI

Teachers identified factors that could promote collaborative discussion and planning regarding the inclusion of AI in the classroom. The need for spaces for coordination and peer exchange emerged as a facilitator. Teachers view these spaces as valuable for sharing experiences and strategies on integrating AI into their practices, in line with the literature on Communities of Practice (CoP) (Cambridge *et al.*, 2024; Wenger *et al.*, 2023): "That coordination space, which is now just two hours... interdisciplinary work and sharing—ten minutes we spent with this teacher in the staff room and they showed me a tool I didn't know about." (FG)

However, both individual and shared time are seen as limitations. This may be related to the workload that teachers often face and the lack of policies supporting dedicated time for training and experimentation with new technologies (INEEd, 2020; Mels *et al.*, 2024; Trillo & Questa-Tortorolo, 2023): "I plan to access it to see how I can use it, but honestly, I haven't had time for that." (FG)

Lack of time, combined with work overload, can lead to a sense of insecurity—especially among late adopters (Rogers, 2003), who may perceive AI as complex and difficult to integrate into existing practices. From the school leadership's perspective, peer exchange is also seen as a key form of support and an incentive for implementing proposals that require stepping out of one's comfort zone. Peer support and encouragement can be important factors in overcoming resistance to change and promoting AI adoption (Rogers, 2003), as the principal noted:

It's a daily challenge for us to work on [the use of technology], to encourage teachers, to support them, to have their own colleagues support and stimulate them to innovate. And well, I think it's partly fear of the unknown, and that mindset of 'this is how it's always been done'. Sometimes it's the mental structure we have. (ED)

In this regard, the creation of CoPs where teachers can share experiences, exchange ideas, and support one another may be an effective strategy to encourage AI adoption and overcome resistance to change (Cabrera Borges *et al.*, 2024).

Time is also a limiting factor when it comes to the class periods available for engaging in critical reflection on these technologies:

That self-regulation also needs to be taught, and in 45 minutes it's just not possible for us teachers to teach that self-regulation. So, we also need—and we've discussed this many times in staff meetings—the support of the community, society, and families for those more socio-emotional aspects, to put it one way. (FG)

This quote also points to the need for building alliances not only within the school but also across the educational community—connecting with families and social organizations to promote the responsible and ethical use of technology and to foster necessary skills. This reinforces the importance of a sociocritical approach (Feenberg, 2002; Winner, 2020) that involves all stakeholders in discussions about the role of AI in education and promotes transparency, participation, and social justice.

Treads and tensions: a synthesis

The findings presented reveal a complex and heterogeneous landscape regarding the integration of digital technologies—and AI in particular—within the context of this study. While there is widespread recognition of the potential of these tools to enhance teaching and learning, several challenges remain concerning digital teaching competence (DTC), technological appropriation, attitudes toward innovation, and access to resources and time.

These challenges are not merely technical but are intertwined with social, cultural, and political factors that shape the adoption of AI in classrooms.

The diffusion of innovations theory (Rogers, 2003) helps explain how AI adoption is influenced by the characteristics of the technology, the stages of the adoption process, and the categories of adopters. This underscores the need for support strategies that take into account teachers' particularities and prior knowledge.

Furthermore, the sociocritical approach (Feenberg, 2002; Winner, 2020) emphasizes the importance of examining the power dynamics that shape the use of AI and promotes an ethical and responsible approach to technology integration in education (Miao *et al.*, 2021).

Conclusions

To conclude, this section revisits the research questions in light of the findings, identifying challenges and opportunities related to AI in Uruguayan secondary education, as well as offering recommendations for teacher training and education policy.

Regarding the inclusion of digital technologies (DT) and AI, the results indicate that although DTs have been promoted in teaching, their appropriation remains a challenge. AI is perceived as a distant technology that has not yet been fully integrated into classrooms. This underscores the need to move beyond simply providing resources

and to ensure teacher training focused on the pedagogical use of DT and AI from a critical and reflective perspective.

In terms of appropriation, diverse levels of digital competence and pedagogical approaches were identified. Some teachers achieve creative and innovative uses, while others limit themselves to instrumental applications or struggle to integrate AI. This highlights the importance of differentiated training strategies tailored to each teacher's specific needs, encouraging collaboration and the sharing of best practices. Such a training approach aligns with the arguments of Williamson *et al.* (2023) and Tuomi (2024), who emphasize that AI education must move beyond a purely technical training model to incorporate critical, ethical, and contextual perspectives on the educational use of these technologies.

Teachers' attitudes toward AI range from enthusiasm to caution. While its potential to improve teaching is widely acknowledged, concerns were raised about its ethical and social implications, such as algorithmic bias, data privacy, and the risk of deprofessionalizing teaching. This highlights the need for an open and inclusive debate about the role of AI in education, promoting its responsible and equitable use.

Teachers identified several factors that either enable or hinder the effective inclusion of AI. Facilitators include coordination spaces, institutional support, and ongoing professional development, whereas obstacles include lack of time, work overload, and resistance to change. Addressing these challenges will require strengthening tech-support roles, fostering environments that value professional growth, and promoting pedagogical innovation.

This study has several limitations. As a single case study, the findings reflect a specific context only. Moreover, voluntary participation may have introduced selection bias, affecting representativeness. The study also focuses on teachers' perceptions; therefore, future research should explore the impact of AI on student learning. Additionally, as the study prioritized qualitative data, it lacks quantitative analysis that could confirm or challenge the findings.

Based on the results, the following recommendations and future projections are proposed: (1) the design of teacher training programs specifically focused on AI; (2) the development of education policies for the ethical use of AI; (3) further research on the impact of AI on learning and assessment; (4) the creation of support resources and tools for teachers; and (5) the strengthening of peer collaboration and learning communities.

These actions aim to help harness the potential of AI to improve the quality and equity of secondary education, both in this context and others. Furthermore, recognizing that the adoption of AI varies across professional fields—such as medicine, law, journalism, and education—enables a better understanding of the dynamics within the teaching profession. This perspective complements the focus on communities of practice by highlighting how institutional conditions, shared values, and professional trajectories influence how AI is appropriated and reinterpreted in education.

Notes:

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Mariela Questa-Tortero: conceptualization, data curation, methodology, administration, writing of the draft and review of the manuscript.

Claudia Cabrera Borges: conceptualization, data curation, methodology, supervision, writing of the draft and review of the manuscript.

Yesika Padrón Maurino: research, writing of the draft and review of the manuscript.

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