DIGITAL SKILLS, ARTIFICIAL INTELLIGENCE AND THE FUTURE OF TEACHING AND LEARNING

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Abstract

Artificial intelligence is revolutionizing education by enabling personalized learning, automating administrative tasks, and transforming pedagogy, which demands that educators develop new digital competencies. The future of teaching hinges on integrating AI for tailored instruction while addressing critical ethical issues like data privacy, bias, and the digital divide. Today, many priorities for improvements to teaching and learning are unmet. Educators seek technology-enhanced approaches addressing these priorities that would be safe, effective, and scalable. Naturally, educators wonder if the rapid advances in technology in everyday lives could help. Like all of us, educators use AI-powered services in their everyday lives, such as voice assistants in their homes; tools that can correct grammar, complete sentences, and write essays; and automated trip planning on their phones. Many educators are actively exploring AI tools as they are newly released to the public. Educators see opportunities to use AI-powered capabilities like speech recognition to increase the support available to students with disabilities, multilingual learners, and others who could benefit from greater adaptively and personalization in digital tools for learning. They are exploring how AI can enable writing or improving lessons, as well as their process for finding, choosing, and adapting material for use in their lessons. This paper examines the availability and development of digital skills in the context of an increasing diffusion of Artificial Intelligence (AI) and other digital technologies within the economy and the wider society. The paper first assesses Ireland's performance with respect to digital skills relative to other EU countries, highlighting important gaps among the younger population. In this context, we place a particular focus on the role of secondary education in providing the skills needed for the digital economy. Drawing on in-depth data across secondary schools in Ireland, the paper examines students' perceptions that school benefits their digital skills and whether such technology positively impacts their school experience. Framed within a socio-cultural framework, the results highlight the complexity and interdependence of factors shaping digital skills development and the impact of technologies at school.

Introduction:

Digital literacy is one of the most important factors driving the digital transformation taking place worldwide within the economy and the wider society. The availability of digital skills enables the adoption and diffusion of digital technologies such as Artificial Intelligence (AI) and enhances their effects on innovation and productivity. The rapid advances of AI and other digital technologies are reshaping the role of education in providing the digital skills that are needed in an increasingly digital economy and society.

Policies are urgently needed to implement the following:

leverage automation to advance learning outcomes while protecting human decision making and judgment;

interrogate the underlying data quality in AI models to ensure fair and unbiased pattern recognition and decision making in educational applications, based on accurate information appropriate to the pedagogical situation;

enable examination of how particular AI technologies, as part of larger edtech or educational systems, may increase or undermine equity for students; and

take steps to safeguard and advance equity, including providing for human checks and balances and limiting any AI systems and tools that undermine equity.

How is AI in Education Transforming the Digital Learning Sphere

The role of AI in education is significantly increasing, with over 64% of educational institutions leveraging this technology as a catalyst for business continuity.

The educational industry has come a long way, especially with new technologies and trends transforming the learning domain. Advanced tech solutions like AI, ML, and AR/VR helped develop a more intuitive approach to learning and teaching.

AI trends in education and advantages of AI in enhancing the learning experience

The real-life use cases of this technology in the education sector

The impact and future of AI in education

Our preliminary definition of AI as automation based on associations requires elaboration. Below we address three additional perspectives on what constitutes

AI. Educators will find these different perspectives arise in the marketing of AI functionality and are important to understand when evaluating edtech systems that incorporate AI.

Key Themes in AI, Digital Skills, and Future Teaching

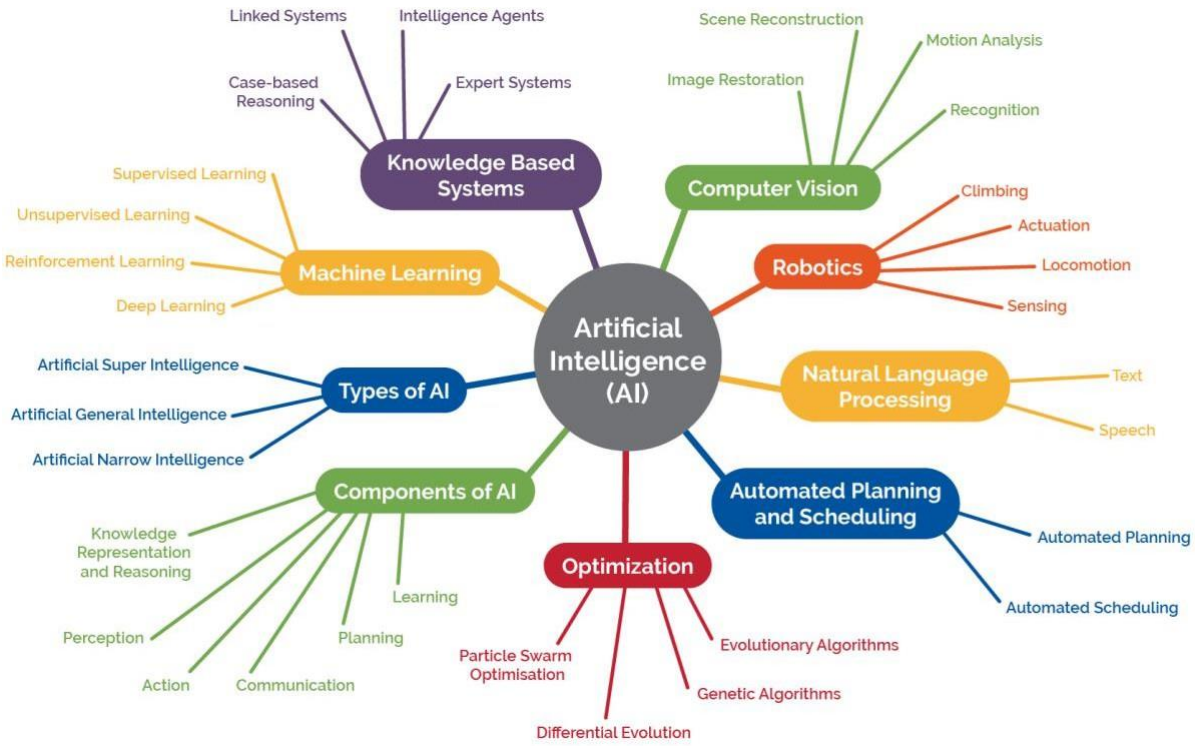
Impact on Pedagogical Approaches: AI enables personalized learning journeys, virtual tutoring, intelligent content creation, and adaptive assessment methods that can reduce learning gaps.

Essential Digital Skills for Educators: Teachers need to develop "AI literacy"—the ability to understand, use, and evaluate AI technologies and their, data, and implications. This includes leveraging AI for lesson preparation and addressing diverse student needs.

The Future of Teaching: AI is transforming teachers from information providers to mentors and curators of learning, allowing them to focus on high-impact student interactions.

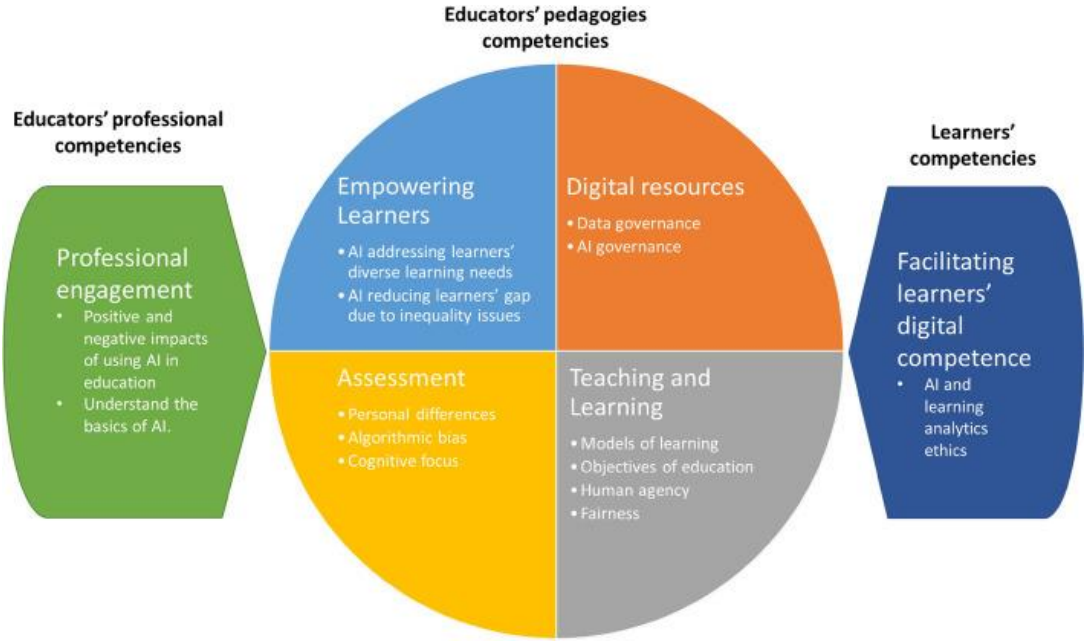
Challenges and Risks: Key challenges include ethical concerns, algorithmic bias, the potential for reduced human interaction, and the risk of over-reliance on technology.

Educational Transformation: The integration of AI requires infrastructure, including robust connectivity and devices, alongside comprehensive professional development to ensure equity and effective adoption.



Review of Literature:

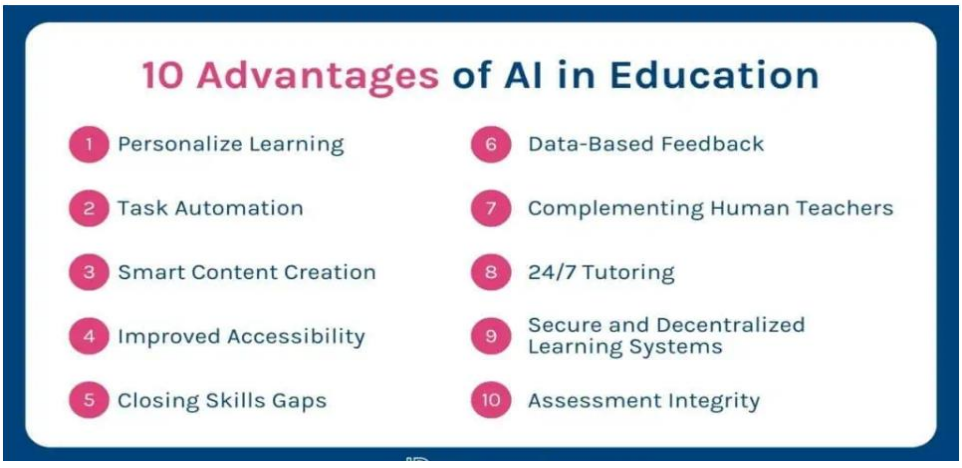
AI impacts both the demand and supply of educational opportunities (National Academies of Sciences, Engineering and Medicine, 2024). Thus, on the demand side, rapid advances, in particular in the area of generative AI, are changing the demand for skills and therefore the demand for education and training. On the supply side, AI could be an input in education, providing new online learning opportunities for primary, secondary and continuing education. Recent advances in Large Language Models (LLM) have the potential to design more flexible and adaptive computer-based teaching environments and adapting to different learning needs and learning styles. As documented by research-based evidence, more personalised teaching and access to adaptive computer-assistedlearning (CAL) technologies lead to substantial learning gains (see for example, Banerjee et al., 2007; Escueta et al., 2020). Risks associated with AI, particularly in the context of educational assessment, are also increasingly emerging, as many countries grapple with the unique opportunities and challenges associated with AI in assessment. In the Irish context, Marcus-Quinn and McCoy (2024) highlight major gaps in schools' procedures around technology, with many relying on outdated policies that lack clear guidelines on recent technological advances, particularly AI.



Insight: AI Systems Enable New Forms of Interaction

AI models allow computational processes to make recommendations or plans and also enable them to support forms of interaction that are more natural, such as speaking to an assistant. AI- enabled educational systems will be desirable in part due to their ability to support more natural interactions during teaching and learning. In classic edtech platforms, the ways in which teachers and students interact with edtech are limited. Teachers and students may choose items from a menu or in a multiple-choice question. They may type short answers. They may drag objects on the screen or use touch gestures. The computer provides outputs to students and teachers through text, graphics, and multimedia. Although these forms of inputs and outputs are versatile, no one would mistake this style of interaction with the way two people interact with one another; it is specific to human-computer interaction.

With AI, interactions with computers are likely to become more like human-to-human interactions. A teacher may speak to an AI assistant, and it may speak back. A student may make a drawing, and the computer may highlight a portion of the drawing. A teacher or student may start to write something, and the computer may finish their sentence—as when today's email programs can complete thoughts faster than we can type them.



Key Recommendation: Human in the Loop AI

Many have experienced a moment where technology surprised them with an uncanny ability to recommend what feels like a precisely personalized product, song, or even phrase to complete a sentence in a word processor such as the one being used to draft this document. Throughout this supplement, we talk about specific, focused applications where AI systems may bring value (or risks) into education. At no point do we intend to imply that AI can replace a teacher, a guardian, or an educational leader as the custodian of their students' learning. We talk about the limitations of models in AI and the conversations that educational constituents need to have about what qualities they want AI models to have and how they should be used.

- Smart Content Development
  AI and ML in education help teachers, researchers, and content developers with creating fresh, relevant, and personalized learning materials. Some popular examples include:
- Facilitating bit-size education with digital lessons
- Easy data interpretation with data visualization
- Providing up-to-date information with frequent content updates
- Personalized Learning
  One of the prominent examples of technology in education is a shift from traditional schooling to personalized learning. The progressive utilization of AI in education has helped learners figure out the optimal way to comprehend and study their curriculum.
  Personalized education with artificial intelligence aims to tailor the learning experience of every student based on their unique needs. The ideal combination of AI and education focuses on these requirements by offering adaptive learning programs, AI-embedded games, etc.
- Task Automation
  Artificial intelligence in education facilitates task automation, streamlining the management and administration tasks and helping teachers focus more on the teaching part. These tasks include report maintenance, attendance tracking, and other administrative roles. It helps in making the learning environment more efficient and productive.
- AI-Assisted Assessment Grading
  Assessment grading and examination evaluation are undoubtedly time-consuming tasks for teachers. However, AI- and ML-based algorithms can significantly help them grade more efficiently with little or no human intervention.
  These algorithms analyze student work and cross-check it with the data fed to the AI models to provide automated feedback and grading. It frees the teachers' time to focus more on designing informative and interactive curricula. One thing to note is that this automated practice is suitable and recommended for assessments with objective-type questions only.
- 24*7 Assistance with Conversational AI
  One of the latest trends in the AI domain is productivity optimization with conversational AI assistance. Conversational AI in education utilizes virtual assistants and chatbots to help learners with their individual problems, promoting independent learning.
  Today, more than 50% of educational institutions and universities prefer AI for assistance to ensure enhanced quality of education. Consequently, conversational AI will be beneficial for both students and teachers to a great extent.
- Learning Analytics
  AI-powered learning analytics help educational institutions collect, evaluate, and report data about learners and their level of understanding. These insightful analytics can significantly support course designers and instructors in analyzing data and optimizing courses in a way that learners do not abandon them.
  Learning analytics can also be helpful for students to track their progress and performance while working on a course. The recommended feedback can then be used to overcome potential challenges and improve overall learning efficiency.
- Improved Accessibility
  Another great benefit of artificial intelligence in education is improved accessibility of learning resources to a wide-ranging audience. In fact, a study revealed that almost **60% of educational**

institutions are allocating AI-ML-based learning material backed by advanced features and tools.

Besides, with AI technologies, it is now possible to teach visually or hearing-impaired individuals. Innovative solutions like presentation translators and screen readers offer real-time subtitles and enhanced descriptions for virtual lectures, becoming one of the greatest AI in education examples.

- Customized Feedback

Along with automated grading and assessment evaluation, using AI in education can also help in providing customized feedback and suggestions for improvement.

Personalized feedback analysis aids students in understanding their weaknesses and recommending the best solutions to transform into their strengths. Moreover, it also assists students in writing answers with clarity and precision.

- Learning in Native Language

Schools and colleges promoting multilingual curricula (especially native languages) need staff and resources proficient in specific languages. By using AI in schools, instructors can help students understand the course in their native language.

NLP- and ML-powered systems provide real-time feedback on grammar, pronunciation, and vocabulary, making learning more effective and engaging.

- AI in Examinations

AI-based software systems and devices can be used in examination halls to monitor and detect suspicious behavior. Development partners can integrate these monitoring solutions with computer vision technology to analyze the students' behavior in real-time, alerting invigilators in case of any suspicious activities.

Differences that teachers and students may experience in future technologies.

	Familiar Technology Capabilities	Future Technology Capabilities
Input	• Typing	• Speaking
	• Clicking and dragging	• Drawing
	• Touching and gesturing	• Analyzing images and video
Processing	• Displaying information and tasks	• Assisting students and teachers
	• Sequencing learning activities	• Planning and adapting activities
	• Checking student work	• Revealing patterns in student work
Output	• Text	• Conversations
	• Graphics	• Annotating and highlighting
	• Multimedia	• Suggesting and recommending
	• Dashboards	• Organizing and guiding

Real-life Use Cases and Teaching

Teachers have long envisioned many things that technology could make possible for teachers, their classrooms, and their students but not the changes wrought by the recent pandemic. Today, nearly all teachers have experienced uses of technologies for instruction that no one anticipated. Some of those experiences were positive, and others were not. All of the experiences provide an important context as we think further about teaching and technology.

There is a critical need to focus on addressing the challenges teachers experience. It must become easier for teachers to do the amazing work they always do. We must also remember why people choose the teaching profession and ensure they can do the work that matters. This section discusses examples of AI supporting teachers and teaching including these concepts: AI assistants to reduce routine teaching burdens; AI that provides teachers with recommendations for their students' needs and extends their work with students; and AI that helps teachers to

reflect, plan, and improve their practice.

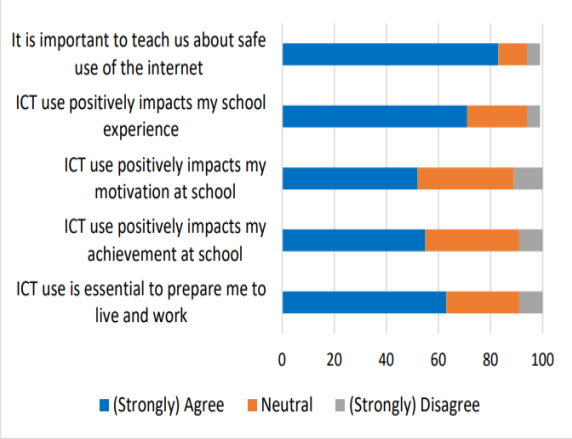
Facilitating learners' AI competency

Educators enable learners to creatively and responsibly use AI technologies for information, communication, content creation and problem solving. The DigCompEdu framework proposes that educators need to equip themselves with five competencies: (1) information and media literacy skills, (2) digital communication and collaboration, (3) digital content creation, (4) responsible use of AI, and (5) digital problem solving.

Insight: Using AI to Improve Teaching Jobs

The job of teaching is notoriously complex, with teachers making thousands of decisions each day. Teachers participate in classroom processes, in interactions with students beyond classrooms, in work with fellow teachers, and in administrative functions. They also are part of their communities and thus are expected to interact with families and caregivers.

Perceived value of computer/digital use



Conclusion:

The evidence highlights the complexity and interdependence of factors shaping digital skills development and the impact of technologies at school. The importance of teacher skills and adoption cannot be overstated. Teachers' openness to new innovations is key, perhaps reflecting cultural factors at the school level as much as professional development. The findings point to the importance of technological pedagogy in teacher education programmes (both initial and continuous professional development), as well as supportive school climates. This has been highlighted across many contexts, including in Finland, a leader in technology integration in schools. Here teachers' digital competence, related to pedagogical understanding of using technology in education, is argued to be the cornerstone of supporting students' digital competence.

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