

Educational Innovation Through Artificial Intelligence: Transforming the Classroom of the Future

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Resumen

A medida que la IA se convierte en una herramienta esencial, su capacidad para personalizar el aprendizaje y facilitar la enseñanza destaca como una ventaja significativa; la IA no solo ayuda a los educadores a diseñar planes de estudio más efectivos basados en el análisis de datos, sino que también permite a los estudiantes aprender a su propio ritmo y según sus necesidades individuales. A pesar de su potencial, la implementación de la IA en educación aún enfrenta desafíos, incluido el acceso desigual a la tecnología y preocupaciones éticas sobre el uso de sistemas automatizados. En el contexto actual, donde la educación está en constante evolución debido a los avances tecnológicos, se subraya la necesidad de preparar a los estudiantes para un futuro donde la IA será omnipresente en el lugar de trabajo. A través de la colaboración entre educadores, investigadores y estudiantes, se busca un enfoque más inclusivo y equitativo que considere las diferentes realidades educativas. El texto resalta la importancia de la alfabetización en IA entre estudiantes y educadores para que puedan interactuar de manera efectiva con estas tecnologías emergentes, haciéndose un llamado para la mejora de programas de formación docente y la creación de un currículo que incorpore conceptos de IA desde niveles educativos tempranos.

Palabras Clave: Inteligencia Artificial (IA), Personalización del Aprendizaje, Innovación Educativa, Ética en Educación, Alfabetización Digital, Colaboración Educativa

Abstract

As AI becomes an essential tool, its ability to personalize learning and facilitate teaching stands out as a significant advantage; AI not only helps educators design more effective curricula based on data analysis but also allows students to learn at their own pace and according to their individual needs. Despite its potential, the implementation of AI in education still faces challenges, including unequal access to technology and ethical concerns about the use of automated systems. In the current context, where education is constantly evolving due to technological advances, the need to prepare students for a future where AI will be omnipresent in the workplace is underlined. Through collaboration between educators, researchers and students, a more inclusive and equitable approach is sought that considers different educational realities. The text highlights the importance of AI literacy among students and educators so that they can interact effectively with these emerging technologies, calling for the improvement of teacher training programs and the creation of a curriculum that incorporates AI concepts from early educational levels.

Keywords: Artificial Intelligence (AI), Personalization of Learning, Educational Innovation, Ethics in Education, Digital Literacy, Educational Collaboration

Keywords: Education, Technology, Globalization, Critical Thinking, Digital Literacy, Inclusion

1. Introduction

Artificial Intelligence (AI) has become very popular due to its potential for automation, acclimatization and

integration, technologization, delineation, and identification capabilities. Powered by algorithms, AI is capable of learning adaptively and finding deep data

analytics. By understanding huge databases, AI could identify and assist in decisions regarding the most significant trends. With the goal of not replacing instructors, but helping them, AI-powered analytics could considerably identify educational trends that help instructors generate effective curricula and materials. By owning its own data, the education system could develop flexible AI systems that identify the strengths and weaknesses of students' learning areas. Artificial intelligence (AI) is increasingly being used in schools and predictions of their exponentially greater involvement in academia and schools are being provided in the future. The use of AI devices in basement and kindergarten schools is projected to grow by 300% and in primary schools by 200% within five years.

Despite the fact that the early educational application of artificial intelligence was examined three decades ago, there is still much to learn about the educational potential of AI technologies that help students in very diverse subjects. This potential has yet to be widely realized in post-secondary learning, although considerable effort is being devoted to the creation of artificial intelligence systems. However, this effort continues to emphasize ethical and legal concerns rather than the effectiveness of the education systems themselves.

2. Background and justification

In the information age, where human comfort is highly dependent on technological advances, classrooms must be transformed to accommodate a new generation of learners. As with previous technological advances, classrooms must breathe, adapting to new teaching and learning methods based on generative AI developments. The convergence of generative AI and pedagogical adjustments will inspire a rethinking of classroom configuration, the use of the medium, and teacher intervention (Aliabadi et al., 2023). The transition from liberally designed, transitional and flexible pedagogical arrangements to classroom designs places great importance on the physical learning environment. While pedagogical designs in education and learning research address the form and material arrangement of the classroom, inquiry-based education places greater importance on the negotiation of meaning through experiential learning than on the form of classroom arrangement. Should the classroom experiment with pedagogy as a new form beyond its confinement? Or would a classroom still be necessary but in a new aspect, such as an art and research laboratory, a performance space or a studio, where the generative occurs? These questions open a broader debate on the position of the classroom in educational innovation (Schiff, 2021). Considering the immensity of this discourse, a more focused speculative study is presented, proposing what a classroom in educational innovation could be, particularly in K-12 education. It begins with a review of current classroom

designs to accommodate educational innovation, presenting speculative orientations for future design. Each design consideration is summed up with an example to demonstrate how it has been articulated with a particular focus on space, medium, and intervention. However, these demonstrations are not prescriptive design solutions, but rather considered experiments for material products, inviting educators to shed more light on needs and possibilities.

Artificial Intelligence (AI) is a topic that has caught the attention of the public, academia, and industries. Currently, systems such as generative AI and ChatGPT have emerged, where Artificial Intelligence refers to machines or computer systems that mimic human-like intelligence in learning, reasoning, problem-solving, perception, and language understanding/use. It is the responsibility of schools to prepare young minds to thrive in a rapidly changing social landscape. Currently, AI is misunderstood by most elementary and middle school students. Having an AI curriculum in schools becomes a necessity to promote students' willingness to understand AI and reinforce their intention to explore AI.

Consequently, a transdisciplinary approach to AI education with units of inquiry for primary school students has been proposed (Aliabadi et al., 2023). AI education should emphasize learning content about practical AI activities rather than theory. Attendance and accessibility must be considered when designing AI education. AI educational environments should provide all the necessary resources if the target audience needs exclusive resources, such as coding skills or laptops/devices. The educational research community agrees that school curriculum should transition to more casual, interactive, experiential, and collaborative learning environments.

3. Fundamentals of Artificial Intelligence in Education

Artificial Intelligence (AI) is changing the world as we know it, creating new job opportunities, automating monotonous tasks, and significantly transforming healthcare, education, agriculture, science, and business. Educational institutions have begun to incorporate AI into their classrooms, which has a profound impact on the future of education. The advancement of Artificial Intelligence in Education (AIEd) has the potential to reshape the teaching-learning process, replacing traditional systems driven by ancestral methodologies with more engaging and interactive educational environments. AI technologies in education can help with personalized learning, intelligent tutoring, automated feedback, collaboration and group learning, and analysis of students' behavioral patterns, strengths, and weaknesses (Ferreira Mello et al., 2023).

Innovative and emerging AI technologies can be incorporated into classrooms to help teachers and students. In AI Education (AIE), students are trained to build

intelligent education systems for teaching, learning, and assessment, which is becoming an essential part of the curriculum of engineering and computer science departments. The AIED system suggests that students understand AI concepts before modeling intelligent systems, which may require incorporating AI concepts into K-12 education. AI in Education (AIED) improves the education system using AI technology and intelligent systems. Computer-based education, smart learning environments, smart classrooms, and educational robotics are components of AIDE (Aliabadi et al., 2023).

Artificial Intelligence (AI) is a technology that has recently gained recognition and attention worldwide. There are numerous reasons for this, but a few prominent ones stand out. Most mundane and basic processes of everyday life can be outsourced and automated with the help of technology, allowing teachers to spend more time connecting and building relationships with students, taking the educational experience to the next level (R. Kshirsagar et al., 2022). In addition, AI embedded in the curriculum can help students immerse themselves and kick-start the technical innovation of their life, helping students and society as a whole thrive. In addition, AI technologies help educators better serve students by determining the best ways to explain complex topics through integration with IoT networks and other IT projects. AI-powered analytics in education helps identify trends, allowing instructors to develop successful curricula, while data analysis done with the help of AI systems makes it possible to identify the most critical areas of learning for students who are struggling.

Artificial Intelligence is slowly seeping through the cracks in the walls of schools and educational institutions, and its use is mundane and routine in some places. Predictions say that this will increase exponentially in the coming years. Studies exploring the educational application of Artificial Intelligence date back more than three decades, with ongoing explorations of its potential assistance to students at all educational stages. As a result of Artificial Intelligence and its generative applications, the steps taken to incorporate Artificial Intelligence into education are still naïve. However, reviewing previous attempts to incorporate AI into education can help avoid mistakes that could hinder progress in the right direction. Education, as we know it today, is changing dramatically, and an overview of the changes that Artificial Intelligence brings to education can help to better understand its role in the classrooms of the future (Ferreira Mello et al., 2023).

Artificial intelligence is increasingly being adopted in schools. AI in education is projected to grow significantly in the coming years (R. Kshirsagar et al., 2022). Artificial Intelligence (AI) will have a major impact on the future of post-secondary learning around the world. During the 1970s, there was research on academic artificial intelligence. However, there is still limited understanding of the educational potential of AI technologies to help

primary and secondary school students. Teacher training institutes are concerned about the inappropriate use of AI technologies by students. Part of the focus is on the adverse effects of AI technologies on education and potential preventive measures and solutions. However, attention is also paid to the educational and development possibilities of artificial intelligence. Many professional organizations in countries offer services to help teachers deliver AI education. Overall, there are four reasons to consider artificial intelligence in education. The first reason is automation. Many basic processes within the education system could be automated. By outsourcing these processes, teachers can spend more time connecting with and helping students. The second reason is integration. AI technologies could be integrated with other IT projects, such as a managed IoT network in educational institutions, helping educators better serve children and parallel technological development with educational growth. The third reason is delineation. Significant trends could be spotted through AI-powered analytics in education, helping instructors develop the most successful curriculum for students. The last reason is identification. Data analysis could allow us to see how flexible AI systems will be able to identify critical areas of learning for different students.

3. AI-Powered Personalization in Education

Artificial Intelligence (AI) is set to transform the education of both students and teachers in conventional primary, secondary and higher education institutions. It is useful to look at the past, present, and future of education and technology. The integration of technology in education is as old as education itself (Aliabadi et al., 2023). It dates back to the discovery of the first writing systems used on clay tablets, followed by papyrus scrolls, printing, radio, television, overhead projectors, computers, the internet, and now artificial intelligence. Each of these innovations went through stages of acceptance, rejection, mockery, resistance, criticism, reform, and finally acceptance. AI is the most powerful, disruptive, ubiquitous, and affordable educational technology ever invented by humanity. Faculty members should embrace the integration of AI in education to reduce the limitations and shortcomings of existing methods. Students also have a responsibility to use this powerful tool effectively and responsibly.

Educational institutions have a responsibility to prepare students for future jobs that will be dominated by AI. This includes developing and cultivating the ten skills needed to thrive in an AI world. Integrating AI into education will encourage students to be active participants in the construction of knowledge rather than passive recipients. This integration will personalize education for each student based on their cognitive needs. This article examines the current state of AI in education and explores the potential benefits and challenges of incorporating AI

technology into the classroom from the perspective of educators.

Education has undergone a profound transformation in the last 20 years. The widespread integration of computers, various web-based technologies and devices, wireless networks, and broadband internet access have stimulated traditional "pen and paper" education to gradually evolve online, thus creating an entirely new paradigm of teaching and learning. The COVID-19 pandemic crisis has further accelerated this rapid innovation and change in education, especially in K-12 public schools, forcing millions of school districts around the world to shift from in-person classes to online distance learning classes overnight. This sudden and demanding infusion of educational technology sheds light on the good, bad, and ugly aspects of technology-backed educational changes. Prior to the pandemic, teaching and learning technologies were largely seen as complementary and assistive development tools to facilitate traditional pedagogies. Given that drastic changes in education may be here to stay in the post-pandemic future, and given the structural flaws and huge disparities in current technologies, it would be prudent to reflect on how to strategically optimize, integrate, and innovate technologies in education to promote equity, effectiveness, and quality in teaching and learning (Cui et al., 2019).

Artificial intelligence (AI) has proliferated rapidly in everyday life over the past 10 years, and it has the potential to have an enormous impact and transform education and society over the next 10 years. On the one hand, technology and data mining in education are generally referred to as educational technologies, such as Computer-Aided Instruction (CAI), Intelligent Tutoring Systems (ITS), and hypermedia-based systems. The emergence of big data in education has fueled the rise of learning analytics, which examines data to better understand and optimize learning. Finally, AI in education refers to educational technologies integrated with AI capabilities. Educational technologies broadly encompass AI technologies, while AI in education focuses on a subset of AI-integrated educational technologies. On the other hand, with the rapid development of Web 2.0 technologies, social networks and user-generated content, there is talk of the so-called "webness" of educational technologies. Webness emphasizes the synergistic and emerging change in education from traditional, individualistic, and simple to technologically mediated, collective, interconnected, and complex (Coffin Murray & Pérez, 2015).

The diversity and individuality in human learning habits and knowledge retention emphasizes the need for a significant change in the existing educational paradigm from a group education to a more personalized one. Rapid progress has been made in the design and development of a myriad of Web-based education systems. However, almost all systems available today have one big common drawback, which is that they don't take advantage of

customization. Basically, they all employ the same "one-size-fits-all" teaching methodology, regardless of different student learning behaviors and performance. Given recent advances in information technology and artificial intelligence (AI), web-based education systems have become viable alternatives to traditional classroom teaching (Tekin & van der Schaar, 2014).

Contemporary web-based education systems attempt to replicate classroom teaching in a virtual environment composed of a collection of static video lectures. Although these video clips tutorials are useful for getting students to revisit a particular lesson, in general, a similar lecture given to a group of students may not be particularly effective for a specific individual student. Therefore, the pedagogy of teaching must be redesigned for a web-based education system to maximize the efficiency of an individual student's learning. In other words, the educational methodology must be customized in such a way that the best teaching methodology is learned for each specific context of the student. In addition, the web-based education systems available today do not adapt the teaching methodology to the particular characteristics of each student. Once a particular pedagogical methodology is employed for a web-based education system, it is fixed and cannot be changed online. However, it should also be possible to customize online educational methodology based on student performance (Iyer & Debang, 2023).

4. Improve teaching practices with AI

Artificial Intelligence (AI) is attracting interest as automation opens up new avenues for human intelligence. Paying attention to automation allows teachers to outsource the most basic and essential teaching processes and better connect with students, focusing on higher-order learning and behavioral skills rather than rote learning. Schools, colleges, and universities are incorporating today's technologies into the academic and corporate environment. To develop educational and intellectual innovation through technology, students must be encouraged to incorporate technology into the curriculum and drive technical innovation. Students can drive technical innovation as technical engineers for the design, analysis, development, testing, and implementation of IoT-based managed network-enabled smart technologies and development of AI systems in colleges or universities. The AI system can be trained to perceive data and carry out actions based on perception and past learning. The classroom can be enriched and transformed with a fully managed network of IoT-enabled smart smart technology, which helps educators better serve children. A single classroom can be connected to multiple IoT networks that perceive data through various smart sensors, including temperature or humidity or noise, light, air quality, and smart cameras, monitored and pre-processed using edge computing and smart convergence technology, and then

transferred to a central server via a WAN-connected IoT gateway. AI-powered analytics can be developed to characterize the underlying trends of perceptual data and help teachers develop effective curricula. Understanding data analysis techniques makes it possible to identify areas of learning for students with respect to differences in perception data (R. Kshirsagar et al., 2022).

4.1. Automated assessment and feedback Automated assessment and feedback systems have the potential to enhance learning experiences by providing immediate guidance to students, particularly in large classes. A research project employing generative AI to automate feedback on programming tasks revealed that taking into account educational context and learning objectives is vital for effective implementation (D Lindsay et al., 2023).

Automated feedback on tasks is crucial to the learning process, as faster feedback is more valuable. Generative AI offers opportunities for scalable and instant feedback, which students increasingly expect in on-demand formats. However, this change raises concerns about the potential devaluation of feedback, as students may come to see automated feedback as equivalent to human-provided feedback. In addition, the value derived from feedback lies in its ability to stimulate a reflective cycle in students to improve their work. If students receive abundant automated feedback, they may simply review their work without engaging in deeper reflection, which could hinder skill development. So, while generative AI can automate the provision of critically needed feedback, its implementation creates challenges that need to be carefully addressed.

Artificial Intelligence has provided Education with Intelligent Tutoring Systems in which a computer has the ability to be a teacher of students without the help of any human intervention. Intelligent Tutoring Systems (ITS) are based on Artificial Intelligence, which is capable of simulating the actions of a human tutor. An ITS consists of three basic components, such as the mastery model, the student model, and the mentoring model. The mastery model maintains knowledge of the subject matter taught in the ITS (Jugo et al., 2016). The student model represents the individual student's knowledge in the ITS and keeps track of what each student knows, doesn't know, and misunderstands. The tutoring model represents the knowledge of how to teach and controls the interaction between the student and the system.

A smart tutoring system, also called an adaptive tutoring system, is a computer system that aims to provide immediate, personalized instruction or feedback to learners, usually without human intervention. ITS is one of the applications of artificial intelligence. Traditionally, ITS is an expert system that contains a pedagogical model as well as a model of a particular domain (Chen et al., 2008). Pedagogical models include the type of instruction that would be appropriate for a student with a given

mastery model. The mastery model represents the knowledge that a student possesses in a particular domain.

5. AI for student support and engagement

AI can help make learning more personalized, giving students what they need exactly when they need it. This helps students learn better and perform better in school (Seo et al., 2021). However, to keep students engaged in learning, schools need to do more than just use new technologies. They need to think carefully about how to use new technologies to support students as learners and ensure that the benefits of new technologies are shared equally. Since the onset of the COVID-19 pandemic, many schools around the world have moved classes online to prevent the spread of the virus. But online learning can feel lonely because students and teachers can't be together in person. In addition, not all students have the same access to technology, the internet, or even a quiet space to study. So while some students have adapted well to online learning, others are falling behind.

Artificial intelligence (AI) is a new technology that is starting to be used in many different areas such as education, business, and healthcare. AI can help students learn in a way that suits them best. For example, AI can provide suggestions for study materials based on a student's performance, set up study groups with classmates, and estimate how long it will take for a student to be ready for an exam. AI is intelligent and can also help teachers, for example, by grading students' work automatically. The use of AI can change the way students and teachers interact with each other, and there are questions about how the roles of students, teachers, and AI will change in the future. It is very important to observe how students and teachers feel about using AI to support learning.

The classroom of the future will involve Educational Innovation through Artificial Intelligence. It will be a totally new experience for both students and teachers. This article offers a conceptual framework of educational innovation mediated by technology with Artificial Intelligence. The technology will excite students and ensure their active participation in the discussion. Peer-to-peer learning will be promoted by sharing technology with students (Köbis & Mehner, 2021). They will create animated videos on selected topics for deeper understanding. Beyond creating videos, students will engage in learning through video review. Students will be encouraged to actively participate in reviewing videos created by their peers to improve conceptual understanding. Students will review videos of their peers created on selected physics topics. A system will be designed to review animated videos on educational topics. The research will contribute to the design of mentoring and advisory systems enhanced or supported by Artificial Intelligence (Hsu et al., 2023).

Artificial intelligence (AI) is on the verge of mass adoption across society as technology evolves rapidly. Education could benefit greatly from the new and innovative applications of AI that are expected in the coming years. Therefore, the educational potential and main concerns of generative AI technologies are analyzed. Recent AI technologies, such as ChatGPT or stable broadcast image generation, have proven to be novel and powerful tools for learning or teaching. However, harsh criticism of its disruptive effects on society raises major concerns for its integration into education. This duality of their educational potential and their main concerns is considered a transformative disruptive innovation that requires deep consideration when integrating these technologies into education. Experimental cases of implementing generative AI technologies suitable for learning or teaching in architecture higher education and beyond are shown. There are two possible educational use cases for students. On the one hand, generative AI can be used as a learning tool to engage students more exploratorily with AI technologies as they generate relevant educational material for course input, i.e., text, drawings, and images. The second option is to develop generative AI as a fully pedagogical didactic tool that can promote architectural design pedagogy without direct academic input (Ploennigs et al., 2023). Ten years of gamified courses in higher education (HE) are summarized and the course "Multi-agent systems for the Internet of Things" is re-examined. The first iteration of the gamified course aimed to foster the competitiveness of players for a new scenario with a different educator style. A second iteration of the course proposed a redesign of the game to account for the untested player styles of the first. For the fourth iteration of the course, a new card design was created based on previous student surveys to show the game's activities. Throughout the cards made in all iterations of the course, students felt engaged and engaged with the gamified class and perceived that they learned in almost all activities (Baldeón et al., 2018).

6. Ethical and privacy considerations in AI education

Artificial Intelligence (AI) is set to have a major impact on the educational landscape, which poses challenges and opportunities. In a secondary school in India, an AI system is being tested to transform and co-evolve the classroom environment. The AI system, integrated into a multimodal collaborative platform, allows students to tackle challenges cooperatively with an AI agent that illuminates the underlying concepts through guidance and suggestions. Aimed at researchers and educators, this article reviews the design of the system by addressing the ethical and reliable concerns raised by the implementation of AI in education (Lakkaraju et al., 2024). Student trust in AI is vital to effectiveness, so trust and transparency concerns need to be considered. This is accentuated in a

classroom context with a lot at stake for the future of students. For the sake of transparency, AI explanations should be offered alongside AI actions. In addition to trust, the ethical implications of educational data mining and AI data handling must be considered. Adhering to high standards for the protection of children online is vital to protecting privacy, mitigating abusive content, maintaining fairness, and providing informed consent. Currently, many child-directed systems are poorly designed in this regard, creating a demand for design principles to address this gap. Five secondary-level activities are described that focus on the educational potential of AI and its ability to facilitate collaborative problem-solving. The educational, ethical, and technological considerations that inform activity design are elaborated, focusing on a high school-level Rubik's Cube activity that addresses student-AI collaboration and trust in AI (Latham & Goltz, 2019). Emphasizing the pedagogical role of AI by providing information to the user's understanding and guiding them towards a solution encourages the design of questions that probe students' understanding.

The use of artificial intelligence (AI) in education raises significant concerns about data privacy and security. Educational institutions and policymakers must address these issues to safeguard sensitive student information. (Zeide, 2017). AI technology can improve quality, equity, and access to education, but it also poses risks such as security breaches and misuse of sensitive data. Schools must comply with relevant laws and regulations when procuring AI technology.

In light of recent events that have highlighted violations of security protocols, it is essential to review existing legal frameworks and identify areas for reform. Currently, there is a patchwork of laws governing data protection in the United States, without a comprehensive federal framework addressing issues such as student data privacy, accountability, and enforcement mechanisms. This emphasizes the importance of ensuring educational equity and access through AI technology, while protecting the privacy and security of student data.

Educational decision-making is increasingly supported by automated systems. This growing trend raises concerns about bias and fairness issues, especially as education remains a sensitive area for data protection and ethical concerns. While attempts have been made to implement fair AI in education systems, these efforts often overlook the particularities of education policy and practice, as well as the wider school context. There are fears that AI systems implemented in education will favour certain groups of students over others. Accumulating evidence suggests that AI systems often reproduce social, and even educational, biases as they are developed using data from previous contexts and decisions (Utterberg Modén et al., 2023). As a consequence, there are general concerns regarding the governance of AI in education. The EU's efforts to regulate

AI systems include recommendations for impact assessments that address the potential harm of AI systems. These assessments are difficult to apply in education because they do not take into account the specificity of educational settings.

Broader societal debates around the importance of equity in AI systems often ignore the particularities of the educational environment. Efforts towards "fair AI" often fall into the "trap of formalism" by failing to satisfactorily account for the context in which AI systems are applied. This trap complicates the ability of the education community to conduct analyses of current AI systems used in schools and implement new systems in educational settings. There is a persistent gap between the development of AI systems and the educational context in which these systems are implemented. Addressing issues of bias and equity in AI systems is crucial for the education community to conduct analyses of harmful AI systems currently deployed in schools.

7. Implementing AI in educational environments

An analysis of the current research literature was conducted to investigate the implementation of AI in educational settings. Distance learning during the Covid pandemic highlighted the need to innovate in education to find innovative solutions. Educators are in a unique position to use AI to their advantage and create educational innovation through it if they understand it. Many educational institutes have tried to meet their community's need to understand AI through one-off workshops or conferences. Empirical evidence showed that these brief engagements with AI did not meet the community's need to understand it. On the other hand, as the need for AI education in the community grew, teachers not trained in AI took on the responsibility of exposing their students to AI through inaccurate and incomplete representations of AI (Aliabadi et al., 2023). The integration of technology into education has been primarily the responsibility of the individual educator who uses it in their classroom. Using a technology grant awarded to the Department of Education as a case study, an effort was made to analyse how, within an academic higher education department, the educational innovation service comprising AI could play a leading role in transforming the educational practice of other educators. Several obstacles were encountered during the effort, ranging from the cognitive leap needed to understand AI to questions about ethics and responsibility. AI chatbots have taken off quickly but attempts to contextualize their use in pedagogy take a back seat outside of general precautionary recommendations.

Artificial Intelligence (AI) refers to intelligent computer programs that can perform tasks normally performed by humans, such as language understanding, image recognition, and decision-making. The purpose of AI is to augment human capabilities, working alongside humans to

complete tasks. Educational innovation is the evolution of teaching, training and classroom activities. It encompasses new ideas that bring change and advancement, including new technologies, reforms, and improvements in pedagogy. AI technology can transform today's classrooms into smart classrooms or the classroom of the future. A smart classroom is equipped with devices to facilitate and enhance the learning experience, introducing a new approach to education. A smart classroom can recommend personalized learning paths for students and provide real-time performance analytics. AI could take on the role of a teaching assistant in the classroom of the future, monitoring students' levels of attention and understanding. You may notify the teacher when an adjustment in teaching is needed. AI could also enable education anytime, anywhere through virtual classrooms. With the integration of AI, education systems will need to adapt and redesign the way technology complements education. It is necessary to address the infrastructure and resource requirements to implement AI technology in educational innovation (Aliabadi et al., 2023).

In addition to addressing teacher shortages, AI can be used to provide professional development for educators. Prior to the pandemic, schools struggled to provide educators with relevant professional development related to needs within their classrooms (L Geurkink-Coats & A Regina, 2019). School engineers can use AI to generate professional development sessions that are tailored to the needs of school educators. Educators would conduct a survey about their professional needs, and AI Agents would generate a professional development session that would address the needs presented by educators. In addition, this technology could also transcribe professional development sessions and provide summaries of the key topics discussed. This could provide professional development managers with an opportunity to review what was discussed at the meeting. Professional development is crucial to educator growth and ultimately student success. Using artificial intelligence to create rich professional development that meets staff needs can lead to positive outcomes for students.

8. Case Studies and Best Practices

The implementation of Classroom of the Future projects is more likely to be successful if pilot projects are organized, carried out by teams of educators from different disciplines, and the co-design process starts as highly collaborative, long-term and transdisciplinary involving teachers and end users, as well as researchers. Teacher training in artificial intelligence should focus on the development of transdisciplinary training modules, the translation of educational innovation technology into desirable and accessible formats for teachers, and integration into teacher training programmes. Training is best if it is carried out in close collaboration with teachers

and other trainers, in order to build ownership and trust in new educational technologies (Aliabadi et al., 2023).

AI-based learning modules that augment education with innovative new technologies are more likely to be implemented in everyday education if they are developed and tested as co-designed projects with teachers from different educational levels and disciplines and researchers. Co-design is most effective when it involves teachers as equal partners from the outset, and the design and implementation of AI-based learning modules is considered a multi-year research project. Classroom of the Future's co-design projects, technologies, and learning modules are more likely to have an impact beyond research and development if they relate to current social and political issues relevant to many educational institutions.

By leveraging artificial intelligence, educators and schools around the world have already begun to develop creative solutions to teach their students efficiently. Below are several examples of integrating artificial intelligence in schools, representing how innovative educators are and how artificial intelligence is being used in education today. AI is aiding in the automation of education committee minutes. AI is also giving instructors real information about their students. Teachers developed an AI chatbot to help children with their lessons. Teachers use AI to assess students' social and emotional growth while teaching them. AI can help educators improve educational innovation and pedagogical fit to meet student needs and drive learning effectiveness, based on current situations and successful instances. Instructors can gather feedback on the classroom environment and students' assimilation of knowledge through AI perceptions.

A pilot study at a Neom community school on educational innovation through AI was detailed to share lessons learned and recommendations. Overall, it was an extremely positive experience to move from a transdisciplinary workshop to full-time integration into the classroom. Challenges experienced during the academic year regarding staffing, resources, implementation, and external validation that may resonate with others attempting similar innovations were reviewed. Solutions to these challenges were proposed to avoid mistakes made and replicate successes. Finally, initial recommendations were shared on the ideal composition of workshops and classes in the design phase, including considerations on resources, location, and approach for educators and administrators.

A significant amount of research and development in artificial intelligence (AI) has been carried out in recent decades, resulting in many applications that are now commercially available and in widespread use. However, most K-12 educators are only aware of a subset of these applications, and many more are unaware of the effort that has gone into AI research (Schiff, 2021). Even fewer high schools offer courses or educational content on AI, despite the growing importance of young people being AI literate.

AI literacy here includes basic knowledge of what AI is and understanding how it will shape society and the role of young people in it, as well as understanding how AI works and the ability to build your own AI. In addition, awareness of the importance of AI education is growing among education leaders, policymakers, and researchers. As young people are shaping and being shaped by AI, they need to be informed citizens and workers in the age of AI, who understand both the societal implications of AI and are able to create it themselves (Aliabadi et al., 2023). Meanwhile, the AI community is struggling with rendering issues, wanting young people from different backgrounds to participate in shaping AI. Therefore, young people, along with those who are currently underrepresented in the field, need to be educated in the language of AI.

9. Challenges and future directions

Like many educational technologies, initial implementations of AIED systems have been limited in scale, short-term, and localized. Several challenges, both practical and conceptual, must be addressed if its promise to help improve learning and education on a larger scale is to be fulfilled.

The future needs of education and the role of AI: There is general agreement that education must evolve to meet the needs of learners in the future. The increasing complexity of knowledge, the need for more formal education and a more diverse knowledge base are challenges for the education systems of the future. Current education systems cannot meet future demands for learning and education (Schiff, 2021). Today's industrial-age mass education school systems are too inflexible, too dependent on human teachers, and are "one-size-fits-all" systems, leading to a mismatch between what students want to learn and what education can offer.

The education systems of the future must emulate today's human capacities for social learning and natural language understanding. The essential hope for the use of AI in education is that cognitive artifacts can simultaneously transform learning, knowledge, and educational processes and the forms of systems, enabling capacities and understandings that are currently beyond our reach. The need for students to cope with the exponential growth of knowledge is the strongest driver for the development of new cognitive tools for learning and knowledge creation.

Artificial Intelligence Systems in Education (AIED) today: There is a growing diversity of applied AIED systems, from the simplest to the most sophisticated, but most of the systems already deployed tend to use AI technologies in a somewhat superficial way. Current AIED systems generally fall into three categories: those that do not use AI technologies; those that use relatively simple AI technologies, such as rule-based systems; and those using sophisticated AI technologies. The most commonly used AIED systems employ relatively simple AI technologies.

Very few systems take full advantage of advanced AI technologies. AIED systems simply automate pre-existing human processes, augment the capabilities and work of humans, or emulate human functions. However, most current implementations of AIED are localized innovations that address isolated problems in education. They do not fundamentally transform educational processes, the forms of systems, or the roles and functions of human agents within systems.

Artificial intelligence and education: a transformation in the making: The adoption of AIED systems is too focused on problems that are easily solvable with existing technologies, limiting the desired transformations in education. D&A systems have been implemented primarily in back-office functions in education, including basic administration and reporting, monitoring and evaluation, compliance and accountability, and advisory functions, relegating covert pedagogical functions to d&A systems (Aliabadi et al., 2023). Current systems of IDAd are not visible to students and teachers, who cannot interact directly or explicitly with them. These systems provide information to human actors who then make informed decisions and take action. Rather than an agent role for AIED systems, the focus is on the human role, which has been amplified by AIED systems, making them passive in terms of agency.

Most AIED systems and, more generally, edtech systems embedded in current educational processes undermine learning, discovery, and knowledge creation efforts. Educational processes remain fundamentally the same, with the same or similar forms of system. Forced compliance with standardized processes mediated by technology thwarts attempts to rethink possible educational processes based on new forms of knowledge (i.e., networked, social, and public) and new epistemologies (i.e., experiential/situated, discovery, and emergent). Knowledge creation and improved learning capacity cannot be achieved simply by reducing current processes or incorporating them into new technologies. Educational processes must be radically reconceived from scratch on the basis of first access, empowering students to create their own knowledge artifacts or cognitive tools without the mediation of human systems.

Artificial Intelligence (AI) has progressed rapidly in various domains and is now entering education. Technologies like ChatGPT can teach languages, write essays, and provide tutoring on various topics. However, integrating AI into education is not as straightforward as it seems. Currently, the applications of AI in education have certain limitations. First, educational AI is not widely used. Despite the potential for AI tools to revolutionize education, their implementation remains limited. Many institutions are hesitant to adopt these technologies, and even commercially available AI applications are not being used to their full extent in schools and universities (Schiff, 2021).

Second, existing AI applications do not meet pedagogical requirements. The pedagogical design of available AI educational applications often falls short, undermining the effectiveness of learning. For example, AI chatbots for language learning lack essential pedagogical principles and design, which inhibits optimal learning outcomes. While AI can be beneficial for entertainment or computer games, it cannot effectively replicate education without proper pedagogical design.

Third, the educational application of AI technology requires significant financial investment. Designing effective AI educational applications requires time, expertise, and financial resources. At present, there may not be enough financial incentive for educational institutions to invest in carefully designed AI applications. While tech companies can develop AI applications for non-educational domains, their educational use would require a large expenditure on pedagogical design, which is unlikely to happen.

The integration of artificial intelligence (AI) in education has the potential to transform the way we learn and teach. Educational institutions must prepare students for a future that is questioned and reshaped by AI. Meanwhile, ChatGPT has sparked interest in generative AI tools in schools. However, incorporating technology into the classroom is often approached through a trial-and-error lens. Research-backed examples of successful AI integration could guide educators in designing innovative lessons. Education is crucial for meaningful interactions with AI, but teaching AI technology is challenging due to its complex and varied nature. In addition, many instructors lack AI training or familiarity with software design. AI teaching should not be siloed or interdisciplinary. Rather, AI teaching should be transdisciplinary, including connections to the broad curriculum and community in which students are learning. This approach to education connects the subjects of a curriculum into one main guiding question at a time.

Education is crucial for meaningful interactions with AI. Students need to understand the society in which they live: how it works, its strengths and its shortcomings. Currently, society is dealing with an AI takeover, and students have the right to be educated about it. There are multiple interpretations of AI. AI is a term that has different meanings for different fields. In computer science, AI refers to algorithms that learn patterns from data to make predictions. The future lies in an AI-infused society, and it is the responsibility of schools to prepare young minds to thrive in a rapidly changing society. Governments are under pressure to rethink education priorities as industries transform. In this context, young people may need to understand the basics of AI in order to thrive in science and engineering. Therefore, developing an AI curriculum in primary or secondary school becomes a necessity to promote students' willingness and reinforce their intention to understand AI (Aliabadi et al., 2023).

The educational research community agrees that the school curriculum should move from traditional expository classes to more informal, interactive, experiential, and collaborative learning environments. AI education for students should emphasize learning content in hands-on AI activities rather than theory (Schiff, 2021). Activities that help them learn AI technology through AI applications should come first. Students' projects that relate AI technology to their daily lives should also be encouraged. A collaborative framework is presented to support school instructors in designing AI lessons for students ages 8-18. Four types of lessons are proposed involving audio processing, computer vision, natural language processing, and multimodal data.

10. Conclusions

In this research, innovative pedagogy and developments in artificial intelligence were examined. It offers ideas and alternatives to address contemporary pedagogical problems and discuss a new educational model of artificial intelligence and an experimental system of learning with artificial intelligence. This design-based experiment looked at the instructional and learning processes of the artificial intelligence educational model and system with K-12 students for nine weeks. The artificial intelligence educational model was developed at four levels: educational intelligence and innovation, integration of artificial intelligence and emerging technologies, pedagogical designs of artificial intelligence education, and the applications and implications of artificial intelligence education. The experiment demonstrated that an artificial intelligence educational model and system could effectively help K-12 students understand essential artificial intelligence concepts, principles, technologies, and applications. The intersection and integration of artificial intelligence and educational innovation are fundamental for future developments in classrooms. Learning environments created by immersive emerging technologies can take learners to extraordinary places and spark interest in scientific and AI concepts and applications. In addition, interest, understanding, and self-efficacy in artificial intelligence can be enhanced through the integration of artificial intelligence and immersive technologies involving the design and development of an artificial intelligence educational model and system, collaborative Jupyter Notebook workshops, and smart healthcare and agro-plantation agents (Aliabadi et al., 2023); (Schiff, 2021).

These burgeoning advancements in AI technology are driving interest in the application of AI in education. Educational programs supported by AI technologies are predicted to significantly alter the way knowledge is acquired and taught. In particular, the rapid proliferation of generative AI technologies offers substantial new possibilities for integrating AI into education. Education

must change in tandem with generative AI technologies for an AI-empowered society. Emphasizing the importance of education, especially formal education systems, and presenting the fundamental principles for generative AI-driven educational innovations are crucial aspects of this. Generative AI technologies, advanced educational technology tools, and effective teaching and learning approaches can facilitate the educational transformation needed for the AI society (Schiff, 2021).

Transdisciplinary paradigms actively develop curricular processes by synthesizing community needs, teachers' interests, and student participation (Aliabadi et al., 2023). The focus is on co-designing and implementing pathways that address local contexts, workforce needs, and student agency. Initial efforts to establish transdisciplinary projects in literacy and AI education are shared, along with lessons learned from applying those principles to AI workshops in a secondary school. This includes challenges with curricular specificity versus flexibility and reconciling technical versus thematic priorities. High-level adherence to the framework promotes relevance within a community and helps stakeholders feel empowered, engaged, and curious despite differences in interest and experience.

Artificial intelligence (AI) is expected to have a transformative influence on education during the second decade of the 21st century. Classroom education has been criticized for its outdated approach to teaching, which does not take advantage of the possibilities offered by new technologies. The advent of a wide range of devices with internet connectivity has paved the way for the establishment of smart classrooms. Innovations in AI technology have advanced by leaps and bounds, with triumphs widely publicized, however, an assessment of the status and prospects of Smart Classrooms enhanced by AI technologies, or Artificial Intelligence in Education (AIED), reveals an absence of debates or limited debates. Since the mid-1960s, education has spurred the birth of AI technologies. The first demonstrations of Natural Language Processing (NLP) systems, then known as "comprehension" systems, were the result of attempts to create computer-aided instruction (CAI) systems that would use English as the language of instruction. This historical link is expected to foster innovation in AI-enhanced educational technologies (Schiff, 2021). First, it is important to understand how educational environments are predicted to be altered by AI-enhanced institutional technologies. Understanding the context of education sheds light on non-technical considerations that significantly affect the design and implementation of the IEA's innovations. Broadening the focus beyond the technologies themselves reveals that the social and political environments in which schooling occurs play a crucial role in shaping the design, implementation, and educational consequences of innovations. This is particularly relevant with regard to the debate around the

IEA. On the one hand, AIED's solutions are heralded for their potential to individualize or differentiate education and recognize the limits of "one-size-fits-all" pedagogies. Rather, the risks of dAI solutions exacerbating inequalities, undermining human agency, or entrenching vested interests are emphasized (Hemachandran et al., 2022).

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