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Chapter 9: Implementing secure and compliant artificial intelligence-driven solutions that address privacy, ethical concerns, and data governance in modern learning environments

9.1 Introduction

AI technologies are increasingly being integrated into a wide range of learning settings. Given the enthusiasm about AI technologies, the next major challenge is to implement AI in a way that is both effective and focused on educational goals. In the educational sector, there is a need for secure and compliant AI-driven solutions that are able to ensure learning outcomes and meet the requirements of institutions, teachers, and learners. Strategic principles and guidelines based on empirical studies are still lacking in the field. Empirical research in this field is scarce and largely anecdotal, with studies focusing on long-term outcomes and benefits rather than on what can be done now. This paper proposes a blueprint for secure and compliant educational AI, focusing on stakeholders and proposed ideas with outcomes. The document proposes a case for action emphasizing different approaches for development. The AI for Learning Project is located at the intersection of various domains, including technological and legal, and interacts with other stakeholder interests. The document will be useful to policymakers, academics, and researchers, to promote understanding of AI integration into learning environments. The essay is structured to ensure clarity and will address some of the academic interest in AI, in terms of positive and negative behavioral impacts and how the solution can influence motivation and ethics in learning environments. The essay also addresses relevant researchers and market analysts, to widen understanding around AI technologies that are further being included in the classroom. The essay is also aimed

at educational bodies such as liberal adult education providers and public administrations, to highlight support for long-term sustainability.

9.1.1. Overview of the Study

The present study was designed to investigate the implementation of AI in education to realize the potential benefits while safeguarding the educational values, information

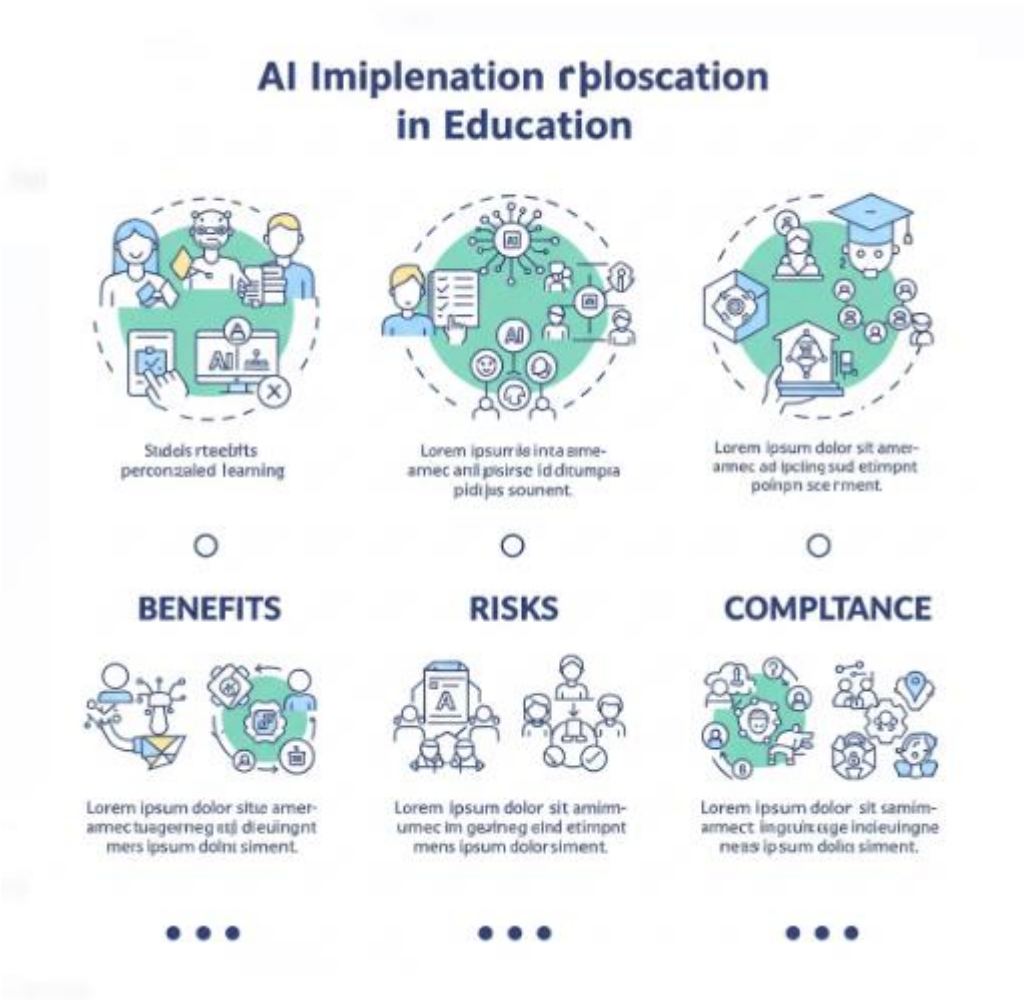

Fig 9 . 1 : AI Implementation in Education: Benefits, Risks & Compliance

security, and data privacy issues. We were guided by the following questions: To what extent does the existing literature show that the implementation of AI in learning

environments is appropriate? Are implementers guided by ethical, legal, and security considerations? Are there empirical data available to confirm the benefits and risks of the AI-based learning environment systems? The objective of this study is to present empirical evidence to address these questions. Implementing secure and compliant AI-driven solutions in learning environments adds to the existing literature by systematically examining both the top AI conferences and journals as well as grey literature. This interdisciplinary analysis brings these worlds together by focusing on a blend of technology, ethics, and education. This perspective is still original, necessary, and required as implementing AI in learning is largely guided by pragmatic considerations such as 'what works' and 'what is allowable,' with little thought given to questions such as 'what are the risks and benefits of such implementation?' The empirical investigation shows that there is a lack of clear direction, information, and advice on what security and data privacy compliance factors to consider when implementing educational AI. This study therefore has potential impact as the direction of AI implementation depends on perceptions of associated risks, combined with the potential benefits and the current and potential mitigations. This is particularly so in a regulatory landscape, such as the implementation of the General Data Protection Regulation within the EU.

9.2. Understanding AI in Education

The spectrum for applications of AI in learning contexts is rather wide. Artificial intelligence R&D activities as well as production-oriented technology design experiments are in full swing right now, hopefully leading to a transformation of educational paradigms and learning experiences – educational concept 4.0 might be the result, acknowledging diverse learning and teaching preferences and offering a vast array of digital tools to address personal learning goals.

Learning, despite being a situated, embodied, and social practice, has been largely conceptualized as a cognitive-emotional phenomenon. AI offers further attractions – for administrators it may improve the process of next-generation data-driven decision-making, such as medium- to long-term prediction of labor market demands and trends. Alluringly, it offers some potential for tackling societal inequities in and through education. In the context of digital learning, AI is often hailed as a game-changer that will lead to the realization of personalized learning. Techniques such as adaptive learning and intelligent tutoring systems have been designed to provide learning content that meets individual learners' specific needs. From the viewpoint of motivational psychology, the potential of AI applications in education can also be related to the theoretical construct of "flow," which is thought to reflect the highest levels of engagement, learning, and motivation.

9.2.1. The Role of AI in Modern Learning

Strategies and tools to design, develop, and evaluate secure and compliant AI are critical. AI in educational environments uses big data and learning analytics to support a spectrum of use cases, such as providing real-time, predictive, and/or personalized analysis of didactic processes, educational outcomes and performance, instructional design, and adaptive assessment. AI-led assessment systems are exemplified by intelligent tutoring and learning systems, student and learning analytics, and chatbots, which are designed to provide interactive access for students to handle day-to-day learning in real-time, anytime. They are being integrated into traditional and virtual environments to enable learning processes that adapt to the learning rhythm and difficulties of each individual learner. This continuum of tools constitutes one of the keystones underpinning the personalized learning paradigm that combines responsive and predictive analytics for learning.

As such, AI has the potential to significantly facilitate student-educator collaboration and dialogue, for example, automated recommendations for mediating assistive learning contexts for students with disabilities or impairments. A large cadre of reports and case studies has adapted and extended these dimensions, as well as defining the benefits of and good practices for deploying AI and learning analytics in practice, for example, the potential for AI to enable more efficient and effective learning and assessment, or personalized and adaptive instructional design. However, some studies provide evidence of potential problems arising from the commercialization and scaling of AI tools. The mere provision of AI tools does not guarantee their success if they are to be used in the future. A substantial number of studies in the realm of adaptive teaching software, chatbots, and intelligent tutoring systems underscored the necessity of providing continuous statistics concerning AI-LA tools' effectiveness in addition to uncovering the impact of AI on several learning outcomes and the learning experience. In conclusion, the potential usefulness of AI for improving and personalizing learner experiences is especially common in the extant literature, justifying the question of whether findings to date warrant this high level of optimism.

9.2.2. Benefits of AI-Driven Solutions

AI-driven solutions have the potential to offer an array of benefits. First, personalized learning can be improved by using AI to tailor educational materials, tasks, recommendations, supports, pacing, and assessments to the individualized or subgroup needs of learners, acknowledging diversity through different background knowledge, culture, learning styles, and pace. Second, time can be saved by having some tasks automatically done instead of manually done, freeing up potential time for teachers,

administrators, or students. An example includes AI-driven grading of multiple-choice questions.

Third, the data generated by these systems can be analyzed to provide insights into learners, content, or processes so that better support can be provided to improve, assist, or streamline educational experiences. Fourth, technology can be designed to support and foster learner interactions, either between students, students and teachers, or across global environments. This increases accessibility to expertise and learning possibilities by broadening available contacts. Similarly, these experiences can foster collaboration across cultures and countries. By virtualizing our experiences, we can distribute our expertise and insights quickly and easily to broader audiences. AI has also been demonstrated to hold substantial potential to enable social good and reduce inequity within education by revolutionizing and enhancing the ways humanity teaches and learns. For example, AI-driven systems have been used to efficiently and effectively teach advanced technical subjects to refugees or young women in regions with little in the way of technological infrastructure and/or educators with the desired technical training. Additionally, there is potential for AI to use language translation and cultural awareness to teach communities in need, delivering content in a form most suited for local understanding and sustainable learning.

9.3. Privacy Concerns in AI Applications

From the data collected within these AI applications, you can both instantly and gradually profile students with indicators of personality, mental state, and other characteristics. This makes the data very sensitive and volatile for students, so their privacy is immediately threatened and possibly violated. If handled responsibly, the performance data could also inform student support and improve their learning experiences, making access to real-time data potentially beneficial if managed consistently and ethically. Ethical usage will most often be found within the boundaries of existing guidelines, along with informed consent and a broad and transparent data policy that goes beyond being retained on institutional servers. The rapid evolution of IT environments also indicates that it will be necessary for IT employees to consider the decreasing administrative gain of locally storing all sensitive data. Although consent allows researchers to access data, it is argued that student consent should hold substantial weight in determining who can view an analysis of student data. Ultimately, institutions must balance these interests with the students' rights over their data. Emerging privacy regulations continue to drive discussion about the intersection of AI and ethics. Some schools and vendors are waiting for more powerful regulations to catch up with what current vendors are doing; this behavior can lead to organizations that are chasing the latest regulation policies, rather than leading by example. Next, this study reports system

administrators' perceptions regarding privacy practices in the platform. This information will help organizations understand the dilemmas and conflicts of interest that system administrators and IT professionals experience when working with AI platforms in the pursuit of solving wicked problems. The increasing dilemma promotes a deeper understanding of the humans currently engaged in the decision-making process, particularly in relation to sensitive privacy trade-offs. Next, this study reports on operationalizing privacy in a cornerstone AI normally deployed in psychology applications. By doing so, we hope to extend the knowledge base on how to responsibly implement advanced AI capabilities, such as in educational settings, while observing the constraints laid out by legal mandates and ethical guidelines. Given the AI used in psychology and education, ethical guidelines at a minimum demand consent for sensitive data. The right to not share educational outcomes may be as important as the right to confidential psychological counseling. These guidelines emphasize system oversight and the need to meet ethical standards that are not handled with overconfidence or other problems demonstrated within the remaining privacy. Guidelines suggest that students own their privacy regarding educational information. If an institute of education receives federal funds, it must adhere to these guidelines; it does not matter the student's gender or age. Privacy is one of the biggest concerns in AI applications, and for psychologists in particular, it absolutely must be one of the top priorities. Patients prioritize privacy over payments and actually receive a significant portion of potential payments to ensure the privacy and control the release of their information even at the cost of their own healthcare if it means maintaining their privacy. All of this is by way of saying consumers are very often willing to forgo potential benefits for privacy, particularly with data they see as particularly sensitive.

9.3.1. Data Collection and Usage

Traditionally, the input data used for updating weights of AI models in education can be predominantly categorized into five types: academic performance, behavioral patterns (including activities and interactions), biometric data, data based on instructors (including demographics and teaching styles), and demographic and social data (including student grade level progression). Pedagogical and personalized information developed through observational or self-report studies can also be used. A variety of information can be collected from an AI-based system, learner profile, and learning analytics. Student participation, time spent collaborating, viewing lecture recordings, sticky note usage, etc., are examples of this. There are a number of AI-based user models established in the applications developed by online educational solution providers. The application collects user-based and machine interaction data, and content-based feedback information.

At the same time, ethical considerations need to be addressed. Some data can be considered private or sensitive. Using such data for illegal purposes (or otherwise unethical purposes) may cause legal action to be taken against the user. Although security methods can be implemented to maximize the amount of data anonymized, it is possible to involve all members of the data processing chain, including data collectors, processors, and data controllers, in draft legislation. For this reason, instead of immediately examining alternative data enrichment measures, it is generally advisable to ensure that the law is well-drafted with the consent of all data processing stakeholders. Data collectors' adherence to data collection standards is dependent on several stakeholders. Given the evolving regulatory landscape, motivation for compliance is paramount. In addition to the ethical principles established, data is protected by data protection regulations. Failure to comply with appropriate legislation has adverse publicity on an international scale, and it is not limited to a single continent or country. The best way to rectify such an issue would be to minimize data collection activities that do not comply with regulatory standards. Users are also made aware of this for transparency purposes.

9.3.2. Student Consent and Rights

Unlike traditional learning systems, using AI in education often results in the generation of large datasets containing information about each student. Although this data is not always directly identifiable to an individual, consent is usually sought for its collection and use. Indeed, a central tenet of most data protection and privacy regulations is that of informed consent and the assurance that all data is collected and processed in a lawful and transparent manner. Students, or in the case of educational contexts, their legal guardians, have the legal right to make decisions about their information. This includes deciding who can collect and have access to the information as well as the ability to review the information collected. Schools and education organizations must be transparent about the data they are collecting, the learning technologies to be used, and students' privacy rights. It may be that transgressions to such consent regulations are particularly important within educational contexts given that these data relate, by default, to minors and are generated as a by-product of their attempts to learn.

Obtaining permission to track or analyze the actions of children below a certain age may be controlled, for example, by specific regulations. However, the specifics often leave local interpretations and questionable adequacies that are still to be resolved. Due to the variety of educational environments present today, what constitutes a valid consent and the individual stakeholders who hold these rights can vary. Furthermore, the potential to train tutors outside a national boundary begs the question of whose standards should be used in assessing ethical standards in such matters. In summary, the continuing focus on

consent and individual rights cannot reasonably be dropped from the agenda, given the uncertainty in this field, which is prevalent among stakeholders.

9.4. Ethical Considerations

There are a number of considerations around the use of AI that relate to ethics. Foremost among these is the need to ensure fairness and equity in the development and deployment of the technology. Although it has been suggested that AI has the potential to improve educational outcomes, if AI algorithms embody the biases of the society in which they operate, their application could have the effect of exacerbating current inequities. Indeed, the use of automated decision systems in the training and employment sector has been shown to produce discriminatory treatment. Research has found that using big data leads to the appearance of fairness, in this instance, in relation to college admissions, whereas when evaluated from a multidisciplinary perspective and with a non-big data approach, clear unfairness was identified.

It has been demonstrated that diverse student populations may experience educational disadvantage as a result of inherent flaws in AI systems, due to, for example, the use of unrepresentative or discriminatory data, particularly if the data are historical and reflect inherent inequity. This is of particular concern if these systems are afforded blind trust due to a "black box" effect in which they cannot be scrutinized and interrogated due to a lack of transparency and accountability. It is crucial that AI, including its accompanying ethics, be understood in complex ways, challenging divergences between and within mixes of societal actors as they compete to traverse, understand, exploit, or ignore AI's affordances. It is important to build explicit ethical reflection into the development of AI applications, and that it ventures beyond elite 'tech-optimistic' communitarian discourse to engage diverse publics in determining the future of such technologies. As a result, a working taxonomy for everyday designers which allows for ongoing discussion and navigation of the endless ethical tangles embedded in AI – an approach which may also be useful for educational contexts.

9.4.1. Bias in AI Algorithms

1. Introduction

AI algorithms have been credibly accused of numerous instances of bias. A common appeal of AI programs is their relative lack of bias. Unlike human beings, algorithms are often promoted as being able to make decisions that are both more transparent and more fair, thus avoiding biases. This is true to some extent—algorithms can process and use data more efficiently and effectively than a human can, but they are not fault-free.

Instead, bias in an AI system can arise during the data selection process, during the training of the model to recognize a particular pattern in the data, or as an unintended consequence of the AI's operations.

2. The Impact of AI Bias in Education

When it comes to education, biased AI algorithms can lead to biased aspects of students' learning experiences such as access to programs and services, school climate and disciplinary action, and academic tracking. Bias within educational technologies can be harmful on a large scale. For example, computer-assisted scoring tools for standardized tests seem to automatically discriminate against certain sensitive characteristics, such as gender or dialect. In short, bias can lead to reduced student outcomes in terms of both long-term educational and broader life opportunities. Therefore, it is an absolute and essential priority to ensure that the AIs which determine the ethically pertinent characteristics of educational technologies are not biased.

3. Promoting Fairness

There are numerous strategies for ensuring that AI systems are fair, including promoting diversity in the data, fostering adversarial training, certification, transparency, and accountability solutions, and stakeholder engagement. In fact, promoting diversity is one of the most effective methods of ensuring algorithmic fairness because it endeavors to prevent the AI from inadvertently utilizing unfair or unjust patterns by including a higher proportion of people meant to cover all potential possibilities and reduce the chances of bias, no matter what the specific requirements of the population. Another effective tool in promoting educational equity is stakeholder engagement—getting the right people involved in the process of selecting data, training models, and evaluating the outcomes of the new AI-driven approach to the challenges and opportunities facing K-12 education today. The more people we can involve as part of the search for truth, the greater diversity of thought we can bring to bear on the educational matters we confront, and the more likely we are to succeed.

Fig 9 . 2 : Understanding and Addressing AI Bias in Education

9.4.2. Transparency and Accountability

Transparency is especially important in the deployment of AI-driven systems because of the potential risks and potential loss of public trust that can result from these deployments. In many respects, mechanisms governing whether and how to deploy AI-driven systems in education largely embody the values underpinning technological ethics more generally. Ideally, institutions deploying AI teaching applications will be clear and upfront about their capabilities to stakeholders. Transparent AI systems also support those managing the AI deployment, who need to understand how they were made, for example, to conduct algorithmic auditing or to build trust around the system for the people interacting with it. Finally, transparent AI outputs can support targeted interventions based on the system's reasoning while providing process documentation that can potentially identify flaws, biases, or ethical issues in the machine learning mechanism. Accountability envelops the application of ethical and equitable AI guidelines and principles for the development and deployment of ethical AI in the educational environment. There indeed needs to be a mechanism in place that holds

schools, universities, and researchers accountable for the deployment of AI in educational contexts, and a strict monitoring mechanism that continually assesses if the guidelines are adhered to in the strictest sense. Pragmatically speaking, it is also important that the institution deploying AI-based systems has a feedback model in place for system users to highlight biases and address false positives. Machine learning models are not perfect, and if a tutor provides a grade that is wildly off and unfair, the student being assessed can appeal.

9.5. Data Governance Frameworks

EduData Governance consists of different aspects and dimensions, the managing and steering of which we propose to be approached through a data governance structure. Also, the Data Governance Framework introduces the main data governance aspects of the entire approach to align internal practice with societal concerns. This topic is relevant as educational institutions storing vast amounts of stakeholder data have to be fully compliant with this non-exhaustive list of legal and regulatory requirements. Best practices in what it means to responsibly manage data put forward the conformance of data and AI usage with these stakeholder interests. A business cannot do so without proper data management practices, including governance. The lack of documentation is widely recognized to lead to the illegality of the data. To avoid this pitfall, the law requires data governance policies and the conformance work that flows from the implementation of these policies. Moral and legal standards developed using a top-down approach are enforced through compliance monitoring and penalizing non-compliance. Not following them does not result only in staff's legal liabilities; the institution can also be held legally accountable for the non-ethical behavior of its staff. Increasing the public's and stakeholders' trust in the responsible use of their data and the AI solutions, as well as improved brand and increased trust in the sector, are major reasons to make the effort of aligning one's data governance structure to external requirements. Furthermore, a data governance practice is more than 'just' making sure staff adheres to laws and regulations. Organizations often aim to take it one step further and aspire to be the best in class, the benchmark, which includes continuous training and awareness programs for their employees.

9.5.1. Regulatory Compliance Requirements

Data Governance When evaluating AI-driven solutions in educational environments, regulatory compliance is a critical aspect for ensuring secure, private, and ethical data use. Privacy regulations concern the governance of data and are increasingly being used in arguments against data use practices that educators have historically held. Both

regulations require that district, school, and assisting entities practice data minimization, only collecting the data necessary to complete some end goal, and employ reasonable security protocols to ensure that disclosed data remains secure. For these reasons, it is essential for all educational organizations, including K-12, higher education, and edtech developers, to function as assisting entities. AI use for learning requires access to significant student data, and as such, district, school, college, and other staff members who evaluate AI-driven solutions need to ensure such products are secure and compliant.

As assisting entities, educational organizations are required to comply with either applicable regulations, depending on the specific organization's constituency or location, and have signed an agreement of responsibility for technical and procedural protections of student data. Failing to do so places student data at greater risk of breach and violation. To ensure regulatory requirements are met, periodic walkthroughs of all data systems and audits should occur. Periodic security and practices risk assessments must be done to support the above procedure. The results of such assessments can provide risk assessment surrogates and subsequently provide legal benefits with nonprofit entities focused on legal aid. It is particularly important for the targeted use of new technologies that assessment providers collaborate with regulatory compliance and privacy officers. Changes in federal and international regulations may force departmental partners to ensure that privacy and data protection solutions are also socially acceptable as technical capabilities go through privacy transformations. With varying legal frameworks constantly changing, current limits to processing may eventually recede. Educational processes and goals are not reliant on the technological viability of new private processing. Democracy, fairness, trustworthiness, and luxury are still reserved.

9.5.2. Best Practices for Data Management

Educational institutions will need to ensure better and more effective data management to implement and benefit from AI in learning. Institutions should follow some best practices for data management. One of the best practices for data management is to develop clear data governance within the institutions. This can be achieved by having a data governance policy that outlines roles and responsibilities for data owners, data custodians, and data processors. The other best practice is to provide suitable data privacy and data protection training for all staff to ensure that data protection principles are followed and monitored effectively. Institutions should have robust security measures to ensure data integrity and confidentiality, including managing access control to all data across different systems and devices. The data protection plan should also include proactive monitoring to ensure data protection compliance, data updates, and clear agreements for data disposal linked to data protection retention ability.

Finally, a regular audit of adherence and improvement plans to ensure practice improvement should also be conducted. To foster the culture of data privacy externally, the institutions should have a clear data privacy notice and data consent form for all stakeholders, including parents and learners. The communication and transparency best practice on data governance should ensure that data stakeholders are aware of its existence and have been clearly informed of their rights and have been engaged in data trust negotiation if necessary. The best practice for internal institutions in handling data for AI system compliance is involving stakeholders in designing, drafting, and agreeing on the data governance policy in the institution. It is important to know about roles and responsibilities and identify stakeholders to maintain the data quality in the institution. The CEO is the head of the overall data ownership of all data held by or shared in the institution. Data protection officers should ensure that all staff are given data training and know how to access important data.

9.6. Stakeholder Engagement

1. Introduction

Stakeholder engagement and thorough, ongoing discussions are important components of the decision-making processes that come with implementing AI solutions and robots into learning environments. There is broad consensus that investigations and discussions with all stakeholder groups such as children, students, parents, educators, and administrators are crucial. These diverse representatives contribute to the formation of policy, regulatory, and technological development. Different research sees these stakeholders as highly important and argues for the involvement of multiple stakeholders, including educators, parents, and possibly students.

One of the first hurdles in enacting meaningful stakeholder engagement will be to define a mutually beneficial condition where every party is satisfied in terms of what AI is supposed to ensure. The concerns of all involved parties need to be addressed as much as possible in order to gain buy-in. If not all parties are involved, a requisite level of communication and commitment would remain constantly unresolved. Informing children, parents, and all the staff working in learning institutions of the ethical business practices and policy strategies of modern AI can dissolve the mysteries and uncertainties embedded in our AI solutions. Ensure that every party has a fair understanding of what is going on. Therefore, a participative culture of involvement and collaboration is promoted. Only through active, transparent, and informative engagement of the above-named individuals, who are key stakeholders at every level of education, will it truly be possible to cater to their future behavior. This includes people who develop policies and budgets, those who make plans, and the students they work with on the strategic policy directions. Only by involving the identified key players will a meaningful and clear

understanding of how these agents are involved be developed. By co-producing knowledge about how to engage further, the voice of all the stakeholders may be retained. Therefore, for us, the participatory involvement of people at risk is part of our overall strategy and not separate, insular, or restricted in conventional terms. Crucially, the involvement of certain participants who may take part in the interviews, focus groups, or co-production of resources can be employed to influence the selection of key informants to be approached for avenues of involvement. In essence, however, the aim is to implement a cascading level of stakeholder engagement. The stakeholder involvement process must be part of an ongoing dialogue with various individuals and must accommodate being able to receive input at varying timescales. It follows that the public events and workshops of the project will be vital forums where stakeholders can learn about the project, comment on key research issues, and debate possible suggestions.

9.6.1. Involving Educators and Administrators

To enable effective selection and deployment of AI-driven tools, there must be close involvement of educators and administrators to bring disclosure from their own experiences. Professional development of educators is necessary to assure the better employment of AI tools in general, although most adoption of AI in education stresses the role of professional development mainly on educators. Implementing AI in education requires that educators should be more familiar with such advanced tools. However, little has been established on the association between educators' familiarity with AI and their AI adoption, as well as how they use AI in their workplace.

Effective adoption of AI-driven tools in education requires a strong collaboration between stakeholders in the learning environment. In terms of educator-administrator relations, school leadership needs to assure that educators can effectively deploy AI results in the classroom and shape the plan to integrate AI into instruction. It is necessary to define the communication channels between administrators across the hierarchy to ensure the alignment of the implementation of AI in the learning environment. The involvement of educators in the AI adoption process also minimizes concerns they may have, which is necessary to accomplish AI's impact in education. To assure that their considerations are heard, an educator's voice should be collected and included explicitly in the decision-making process, such as through an advocate level or administrator focus group.

9.6.2. Engaging Parents and Students

An additional critical aspect of the engagement process is the 'failing safe' imperative as far as parents are concerned. Parent-led parental consent models have been shown to be far more stringent than child-led models, with parents generally more risk-averse. There is increasing evidence that when parents are engaged in dialogues about their children's futures and the areas where education and technology intersect, they will act with alacrity to advocate for their children. In the out-of-school environment, evidence from a project found that parents can become powerful advocates. Thus, specific steps enforcement agencies can take include supporting schools to engage in two-way dialogues with parents around the use of technology in educational settings; enabling parents to engage with the process of drawing up and/or updating their schools' AUPs; and facilitating parent-run Information Sharing Question and Answer forums where parents and individual schools can anonymously ask the kind of questions that may make either party feel awkward or embarrassed in other settings.

These steps can foster a climate of openness and a developing culture of trust and transparency between schools and parents. The final point raised was that students are critically important participants in the education conversation. There is an old educational truism – 'yes, of course, we are child-centered in this school, and everyone knows that this is classified in the staffroom before any other sub-group.' There are some occasions and some areas in which, surprisingly, the rest of the school can actually work extremely well. It is very important to involve hard-to-reach families in discussions about technology for learning, and we must always make an effort to invite them to participate. Research and evaluation into programs support that targeted marketing is more effective than mass marketing or blanket invitations. It is also important that all messages are available in minority languages. Parents who do get involved at this stage of introducing technology probably already have strong opinions – we need to look elsewhere for voices and contributions in these discussions. All students are an important source of information and can help identify what is good practice, as they see the big picture of technology, safeguarding, and education. Furthermore, these students will soon be voters, fathers, jury members, and leaders.

9.7. Future Trends in AI and Education

Trend 1.5: AI and Educational Practices: The Bigger Picture When reflecting on the future of AI in education, educational practices are bound to be influenced by the future evolution of AI-driven technologies. Below we reflect on the pros and cons related to those developments.

Learning analytics, AI, and big data-based artificial intelligence are imagined to either have nothing to do with educational methodologies and the very essence of education (such as stimulating curiosity and creating environments for discovery), or they could change the way teaching and learning activities, as well as assessment tasks and processes, work. Advancements in cloud computing and the magnitude of capabilities of AI-driven bots and VR technologies enable a more personalized learning experience that supports individual interests and promotes equality in education.

AI applications could assess students' final learning outcomes. Computational systems during the MOOC years could determine whether a student demonstrated understanding when learning new materials. Hence, we underline AI's potential in stipulating educational trends. However, they may also provide answers that lead to the omnipresence of gamification and adaptive learning, breaking the dogma of today. In an increasingly free choice, from kindergarten to PhD studies, where we advocate for individual synergy and playfulness, how can we resort to using an up or down AI judgment? And how do we find the common denominator in an educational paradigm that voices its opposition to grading and inherently divisive notions such as success or failure, passing or failing?

9.7.1. Emerging Technologies

As part of a task force working paper, key emerging technologies in AI are explored. AI has the potential to influence every activity and aspect of our lives within the next few decades. While technical details are always geared towards a computing audience and potential investors, making the case for how our working lives will be altered and outlining how AI will change human abilities is important; in the discussions of AI, we cannot make policy without attending to the practical consequences.

Machine learning, a subset of AI that is based on pattern recognition algorithms, is emerging as an enabling technology with a wide variety of functions, including data mining, web mining, and text mining. AI can be used for learning analytics and educational data mining, although some consider that AI will simply create a new way for students to cheat. Cognitive technologies based on the functioning of the human brain can model intelligent reasoning like problem solving, narrative understanding, and machine learning. Natural language processing has been applied to enhance social communications between students and edubots. A large trend in the development of AI technology is in the area of user interfaces, making use of visual interfaces, virtual reality, augmented reality, and agent-based intelligences. Tools that make use of AI are also developed for better educational engagement than social web technologies alone. Of course, advancements need to be made to further refine and validate the learning potential of these technologies.

2019 was hailed as the year for personalized and differentiated instruction, with AI making it possible to tailor learning based on individual student needs. AI has the potential to reduce the time educators spend grading student work and allow them to spend more time catering to individual student needs, answering more student questions, and even taking on a mentorship role for specific at-risk students. Here, case studies of AI in the classroom are reviewed to reveal not just the benefits that might be unlocked, but also the difficulties in integrating these new systems into educational culture and practice. Much of the intangible glue that makes education valuable cannot be replaced by AI. Unfortunately, there is no end-to-end AI system in the world that tries to completely replace humans. Researchers design AI with specific access to specific data; therefore, this section focuses on AI's fit-to-purpose capabilities.

The infrastructure and training will be needed for classroom teachers to be able to take advantage of AI technologies. Implementing a translation app using an AI language model may seem simple, but integrating it into existing information technology systems in a school district will require a huge amount of effort to ensure it actually works. There are also equity considerations with accessing the technologies many have come to take for granted. The men and women who have a reasonable expectation of accessing and understanding this technology, on the other hand, are likely younger people with significant family and financial support. A lack of significant data is one of the reasons some ed tech experts have begun warning schools about jumping on this AI-powered learning analytics bandwagon.

9.7.2. Predictions for AI in Learning

Learning is affected by the capability of the technology used. Substantial changes can be expected in education in the next decade, hopefully enhanced by personalized and adaptive AI-driven systems, resulting in new narrations of an old story about educational technologies to be developed on a large scale with the aim of implementing and transforming incredible advances. At the center of the ancient 'new' story was a concern with the partnership between the student and the tutor/teacher, a partnership seen as essential for learning to operate as it should. In larger groups of highly diverse and more distant learners, often physically and personally distant from the teacher, as well as in more autonomous learning facilitated by AI-driven analytics, old educational issues are expected to remain unresolved.

Thus, despite the potential for personalized learning, and the use of motivational and emotional personalization in learning support systems, the increasingly dominant model of this partnership in learning – an early to mid-21st century model – is one of a 'deep and sustained unequal partnership'. This is in a situation in which numbers of students in formal education have increased immensely above what was earlier the norm. It is

also likely that by 2030, AI will be central to most processes for assessment and feedback. Our position was that: 'In the field of artificial intelligence and education, we expect 2020 to be 'the end of AIEd as we know it'. The rapid growth in computing is driving significant advances in data science and AI, which together have an immense potential to enhance and personalize education and even challenge dominant models of what formal education is about. AIEd will emphatically not end in 2020 – but it may change sufficiently for us to need a new rendering of this paper.' Given the immense achievements reported, this expectation is perhaps even more likely to be validated. Ongoing research to develop monitoring and intervention systems will need to anticipate and adapt to significant, as yet only imagined, changes in AI. This positioning implies the need for continuing research into the ethical equity, privacy, management, and governance of AI. It also implies an imperative for preparedness and leadership from all perspectives to contribute to enabling equitably good futures for humanity.

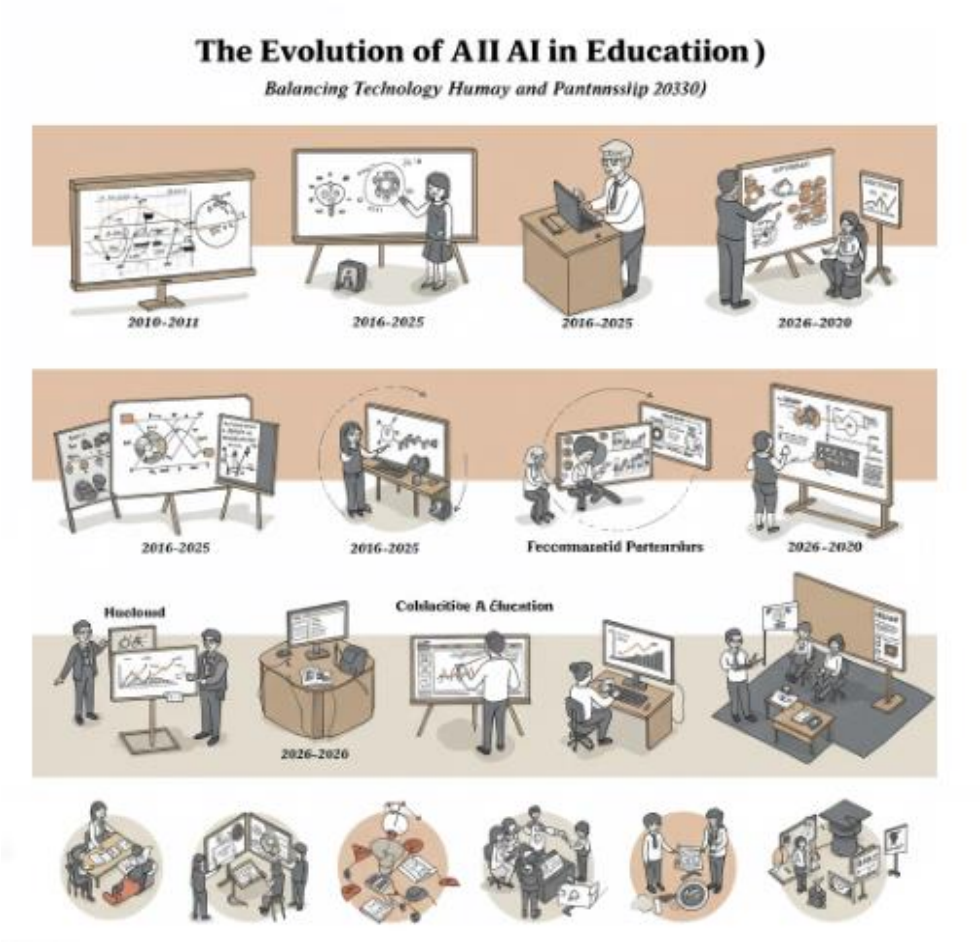

Fig 9.3 : The Evolution of AI in Education (2010-2030) Balancing Technology and Human partnerships

9.8. Challenges and Barriers

Implementing robust AI solutions in educational settings in a secure and legally compliant manner faces both technical and legal barriers and challenges. In on-premise infrastructure-based environments, one of the main technical barriers for educational organizations is infrastructure provision. It may not be possible to allocate and ring-fence infrastructure resources for AI solutions, particularly in the context that these solutions need to be available 24/7/365. To address this, one solution could be to use cloud-hosted AI services. However, these are not necessarily compatible with all educational setups due to networking and other connectivity constraints. An additional potential disadvantage for educators and students could be the time and effort required to integrate AI-driven new tools and services into existing systems or courses. AI tools could range from simple plug-ins to standalone solutions that need to be started up separately, to tools deeply integrated into a Virtual Learning Environment. Different integration levels will require different amounts and types of support, and this change will impact educators.

Approaches to avoid these types of issues can be through policies, cross-campus standards, information, or education. However, in addition to these technical barriers and challenges, there is the real challenge of educators and administrators having concerns such as how easy a tool is to use, how well it integrates with the learning practices of the students, and also the equity concerns of using these tools in areas of the world where internet connectivity is poor, accessibility over assistive technologies is terrible, or there are no assistive technology options. Cultivating a culture of active innovation and discovery by providing a sandboxed space in an ongoing and confidential manner to educators and administrators in which they can try new technologies of all types, get support as needed, attend workshops and communities of practice, fast feedback responses to requests, and value added to flesh out their ideas can be helpful in overcoming some of these barriers. Educational researchers can also help educators in the redesign of their courses to integrate technologies, speak to the potential effectiveness of AI-driven educational solutions, and carry out studies to address some specific ethical concerns and identify and propose solutions related to any educational barriers. AI tools may create digital divides and marginalize students who do not have access to these tools at home. Such issues should be considered in any cost-benefit and risk assessment of new solutions. Some of these barriers could be overcome by involving learners in their design, by ensuring that tools have basic options available in the most popular methods, each solution has a plan for dealing with students who cannot or will not use the tool, by carrying out testing and research to reduce identified barriers and examine alternative models, and by the free solution initiatives which directly address these issues overall. All of these potential barriers involve shared decisions to be effected by identified stakeholders. To only consider upgrade, allocation, or attribution of shared

resources from only the legal perspective is simplistic and high-risk. It represents a leap of extraordinary faith not supported by educational tensions among educational settings that have been noted, when the perspectives of educators and learners could be easily incorporated into current policy analysis. Study after study demonstrates that more information, more policy, or just new systems are problematic if not implemented by both educators' and learners' own free consent, and it has the potential to risk a serious break in trust.

9.8.1. Technical Challenges

One difficulty in applying AI to educational settings is the quality of the data that feeds these systems, as students have less habitual behaviors than clients in e-commerce or banking, and traditional entity resolution systems often associate multiple individuals (Nampalli & Adusupalli, 2024; Nanan & Chitta, 2022; Pandiri et al., 2023). The learning management system and the student information system may be isolated from the other IT systems on which the campus or division relies, and may be difficult to integrate with other systems, especially those based elsewhere in the cloud or on proprietary enterprise resource planning software. While the three learning interventions listed above can be largely paperless on multi-display mobile devices, station-based 'cyber-physical' systems are generally more complex and difficult to introduce, configure, and maintain. Discussions on models for managing secure and high-quality large-scale systems for learning advise instruction to have robust IT support available at its destination and updated in advance to prevent failures caused by sudden increases in use or virus attacks.

It is difficult to acquire the continuing education elements illustrated for people on both sides of the IT Technical/Teaching and Learning Challenges. The 'tenuous status' of instructional technology integration in higher education, especially in the centralized organization due to dependence on the goodwill of IT support personnel, who are generally not eligible, compensated, selected, or reviewed to provide pedagogical support and often postpone competing technical updates. Yet, as in K-12 environments, high-quality educational experiences that involve technology infrastructure increasingly depend on shared cross-sector resources between providers and users or stakeholders. The 'technopedagogical divide' is defined more broadly as the disconnect between educational goals and outcomes on the one hand, and the technical infrastructure and services that 'support or, increasingly, shape instruction and learning' on the other. Distance, hybrid, and related 'impersonal' learning (both credit-bearing and continuing or professional education) often cost more per credit or student hour, in terms of staff time and technological infrastructure, than do equivalent face-to-face activities. If a university is to prepare and use these tools wisely, then it is best for members of its decision-making team to have some direct experience with the challenges and

opportunities presented by them – albeit from the student, not the instructional or administrative, perspective. Failing to do so may put the university infrastructure at risk if an increasing number of poorly developed and managed homebrew tools and plug-ins litter the IT universe with semi-functional technological carcasses that can neither be fully supported nor fully retired, upgraded, or patched.

9.8.2. Cultural Resistance

One key aspect influencing the Maven Mission for Change will be the cultural resistance from educators who question the relevance of AI. In particular, evidence of cultural resistance confronting the deployment of technologies in general within education means that some educators will need convincing that AI could be the foundation for innovative practice instead of simply replacing them (Pandiri et al., 2023; Recharla et al., 2023).

The need for educational institutions to have change management and some leadership strategies in place to manage this cultural resistance has been identified. The development of a culture of innovation, however, will require educators to change their mindset to be open to experimentation and risk-taking. Educators can also be motivated to move towards more innovative practice by the need for learners to develop future skills, such as adaptability, resilience, and problem-solving. A move away from a deficit model of responsible innovation towards a solutionist approach would also help to support innovative practice, with opportunities to showcase successful discussion, debate, or other innovative AI deployments to build interest and confidence. Indeed, the importance of showcasing successes was identified throughout the process.

In a competitive market, it will be the institutions with the capacity for innovation and agility who will be most able to introduce AI tools and use them to best effect. While there will be many forces holding back resistance to introducing AI, leadership that encourages informed risk-taking and open decision-making styles may be capable of shifting opinions, even among the skeptical. However, in times of rapid change and little spare resources, establishing this kind of culture may prove to be the hardest part of the task.

9.9. Conclusion

Reflecting back through the sections, this essay served as a tapestry interweaving both significant technological advances in AI and the discrete education setting with compelling ethical arguments and distinct commentaries on responsible AI in close proximity to practice. Our discussions posed a conflict between the slow introduction by educators of advances in AI and the operational necessity for such progress in a world

where personal data can be packaged and sold as a lucrative commodity. We opined against either extreme flirtation with radical technological advancement and irrational, blanket-curtailed inactivity. Rather, a considered approach is proposed, whereby stakeholders engage with nuance and recognize legitimate ethical considerations, such as those captured within this essay. We suggested the importance of recognizing data privacy as incommensurable and of according centricity of moral obligation over objectives towards profitable enterprise in the education sector. Further, practitioner comments reinforced the importance of stakeholder engagement in building prospective systems and the opportunity of future AI-driven systems to relieve teachers and reconstitute education services.

While a deep understanding of system implementation that embraces the heterogeneous values of diverse stakeholder communities seems possible for the field, few would have predicted the course of AI-led educational reform and the spread of digital learning across the globe following the outbreak of a global pandemic. Digital realpolitik has shepherded academia into an uncertain future, and it is one which we have engaged responsibly. Similarly, despite the near-decade-long focus of this essay being on systems relevant for and populations situated within the United States, the discussion maintains relevance across national contexts. Following policy insertion and preliminary proof of educational efficacy, it is envisaged that pedagogical systems developed by private, neoliberal industries led by world powers will begin to be internationalized. As the digital economy and educational systems become increasingly attractive vectors for international influence and control, it is hoped that our suggestions for policy and implementation will guide global stakeholders working in this field. For while our focus is on the implementation of future educational systems, we believe the argument has global relevance along with global importance, as stakeholders converge at a critical juncture.

9.9.1. Summary of Findings and Implications

In this paper, we underscore some of the potential ways that AI can significantly transform learning environments and explain why educators, administrators, and other stakeholders must ensure that the AI-guided practices they engage in are safe, respectful, and likely to support ongoing learning. We also acknowledge that implementing such solutions is a non-trivial challenge. Our findings highlight that critical conceptual work remains to be done so that educators and administrators can understand how technical decision-making aligns with and supports operational and regulatory compliance. This work will enable more diverse stakeholders to be included in transparent, stakeholder-responsive decision-making. Implications of this work include the importance of

engaging stakeholders in the governance of AI-driven ed-tech solutions and rethinking how we conceptualize the roles of educators and administrators.

We add to research and practice in educational AI by engaging deeply with the ethical implications of deploying AI in learning environments. Substantively, this paper offers educators and administrators key insights into the structure of the challenges that they may overcome, or which may impede them, as they work to safely and ethically implement AI-guided practices in learning environments. We present several strategies to surmount these barriers. These recommendations include focusing on risk prevention rather than compliance and cost savings when selecting and evaluating AI-driven guidance systems, as well as defining data and privacy governance prior to any data collection, processing, or sharing. In closing, we emphasize the importance of ongoing dialogue and engagement with the broader educational community as a way of fostering ethical, regulatory, and conceptual clarity in educational AI.

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