The Coming but Uneven Storm: How AI Regulation Will Impact AI & Learning Analytics Research in Different Countries

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Abstract

This article investigates the state of AI regulations from diverse geopolitical contexts including the European Union, the United States, China, and several African nations, and their implications for learning analytics (LA) and AI research. We used a comparative analysis approach of 11 AI regulatory documents and applied the OECD framework to classify core priorities. The findings showed that The European Union and China have adopted the most comprehensive and strict AI regulations, potentially setting global standards once developed into legal instruments. The United States has adopted a comprehensive AI Bill of Rights, but that framework lacks explicit penalties, making it unlikely to become more than a voluntary framework. Moreover, while the USA, EU, UK, and China prioritize safety and avoiding algorithmic bias, Japan and some African countries emphasize AI systems' economic and societal potential. Certain data types (e.g., Biometric sensors) might become challenging to use for education due to strict guidelines (particularly within the EU), necessitating careful consideration of data nature and privacy risks before use and when transferring data across jurisdictions. As regulations shift, researchers and practitioners must adapt to changing regulations across international boundaries, the legal benefits and risks of using open-source licenses, and regulatory sandboxes to minimize the risks for learners and developers and ensure ethical and legally compliant AI-driven LA systems.

Notes for Practice

- AI system developers should ensure that AI systems are human-centric and prioritize user needs.

- Researchers & institutional leaders should stay updated with and comply with global AI regulations to ensure legality and minimize risks.

- Learning analytics and AI experts should work with policymakers and implementers to understand the trade-offs of specific regulations as they are proposed through conversation and dialogue.

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1. Introduction

Recent developments in Generative Artificial Intelligence (AI) and its impact on education have been described as an "earthquake" and of "seismic" proportions - "We are witnessing the largest rollout of AI in educational history, but in true Silicon Valley fashion, it is moving fast and breaking stuff" (Buckingham Shum, 2023). There is now increasing deployment of generative AI in education and specifically learning analytics (LA) (Crompton & Burke, 2023). LA will increasingly be AI-

driven, necessitating the design, development, and deployment of learning-appropriate AI systems. At present, it is not entirely clear how ongoing developments in AI will impact the use of AI in educational contexts (Holmes et al., 2022), and, specifically, in LA, nor how the development of AI systems will be regulated to address not only various concerns regarding the deployment of AI in education such as ethics and wellbeing, but also to ensure positive outcomes, what has come to be known as "positive AI" (van der Maden et al., 2023).

In response to and amid the current hype and concerns regarding advances in AI, several international and multi-national initiatives have been implemented to provide guidance to the design, development, and deployment of AI. Globally, these initiatives include the *Beijing Consensus of AI and Education,* the European Commission's High-Level Expert Group's publication - *Ethics Guidelines for Trustworthy AI* (European Parliament, 2023b, June 14), the *Ethically Aligned Design: A Vision for Prioritising Human Well-being with Autonomous and Intelligent Systems developed by IEEE* (2019). The IEEE also developed Standards for Recommended Practice for Assessing the Impact of Autonomous and Intelligent Systems on Human Well-Being (IEEE, 2019). More recently, UNESCO published *AI and Education: guidance for policymakers (*UNESCO, 2023) *and* the European Commission published *On the Futures of Technology in Education: Emerging Trends and Policy Implications* (European Parliament, 2023b, June 14). Finally, the Council of Europe (CoE, 2024) adopted *The Framework Convention on Artificial Intelligence*, the first-ever international legally binding treaty (drafted by the 46 member states and 11 non-member states) aimed at ensuring the respect of human rights, democracy, and the rule of law in the use of AI systems (Council of Europe, 17 May 2024).

Among these many initiatives, perhaps the regulatory field changed most dramatically when, on 24 April 2021, the European Commission proposed the *Artificial Intelligence Act* (EU AIA), the first comprehensive legislative framework for AI proposed by any major global economy (European Parliament, June 2023a). Since then, many other countries and regions have followed suit. For instance, the U.S. Senate and House are considering the Algorithmic Accountability Act of 2022 (US AAA) White House. (n.d.). Yet whether and when this bill will pass into law remains uncertain (Mökander et al., 2023). The *Global Partnership on Artificial Intelligence* (GPAI, 2022) further points out that the design, development, and deployment of AI systems are currently concentrated "amongst a small number of platforms primarily in the US and China" (GPAI, 2022) (though this is a rapidly changing space, including the recent emergence of Mistral AI in France), and Hutson (2023) opines that nations will have to carve out different regulatory approaches. These efforts are comprehensive in nature, cutting across many areas of concerns and domains of application. With widespread concerns ranging from privacy risks (Gupta et al., 2023), to algorithmic bias (GPAI, 2022), to the ultimate takeover of society by malevolent AI (Yudkowsky, 2023), perhaps it is unsurprising that policies have rarely focused on the educational sector (European Parliament, 2020). However, this limitation has led to concerns, with one article arguing that the EU "has decided to introduce the explicit regulation of AI in the educational sector without a full understanding of how AI impacts the sector." (Colonna, 2022), p. 335.

In this paper, we are concerned not only with the current state of AI-system regulation but also with how current AI regulation steers research and the development of responsible AI systems, with specific attention to impacts on LA. Koop and Lodge (2017) state that "definitions of regulation are scarce" and that the scope in which the concept is applied is wide-ranging and interdisciplinary in nature (p. 23). In following Koop and Lodge (2017), we use the notion of 'regulation' as referring to "the intentional intervention in the activities of a target population, where the intervention is typically direct–involving binding standard-setting, monitoring and sanctioning—and exercised by public-sector actors" (p. 21). In this paper, "regulation or strategies" refers not only to hard law but also to soft law, such as nonbinding guidelines and standards—sharing the characteristics to guide AI activities, whether nationally, internationally, or trans-nationally. The value contribution of this paper is found in its mapping of the current state of AI regulation and classifying AI regulation to understand ongoing and future developments that will impact the design and deployment of AI-driven LA.

Background

Regulating AI: A Short Introduction

While the possible regulation of AI has always been an integral part of the broader history of AI, recent advances in AI have foregrounded that most of the development is taking place supported by global information and communication technology (ICT) giants (Giegerich, 2023), providing these actors with "extraordinary social and economic power" (GPAI, 2022), p. 8. The question regulators therefore face is how to balance as much freedom as possible with as many limitations as necessary (Giegerich, 2023; Pasquale & Selwyn, 2023). "How much freedom in developing, releasing, sharing and using AI can be allowed without endangering the common good and perhaps even the survival of the human species, considering that the risks

involved are uncertain, but possibly great?" (Giegerich, 2023), p. 3.

The impacts of AI systems "depend on what data is used to develop these systems, how that data is processed, and who controls these activities" (GPAI, 2022), p. 7. Therefore, many argue for regulation of these AI systems "that are strongly cognisant of and sensitive to these issues" (GPAI, 2022), p. 7. However, GPAI (2022) notes that regulation "has struggled to keep up with the multiplying harms and risks of data collection and AI, and the cycle of data enclosure and service monopolisation in platforms that excludes new players and intensifies platform power over users" (p. 8).

Many supra-national policy-making bodies have become involved in discussion of how to regulate AI. For example, as Giegerich (2023) notes, the European Union (EU) has set a goal of leading efforts to regulate AI (*cf.* The Framework Convention on Artificial Intelligence (CoE, 2024)), while the United Nations "only produced soft law rules" (p. 4). Other regulatory initiatives include the Organization of American States (OAS), which "has for some time discussed the impact of AI on the four fundamental pillars of the OAS – development, democracy, human rights and security" but has not developed "any regulatory ambitions of its own" (Giegerich, 2023) p. 4. In the context of the African Union, there is currently a draft strategy, and according to Giegerich (2023), the African Union envisages AI "as a catalyst for unprecedented growth and progress in Africa; the need to ensure its use in a responsive manner is of *secondary* importance" (p. 4). (italics added). Giegerich (2023) further remarks that the approach of the Association of Southeast Asian Nations (ASEAN) will be different from the EU approach and will focus on "best practices by design' rather than anything legally binding" (p. 5).

However, many have noted the specific challenges faced in regulating AI (Giegerich, 2023; Sundar et al., 2023; Wheeler, 2023). For example, Wheeler (2023) notes that the velocity of the developments in AI makes it difficult to regulate, stating that current "regulatory statutes and structures available to the government today were built on industrial era assumptions that have already been outpaced by the first decades of the digital platform era. Existing rules are insufficiently agile to deal with the velocity of AI development." Not only is the speed of development of AI systems a regulatory challenge, but determining the scope poses its own challenges - ranging from "Old-fashioned abuses" (e.g., scams and manipulative applications) at a level of automated scope and scale to "Ongoing digital abuses" including, for instance, "violation of personal privacy, expansion of non-competitive markets, manipulation of individuals, and dissemination of hate, lies and misinformation."

Another major challenge articulated in Wheeler (2023) is the question about the 'who' and the 'how' – who will be regulated and how? In addition, who will regulate and how? In the context of the US, Wheeler (2023) states that it is the innovators and first-movers who make the rules. The essence of innovation or being a first mover is to charter new territories, spaces where current regulations do not have relevance in their current forms, or there is no regulation at all. The first-mover advantage also applies in terms of regulation, as can be seen in the adoption and implementation of the European Union's General Data Protection Guidelines (GDPR) (European Parliament, 2020), as well as the AI Act (EU, 2021) that passed in the European Parliament on 13 March 2024**.**

One approach that some have proposed to regulation is licensing AI platforms (Wheeler, 2023). However, as they note, "licences tend to reinforce the strategic position of those who receive the licence" (Wheeler, 2023) adding costs and challenges to any new entries. Wheeler (2023) therefore proposes oversight focusing on "mitigating the effects of the technology rather than micromanaging the technology itself. This means evolving the regulatory ethos from micromanagement to risk-based regulation with agile implementation." This is the approach found in the EU AI Act (EU, 2021), comprising a "multi-layered, effects-based analysis for AI that recognizes the many and varied use cases for AI are accompanied by differences in application, adoption, and inherent risk." In terms of this, regulation based on applications will have to account for its uses and impacts in many specific sectors, such as health (Meskó, & Topol, 2023), mental health (Singh, 2023) and higher education, to mention but a few. However, as Sundar et al. (2023) notes, regulation based on specific use cases and their risks is difficult, given the unforeseen effects of AI. Regulating possible unintended consequences is a major consideration, but is also a regulatory challenge (Sundar et al., 2023).

However, regulating AI regionally in this fashion will be difficult. Giegerich (2023) states that "regional regulatory approaches will not suffice to establish a proper balance of the chances and risks of that technology for humanity. Global private sector players at the forefront of AI technological developments cannot effectively be regulated by regional law alone" (Giegerich, 2023, p. 21). If the developers and users of AI are global, regulating region-by-region may be ineffective or may create a mishmash of different regulations that are challenging for both vendors and users, particularly users who travel between different regions or work in multinational teams.

AI regulation and/in education

In this article, we focus on the specific context of AI in education – an area of application with a rich and extensive history (Doroudi, 2023), but also one that has seen relatively less attention from policymakers than other areas of AI. As recently as

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in 2021, Bulathwela et al. (2021) found that no policies or regulations had been developed to address the deployment of AI in education specifically (though certainly more general regulations around educational technology and education in various countries have impacted the deployment of AI in education). For example, Colonna (2022) states that "Until recently, the rapid development of technology in this context has generally outpaced policy debates and regulatory frameworks about how best to develop and use AI in HE in ways that are not just equitable, ethical, and effective but also just, fair, and caring" (p. 333). However, recent advances in Generative AI have moved the regulation of AI in education to the forefront (Holmes et al., 2023). In the education sector, regulating AI faces the paradox of making decisions "in the absence of reliable risk information or foreknowledge of technological developments" (Colonna, 2022), p. 337. At the Council of Europe's Conference of Ministers of Education on 29 September 2023, the Ministers passed a resolution on harnessing the potential of AI in and through education, which means that during the next couple of years, the Council of Europe will work on developing a legal instrument to regulate specifically the use of AI in education. As part of this, recommendations have been made to ban the use of emotion recognition software in education and to classify all use of AI in education as "high-risk", steps that would heavily impact the field and sub-fields such as LA, at a minimum within the EU.

Due to the reality that regulating AI will, in all probability, fall outside of the purview of educational systems and individual institutions, much of the research into these issues within the LA and AI in education communities has focused on ethics and governance, with some articles discussing the intersection of these issues with regulation. For example, a recent article by Nemorin et al. (2023) reviews the discourse on the issues within AI in education (AIED), noting that in the light of data breaches and public concern about AI, there is a need to "repair the already damaged public perception while ensuring greater oversight over tech giants in a culturally acceptable form" (p. 47). For Nguyen et al. (2023), ethical principles and regulation are inseparable, and they propose a set of ethical principles to guide policy and regulation of AI in education that includes 1) governance and stewardship; 2) transparency and accountability; 3) sustainability and proportionality; 4) privacy; 5) security and safety; 6) inclusiveness, and 7) human centred AIED. Li and Gu (2023) developed "A Risk Framework for Human-Centered Artificial Intelligence in Education", stating that "the risks of Human-Centered Artificial Intelligence [HCAI] are highly complex, unpredictable, and nonlinear" (p. 187) and that risks in AIED are much broader than just technological but "also involve the relationship between education and society" (p. 189). Their risk framework included eight indicators, namely "misunderstanding of the HCAI concept (MC), misuse of AI resources (MR), mismatching of AI pedagogy (MP), privacy security risk (PSR), transparency risk (TR), accountability risk (AR), bias risk (BR), and perceived risk (PR)" (p. 187). Their research found that the biggest risk in AIED is a misalignment between AI and pedagogy (see also Holmes et al., 2023), followed by a misuse of AI resources. They also highlighted a lack of accountability systems and mechanisms in AIED and personal privacy and security as additional risks. Li and Gu (2023) state that there is a need for a "bridge" to advance collaboration between managers, teachers, students, and parents in the context of AIED and propose a framework along these lines. One area of particular importance for such a framework is *procurement*, where a framework "can provide managers with judgmental evidence on the access regulations and application safety of AIED products" (p. 198).

Another area of relevance to the intersection between regulation, AI, LA, and education is the work to evaluate or audit AI systems for fairness and transparency, which is important to practitioners and policymakers. Concerns have been raised that AI technologies in education may be inequitable and less effective for historically under-supported learners (Colonna, 2022; Madaio et al., 2022), influencing some regional policymakers such as Atlanta Public Schools to adopt recommendations that educational technologies be validated on students like theirs before use (Rauf, 2020). Furthermore, many learners experience inequities due to algorithmic bias, well beyond the most heavily studied demographic categories (see review in Baker & Hawn, 2022). Crompton and Burke (2023) states that auditing AI applications in the context of LA "is a complex process that requires technical capabilities and needs to consider the perspectives of all stakeholders," Their paper proposes a framework for the auditing of such AI applications "from the perspective of learners' autonomy, provides insights into different auditing methodologies, [and] the importance of reflection and dialogue among providers, buyers, and users of these systems to ensure their ethical and responsible use." This framework's attention to auditing requirements, the auditing process and methodologies, and criteria creates a possible template for how regulations along these lines could be implemented. Another potential example is seen in the Certification for Prioritizing Racial Equity in AI Design, developed by Digital Promise and the Edtech Equity Project (Digital Promise, 2022), which provides a formalized procedure for validating that an AI-based learning platform is unbiased, both in terms of its design and algorithms. However, with existing policy and regulations, Williamson (2023) expresses concern that "the burden for ensuring ethical and regulatory compliance often falls upon schools, while edtech—and Big Tech—companies remain unaffected, even when failing to comply with data protection regulation." Developing regulations where the burdens fall in the right places, which do not create unreasonable burdens on well-intentioned vendors trying to comply, but which are enforceable on bad actors is a difficult and ongoing challenge (Pasquale & Selwyn, 2023).

This focus on practical steps, certification, and audits, stands as a contrast to many other researcher- or practitioner-led initiatives on AI in education. In a very critical article, Munn, (2023), in referring to a myriad of ethical guidelines and frameworks, argues that the "deluge of AI ethical principles is largely useless" (p. 869) and that most, if not all, the proposed ethical principles supposed to guide the deployment of AI, are "meaningless, isolated and toothless" (pp. 869-870). In their view, not only do the proposed ethical principles ignore "fundamental normative and political tensions embedded in key concepts" (p. 870), but also much AI development takes place in contexts far removed from *the effects* the deployment of AI may have on individuals, communities, and sectors, with some of these already marginalised and at-risk. Ethical principles are furthermore not "self-enforcing", and within such a framework, there is no consequence for breaches of ethical principles (p. 871). Due to the time, it takes legislation to catch up with technology, Munn (2023) opines that the emphasis on developing ethical guidelines and codes of conduct "allows tech operations to continue unchecked, unhindered by lawsuits, fines, or other penalties" (p. 872). Many companies in the AIED space do care strongly about ethics (Holstein et al., 2019; Sabourin et al., 2015) but producing and implementing ethical AIED remains a "daunting challenge underestimated by a technically focused industry and even by ethicists" (p. 873).

Research questions

The surveyed literature demonstrates that the education sector is shaped by national and international legislation and policy, at the general AI policy level, not specifically tailored to the educational sector. Local, context-specific decisions about AI's ethical and responsible deployment are made based on local circumstances and policies being made at a regional, national, or supra-national level. For educational institutions, LA researchers and practitioners, and institutional policymakers making informed decisions on AI-driven LA, this paper aims to answer the following questions:

RQ 1: What is the current state of AI regulation?

There is a foundational need to understand the diverse and rapidly evolving AI regulatory landscape globally, in order for the LA field to prepare for how changes in regulation may impact our field. By mapping the current state of AI regulations, the study establishes a comprehensive view of how different geopolitical regions prioritize and implement AI governance. This question fills a gap in the literature, as existing studies often focus on specific regions or thematic aspects of AI regulation without offering a comparative analysis. Understanding this regulatory diversity is essential for stakeholders in AI and LA, as it provides the necessary context to navigate legal and ethical constraints effectively across jurisdictions.

RQ2. How do existing AI regulations align with the OECD's AI system classification framework?

We consider AI regulations in terms of the OECD's classification framework because of its comprehensive approach to understanding AI systems across technical, ethical, and societal dimensions. By aligning AI regulations with this extensive framework, this question seeks to evaluate the coherence and scope of these regulations, particularly in addressing the multidimensional impacts of AI. Previous research often overlooks the interplay between regulatory frameworks and the structured classification systems which influence policymaking in many countries. Thus, this question contributes insights into whether current regulations are sufficiently comprehensive in terms of these considerations to guide the design and deployment of responsible AI systems, particularly in educational contexts.

RQ3: What are the implications of existing AI regulations for designing and using AI-driven learning analytics systems?

This question bridges the regulatory landscape and practical application, specifically in the context of LA systems. It addresses a gap in our field's understanding of how regulations are impacting and will impact the design and implementation of AI-driven LA tools. Current research tends to focus on ethical principles or technological advancements in LA, but the intersection of these advancements with evolving legal frameworks remains underexplored. This question unpacks the strategies needed to ensure compliance while fostering innovation in LA systems, and to ensure that they remain effective, ethical, and aligned with pedagogical goals.

Methodology

The primary objective of this study was to conduct an in-depth exploration of AI policies, regulations, and strategies

internationally. To accomplish this, we relied on a secondary data collection approach, employing desktop internet searches as our primary research method. Drawing inspiration from the research of Irwin (2022) and Morrow et al. (2014), we considered the ethical implications and limitations while also recognizing the potential inherent in secondary data analysis. To analyze AI regulations across multiple geopolitical contexts, we employed a comparative policy analysis approach rather than a systematic review. Unlike systematic reviews, which consolidate findings from a stable and clearly defined body of literature, AI regulations are constantly evolving, vary across jurisdictions, and respond to shifting technological and political landscapes. This approach aligns with Huang et al. (2024), who conducted a comparative analysis of national and international AI regulatory frameworks across regions such as the EU, China, the US, the UK, and Singapore. Similarly, our study systematically compares how different national regulations influence LA research and practice, reinforcing the need for a cross-jurisdictional approach rather than a singular focus on one regulatory framework.

*Data Collection: T*he search process was guided by a predefined set of search terms curated to ensure comprehensive coverage of regulations and strategies related to AI. To ensure clarity and consistency, two distinct search queries were used: *Query 1: "(AI policy OR strategy OR regulation) AND (artificial intelligence OR automated OR machine learning)" targeting broad AI policies and regulations. Query 2: "Regulating AI" OR "AI regulation" AND "learning analytics"* . These terms were aimed at pinpointing documents associated with AI policies and regulations across the globe. Our search for relevant documents spanned various sources, including Google searches and government portals, which provided access to a wealth of documents related to AI regulations. Additionally, we searched structured databases such as the OECD's AI Observatory (OECD, 2024) and the African Observatory on Responsible AI (Adeleke, 2024), to ensure that the dataset included authoritative and policy-driven resources. The initial search resulted in a total number of 47 documents which were later screened based on the inclusion and exclusion criteria.

Data Inclusion and Exclusion Criteria: Although our search process produced a total number of 47 documents, only 11 regulatory documents were included in our final analysis. For example, some regulations lacked the depth or specificity required for meaningful interpretation, while others were early-stage drafts subject to change. Huang et al. (2024) emphasize the importance of selecting enacted, officially recognized AI policies rather than preliminary proposals, given the rapid evolution of regulatory frameworks. Additionally, while we identified individual AI strategies for specific European countries, we made a conscious decision to exclude them from the analysis. This choice was made because the European Union's AI regulation, once it is approved, might drive changes in country-level policy; current country-specific policies drive the shaping of EU-level regulations but will likely be rewritten based on eventual EU-wide legislation. For each country or region included, we conducted an in-depth review to identify the most comprehensive and finalized regulatory documents available. Where multiple documents existed, priority was given to those that were the most updated, formally enacted, and widely referenced in regulatory discussions. For example, in the case of China, both *China's Deep Synthesis Provisions 2022* and *the 2023 draft rules on generative AI* were included due to their complementary focus and significance. Draft regulations were excluded unless no finalized version existed for a particular jurisdiction, ensuring that only policies with concrete regulatory standing were analyzed. We also acknowledge that AI regulations exist in diverse linguistic and jurisdictional contexts. Due to language constraints, we relied on English-language documents or officially translated versions available through regulatory bodies. While this may limit access to some national regulations, we sought to mitigate this by utilizing global policy repositories such as the OECD AI Observatory. The data collection process resulted in the inclusion of 11 AI regulatory documents from a diverse array of regions, including three African countries (Egypt, Mauritius, and Rwanda), the European Union, the United States, the United Kingdom, China, Canada, Japan, and the United Arab Emirates. These countries were selected based on the presence of concrete regulations, strategies, or policies related to AI, ensuring a rich and varied dataset for our analysis. The references to each regulation included in the analysis are provided in Table 1.

Core Framework: Within this paper, we rely upon the Organization for Economic Co-operation and Development's (OECD) AI framework for understanding AI systems. While some frameworks, such as the AI Classification Framework (Cachat-Rosset & Klarsfeld, 2023), predominantly emphasize AI features such as automation, and pay limited attention to societal implications, the OECD framework offers a multifaceted classification approach, considering diverse aspects that enable a holistic assessment of AI policy and regulation. OECD developed their framework with the purpose "To help policymakers, regulators, legislators and others to characterise AI systems deployed in specific contexts" (OECD, 2022). Adherence to the principles in the Framework is intended to result in "innovative and trustworthy" approaches to AI (OECD, 2022) p. 3. Some of the dimensions of the framework may apply more in the early development phases ("in the lab") than other dimensions that may apply once AI systems are deployed ("in the field"). As such, the Framework proposes elements of the AI system lifecycle (that are not necessarily sequential), namely "planning and design; collecting and processing data;

building and using the model; verifying and validating; deployment; and operating and monitoring". The framework suggests that these elements "can serve as a complementary structure for understanding the key technical characteristics of a system" (OECD, 2022), p. 7. The OECD Framework has been extensively used not only in classifying AI systems but also in work on ethics in AI deployment (Abramova et al., 2022), the governance of AI systems (Florin, 2022) (despite this not being a focus of the framework itself) and risk assessment and ethics, among other applications (OECD, 2022).

The OECD framework encompasses five dimensions: *People and planet*. This dimension evaluates the potential of applied AI systems to foster human-centric, reliable AI that benefits individuals and the environment. It encompasses considerations such as users, stakeholders, optionality and redress, human rights, well-being, environmental consequences, and societal impact of AI, including its potential to displace human labour. *Economic Context:* This dimension delves into applied AI systems' economic and sectoral landscape. It encompasses information about the industrial sector, business functions and models, critical functions, the breadth of deployment, and technical maturity. *Data & Input:* This dimension characterizes the data and expert input an AI model utilizes to construct its environment representation. It encompasses attributes such as data and input origins, rights, identifiability of personal data collection methods (machine and/or human-driven), data structure, format, and properties. *AI Model:* This dimension interrogates whether, for example, the system is for-profit, non-profit or public service system; whether the model is "symbolic (human-generated rules), statistical (uses data) or hybrid"; whether the model is open-source, or propriety, self or third-party managed; whether the model is generative, discriminative or both; whether the model is universal, customisable or tailored; or whether the model is used in a deterministic or probabilistic manner, and so forth (p. 2). *Task & Output:* This dimension encompasses the tasks performed by an AI system, its outputs, and the resulting actions that impact the overall context. It includes system tasks, action autonomy, task-action combinations (e.g., autonomous vehicles), core application domains (e.g., computer vision), and assessment methodologies. While classifying regulations into the distinct dimensions of the OECD framework, we adhered to the language used in the retrieved documents to maintain our analysis's intended meaning and validity.

Coding and analysis: In the analysis phase, we employed the OECD framework to classify AI regulations. This framework was a foundational tool to gain insights into each regulation or strategy's core focus and priorities, providing a solid basis for considering their implications for LA. The coding process was conducted by two researchers, who independently reviewed all 11 regulatory documents that met the inclusion criteria. Each document was analysed guided by the OECD framework. To enhance reliability, both researchers coded all documents separately, and subsequent discussions were held to resolve any inconsistencies or disagreements in classification. This process ensured that each regulatory document was read and assessed by two individuals to reduce bias. The results of our coding and classification process are presented in Table 1, including the countries' names, the respective regulations/strategies, and relevant textual descriptions.

RESULTS

The analysis of existing AI regulations and strategies around the world yielded a selection of countries and regions that have taken steps to establish policies or concrete strategies for AI. As mentioned above, the analysis resulted in a total of three African countries (Egypt, Mauritius, and Rwanda), the European Union, the United States, the United Kingdom (UK), China, Canada, Japan, and the United Arab Emirates. Each of these countries had a formal and concrete AI-related strategy, regulation, or policy. These countries became the focal points for evaluation executed in accordance with the established OECD AI classification framework (OECD, 2022).

State of AI regulations in selected countries/regions

The increasing advancement in AI has led to countries and economic blocs developing differing strategies to regulate the use of AI across different sectors. The following section provides a brief overview of AI regulations in different countries. Table 1 provides a comparison of these policies in terms of the OECD's AI framework.

African Region: The analysis of AI regulations on the African continent found three countries (Egypt, Mauritius, and Rwanda) with clear strategies or a policy on AI. *Egypt:* National Artificial Intelligence Strategy: The key focus areas of this strategy include - Advancing the use of AI in government to improve efficiencies, transparency and decision-making and advancing the use of AI by the public and private sector in the service of development goals; building capacities around AI – education, skills and research–across all generations; and playing a lead role in international and regional cooperation around AI through bilaterals, shared commitments and partnerships (Ministry of ICT, 2021). *Rwanda:* The National AI Policy of Rwanda: The focus areas of Rwanda's AI policy include 21st-century skills & high AI literacy; reliable infrastructure and

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computer capacity; a robust data strategy: trustworthy AI adoption in the public sector; widely beneficial AI adoption in the private sector; and ensuring the ethical use of AI technologies through the development and implementation of clear guidelines and frameworks (Republic of Rwanda, 2023). *Mauritius'* AI strategy was adopted in 2018, motivated by the government's intention to make AI core to achieving the country's development goals. The strategy includes the prioritization of sectors and identification of national projects; skills attraction and capacity building; incentives to catalyse implementation; ethical considerations of AI; development of strategic alliances in emerging technologies, and the adoption of new technologies for improved public services delivery (Government of Mauritius, 2018).

The European Union AI Act 2024: Within the EU's economic bloc, the European Parliament proposed and recently adopted a legal framework on AI that is intended to address its potential risks. The proposed EU AI Act adopts a risk-based approach, with regulations tailored to the technology's risk level. This framework, praised by some key players within the AI industry, aligns with Google's view that outcomes-based regulation protects research while avoiding innovation-stifling oversight (Google, 2024). Like GDPR (the EU's privacy framework), the proposed framework is set to have strict penalties for non-compliance, extra-territorial scope (i.e., an expectation that countries outside the EU that do business within the EU must also follow the framework), and a broad set of mandatory requirements for organisations that develop and deploy AI. The proposed act has the following focus areas: Address risks specifically created by AI applications; define a list of high-risk applications (including, in recent proposals, education); set clear requirements for AI systems for high-risk applications (such as the recent proposal to ban the use of emotion detection in education); define specific obligations for AI users and providers of high-risk applications; propose a conformity assessment before the AI system is put into service or placed on the market; propose enforcement after such an AI system is placed in the market; and propose a governance structure at the European and national level (CoE, 2024).

United States: In 2022, following consultations, the White House published a Blueprint for an AI Bill of Rights to guide the design, deployment, and development of AI systems. The Blueprint is nonbinding and relies on designers, developers and deployers to voluntarily apply the framework to protect US citizens from the risks that can result from the use of AI. The agenda adopted five principles to address these concerns: safe and effective systems, algorithmic discrimination protection, data privacy, notice and explanation, human alternatives consideration, and fallback. Other efforts in the US to regulate AI include the Algorithmic Accountability Act, requiring companies to assess the impact of the automated systems they use and sell in terms of bias and effectiveness White House (n.d.). Despite some degree of bipartisan support, the Algorithmic Accountability Act has thus far repeatedly failed to be passed by the US Congress. Legislatures in various US states have also proposed AI legislation and regulations.

China: In 2022, China passed and enforced three distinct AI regulatory measures at national, regional, and local levels. Drafted by the Cyberspace Administration of China, the Internet Information Service Algorithmic Recommendation Management Provisions (2022) require that providers of AI-based personalized recommendations in mobile applications uphold user rights, including protecting minors from harm and allowing users to select or delete tags about their personal characteristics. Moreover, on 10 January 2023, China's Deep Synthesis Provisions came into effect. The regulation creates rules for every stage, from creation to labelling to dissemination, leaving room for the potential suppression of organically captured content as well. Further, in April 2023, in response to the fast growth in the popularity and use of AI chatbots such as ChatGPT, The Chinese Government introduced Measures for the Management of Generative Artificial Intelligence Services. The regulation puts more emphasis on the accuracy of text and data used to train and generate models.

UK: While the UK has not yet proposed specific legislation to regulate the use of AI, the UK government has demonstrated its support for the regulation of AI systems through a series of policy papers, frameworks, and strategies. For instance, the Department for Business, Energy & Industrial Strategy and Office for Artificial Intelligence jointly released a policy paper on 18 July 2022 titled 'Establishing a pro-innovation approach to regulating AI'. Four principles underpin the framework: 1) Context-specific – AI should be regulated based on its use and impact, with responsibility for designing and implementing proportionate regulatory responses delegated to regulators; 2) Pro-innovation and risk-based – regulators will focus on high-risk concerns over hypothetical or low risks to encourage innovation and limit barriers; 3) Coherence – a set of cross-sectoral principles tailored to the characteristics of AI will be established, and regulators will interpret, prioritise and implement them within their sectors and domains; and 4) Proportionate and adaptable – cross-sectoral principles will initially be set out on a non-statutory basis to allow for a dynamic approach to regulation (United Kingdom Government, 2022; Holistic AI, 2023).

Canada: Through the Pan-Canadian AI Strategy, the Government of Canada is investing in efforts to drive the adoption of AI across Canada's economy. The strategy has three pillars: commercialisation, standards, talent, and research (Government of Canada, 2023).

Japan: The main regulatory strategy in Japan is the social principles of human-centric AI, developed with the goal of maximizing AI's positive impact on society rather than suppressing it out of overestimated risks. The emphasis is on a risk-

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based, agile, and multi-stakeholder process rather than a one-size-fits-all obligation or prohibition. Japan's approach provides important insights into global trends in AI regulation. The Social Principles set forth seven principles surrounding AI: 1) human-centric; 2) education/literacy; 3) privacy protection; 4) ensuring security; 5) fair competition; 6) fairness, accountability, and transparency; and 7) innovation (Government of Japan, 2023).

United Arab Emirates Strategy for AI (2031) has eight strategic objectives, namely: 1) Building a reputation as an AI destination; 2) increasing UAE's competitive assets in priority sectors; 3) developing a fertile ecosystem for AI; 4) adopting AI across customer services to improve lives and government; 5) attract and train talent for future jobs enabled by AI; 6) bring world-leading research capability to work with target industries; 7) provide the data and supporting infrastructure essential to become a test bed for AI; and 8) ensure strong governance and effective regulation (UAE, 2018).

AI regulations and their alignment with OECD's AI system classification framework

In Table 1, a comparison is presented of the different regulations and/or strategies briefly discussed above. As a quick glance at the table indicates, different regulations and strategies cover different dimensions of the OECD's framework, and no country or supra-national body currently covers all five. China and the EU come the closest to comprehensiveness, each covering 4 of the 5. Overall, the AI Model and Task & Output are the least often considered (both are only covered by China and the EU; in addition, the USA considers the AI Model). Overall, tension can be seen across policies between ensuring the ethical use of AI (EU, China, USA) and promoting economic or other forms of benefit (more emphasized in other countries). However, a range of differences are seen between policies and strategies overall.

On the one hand, there is a strong emphasis on the people and environment dimension in the USA, UK, EU, and China, with their AI regulations mainly focusing on the safety and algorithmic discrimination aspects. This focus is possibly motivated by concerns that AI systems may exacerbate a range of inequalities and amplify "bias, marginalization and discrimination against vulnerable or disadvantaged groups (such as women)" (GPAI, 2022), p.4. For example, the US Bill of Rights clearly states its main aim as 'to protect the American public in the age of artificial intelligence', while the EU's proposed AI Act places emphasis on the protection of users' privacy against risks associated with the use of AI systems other than promoting innovation through AI. The same focus is echoed in China's regulations, which target recommendation algorithms for disseminating content, synthetically generated images and video and generative AI systems like OpenAI's ChatGPT. China's rules create new requirements for how algorithms are built and deployed and for what information AI developers must disclose to the government and the public (Sheehan, 2023).

Similarly, data and input, as well as AI models, are a key focus for the EU's proposed Act, as well as for China and the US. The focus on data as a key component in AI regulations is because the impacts of AI systems "depend on what data is used to develop these systems, how that data is processed, and who controls these activities" (GPAI, 2022), p. 7. For example, the proposed European Union Act fully banned AI for biometrics surveillance using sensitive data such as gender, race, ethnicity, citizenship status, religion, political orientation, emotion recognition and predictive policing. Many of these provisions would seem non-controversial to members of the LA and AIED communities. Still, the ban on emotion recognition represents the closing off an area of potential application that is widespread in our field (though more in the USA, China, and Australia than the EU) (Calvo et al., 2015), with preliminary evidence of benefit to learners (DeFalco et al., 2018; D'Mello et al., 2010). China requires users to select or delete tags about their personal characteristics, and for developers to make a filing to China's algorithm registry and pass a security self-assessment. Similar requirements are echoed in the US AI Bill of Rights, which emphasizes the need for users to be protected from abusive data practices via built-in protections and provide users with the agency over how their data is used. Of direct importance to LA, the US AI Bill of Rights rejects continuous surveillance and monitoring in contexts such as education with a view that this might limit rights and disadvantage users. The protective nature of AI regulations in countries like China, the US, and the European Union have strong implications for how LA researchers and technology developers conduct their research and design tools in compliance with such regulations.

On the other hand, the economic dimension of the OECD's framework has been a major focus for countries such as Rwanda, Egypt, the UK, and the United Arab Emirates. For example, Rwanda's AI policy aims at using AI to promote national projects, Egypt aims to advance AI in the public and private sectors to serve development goals, and UAE's AI policy is primarily meant to increase competitive assets (Oloruntade & Omoniyi, 2023). Japan's AI regulation is also more focused on benefits, with more emphasis on using AI to boost social good rather than suppressing AI. Both the UK and Japan's AI regulatory frameworks are pro-innovation with an emphasis in the UK case on asking regulators to focus on high-risk concerns rather than hypothetical or low risks associated with AI. At a regional level, the African Union's draft AI strategy envisages AI "as a catalyst for unprecedented growth and progress in Africa; the need to ensure its use in a responsive manner is of secondary importance"

(Giegerich, 2023), p. 4 (italics added). In this case, AI and strategies in these contexts are more flexible and open to AI innovations, as compared to the stricter and more suppressive regulations seen in the EU and in China, for instance.

Table 1. Summary of the analysed regulations/strategies in accordance with OECD's AI Classification Framework

Country	Regulation/ strategy	OECD's AI classification dimensions				
		People & Planet	**Economic Context**	**Data & Input**	**AI Model**	**Task & Output**
Egypt	National Artificial Intelligence Strategy (Ministry of ICT, 2021)	Not addressed	Advancing AI in the public & and private sectors to serve development goals	Responsible AI deployment through ethical guidelines	Not addressed	Not addressed
Rwanda	The National AI Policy of Rwanda. (Republic of Rwanda Ministry of ICT & Innovation, 2023).	Human-centric AI systems & fostering a skilled workforce capable of harnessing AI's potential	Investing in robust computing infrastructure	Establishing a robust data strategy & practical ethical guideline	Not addressed	Not addressed
Mauritius	Mauritius Artificial Intelligence Strategy (Mauritius Government, 2018)	-Building AI skills and capacities	Use AI to promote national projects	Ethical considerations of AI	Not addressed	Not addressed
Canada	Pan Canadian Artificial Intelligence Strategy & AI & data Act (Government of Canada, 2023)	Protect individuals against serious risks associated with AI systems	Translate research in AI into commercial applications	Not addressed	Not addressed	Not addressed
European Union	The EU AI Act 2024 (European Parliament (June 2024)	Human-centric & trustworthy AI; Protect the health, safety, fundamental rights & democracy from AI's harmful effects	Not addressed	Full ban on AI for biometric surveillance using sensitive data (such as gender, race, ethnicity, citizenship status, religion & political orientation), emotion recognition & predictive policing.	Providers must register their models in the EU database before their release on the EU market. Generative AI systems based on such models, like ChatGPT, must comply with transparency requirements	Generative AI systems, such as CHATGPT must disclose that content was AI-generated.

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UK	The Department for Business, Energy & Industrial AI Strategy/policy paper (United Kingdom Government (2022).	Focus on the impact of AI on individuals	Encourage innovation and limit barriers	Not addressed	Not addressed	Not addressed
USA	AI Bill of Rights (White House, n.d)	-Human alternatives, consideration & fallback -Users should be free from unchecked surveillance	Not addressed	Data search & seizure are subject to legal requirements & judicial oversight; Users should be protected from abusive data practices via built-in protections; Continuous surveillance & monitoring should not be used in education, or other contexts where use is likely to limit rights, opportunities, or access	Algorithmic discrimination protection	Not addressed
Japan	Social Principles of Human-Centric AI (Government of Japan, 2023)	Human-centric AI; education/literacy	Innovation	Privacy protection; security; fair competition; and transparency	Not addressed	Not addressed
China	China's Deep Synthesis Provisions 2022 The 2023 draft rules on generative AI. -S NXXYH1 7579.	Protecting minors from harm & allowing users to select or delete tags about their personal data	Not addressed	Training data & model outputs to be true and accurate	Developers filing to China's algorithm registry & pass a security self-assessment	Conspicuous labels to be placed on synthetically generated content.
United Arab Emirates	UAE Strategy for Artificial Intelligence (2031). (Government of the United Arab Emirates, 2023).	AI should deliver the greatest public value by making citizens safer, and healthier and happier	Use AI to increase competitive assets, Train talents;	Provide data and support infrastructure	Not addressed	Not addressed

Discussion

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The first research question sought to establish the state of AI regulations in the selected countries. A discernible pattern emerges within the group of the selected countries. AI policies and strategies within African countries were high level, more focused on economic goals than on establishing specific requirements. This could partly be explained by the unique circumstances and demographics of African countries which call for a customised approach that avoids simply replicating regulations from other parts of the world (Adeleke, 2024), as well as by the different development of the AI industry within Africa. By contrast, the European Union's AI Act seems to be one of the most comprehensive regulations with the potential to become a standard for AI use in much of the world since EU rules tend to be adopted by other countries due to market forces (Bradford, 2020). For instance, GDPR's privacy regulations have significantly impacted the behaviour of educational vendors and universities, even in the United States (Hutt et al., 2023). However, the EU's proposed strategy has been criticised for lacking clarity on some of the issues and definitions used in the proposed act, such as 'personality traits', criticized as being too vague and not definitive enough to guide AI researchers, designers, and users (OECD.AI).

At the same time, while the US AI Bill of Rights is equally comprehensive, it is not explicit about penalties, which means that the protections suggested in the bill require new laws and policies. In this regard, unlike the EU Law, it is unlikely that the US AI Bill of Rights will become more than a voluntary framework, although it may influence the laws and regulations being proposed in the US Congress and at the state level. Canada's draft AI Bill prioritizes AI as a technology, emphasizing risk minimization and transparency rather than banning AI applications. Developers must ensure compliance with anti-discrimination laws and clarity in decision-making processes (Government of Canada, 2023).

Overall, the analysis of existing AI regulations showed that most surveyed countries actively work to establish task forces to create and update AI policies. As Wheeler (2023) notes, current "regulatory statutes and structures available to the government today were built on industrial era assumptions that have already been outpaced by the first decades of the digital platform era". Thus, most existing regulations are seen as insufficient to deal with the pace of AI development. For example, even though China had an AI regulation from 2022, on 10 January 2023, China's Deep Synthesis Provisions became part of the government's efforts to strengthen its supervision over deep synthesis technologies and services. The rapid pace of technological development implies that AI strategies and regulations should be designed with high flexibility to deal with the evolving AI changes. However, whether policies are designed to be flexible, the developers of AIED and LA systems will need to be ready for some rapid shifts in policy and regulation.

The second research question sought to establish how the existing guidelines align with the five dimensions of OECD's classification framework of AI systems. The analysis showed that there is considerable variation when it comes to the focus areas of the different AI regulations across different countries and economic blocs, with two core goals in conflict across the policies as a set: ensuring ethical use of AI (EU, China, USA) and promoting benefits, economic or otherwise (more emphasized in other countries).

Implications of AI regulations for the design and use of AI-driven LA systems

The third research question sought to highlight the implications of existing (and possible future) AI regulations for the design and use of AI-driven LA systems. Based on the analysis, we draw the following implications.

Data use: The strict guidelines on the use of AI technologies such as AI-powered sensors (e.g., Biometric, video monitoring, and audio recognition) set by regulations and policies in China, the US, and EU pose serious challenges to AI and LA researchers regarding the nature of data to use and how to analyse and report. In this regard, the nature of data collected and used in LA-AI research (e.g., multimodal LA) should be carefully thought through – forms of data that are considered acceptable today may become infeasible tomorrow, suggesting that it is important to think carefully about what data is truly necessary (KD, 2022). Indeed, the rapid disappearance of much of the educational technology sector in China – formerly a prominent part of the industrial tracks at related conferences such as EDM and AIED–after recent changes in educational policy suggest that careful consideration of possible future changes in policy is warranted.

Moreover, given the different regulations across the world, researchers and developers should be careful when transferring data across different jurisdictions and carefully assess privacy risks in different contexts. Different policies in different countries can provide considerable process complications for learning platforms, which are global in scope (Hutt et al., 2023). However, even though AI regulations such as the EU act are strict about what data can be used, the same regulations also recognise the need for human-centred and trustable AI systems, yet, for this to be achieved, there is a need for AI research and

development (Baum et al., 2023). This implies that there is a need to find ways in which AI research can still be done within the regulatory boundaries of existing regulations. For example, there is a provision in the EU's proposed framework that allows AI researchers to leverage regulatory sandboxes (e.g., Europe's first regulatory sandbox was the Norwegian Data Protection Agency's Regulatory Sandbox for Responsible AI, which in their first round addressed an LA-AI project (AVT, 2022). Open source can also be a challenge, as EU policy frameworks have at times offered exemptions for research activities conducted under open-source licences, and at other times have proposed penalties for the developers of open-source software, even if those developers are outside the EU, if any of the eventual uses of the software are not in compliance with EU regulations. Knowing exactly what is allowed is essential for LA and AI researchers and technology developers, to avoid making mistakes that negatively impact their core mission of supporting learners.

Human-centric and trustworthy AI: A common theme in selected AI regulations and policies analysed is the need to design and use AI tools with humans at the centre. The intention is to avoid harming or disadvantaging the users through transparent and explainable models. In predictive analytics, for example, many have argued for AI-empowered LA tools to be designed to advance equity rather than amplify current biases (Cachat-Rosset & Klarsfeld, 2023; Williamson, 2023). One potential approach involves stakeholders (users, human rights activists, designers, etc.) in the design process to ensure that the designed tools align with users' needs and protect human rights, as recommended in (Baker & Hawn, 2022). Within the LA field, there are already efforts to design human-centred LA tools (Buckingham Shum et al., 2019) with lessons that can be leveraged for AI-driven research. However, these practices are not always used, and this goal is not always achieved. For example, a recent study investigating the landscape of AI policies and use in Southern Africa reported that little information was available on how broader stakeholders were involved in developing and reviewing AI technologies (UNESCO, 2023). Meanwhile, even though human intervention can increase accountability of AI systems, this should be done with caution since humans can also reduce the accuracy of results by introducing errors, depending on the context of use (Google, 2024).

Addressing the risks, threats, and privacy challenges of AI in Learning Analytics: Across the different AI regulations covered in this paper, the issue of privacy is central. It is widely agreed that AI systems used in research and development must not leak sensitive and personal data. Automated systems should be designed and built with privacy protected by default. Privacy risks should be assessed throughout the development cycle of LA and AI tools, including privacy risks from reidentification and appropriate technical and policy mitigation measures to protect direct and indirect users of the AI systems. At the same time, consideration of the benefits to learners from appropriate use of their data, and the risks of over-redacting (such as making it impossible to find and fix algorithmic bias) should not be forgotten (Baker, 2023). Discussions within the LA community increasingly focus on how to mitigate the potential risks AI poses to the field. This paper contributes to these discussions by identifying how evolving AI regulations can either support or constrain LA research. By mapping AI governance landscapes across multiple jurisdictions, this work highlights key areas where LA researchers and practitioners must remain vigilant. For example, AI-powered analytics systems must be designed to align with ethical and legal standards while maintaining their ability to provide actionable insights into student learning and behavior. For example, privacy has emerged as a central concern across different AI regulations covered in this paper. In areas such as the EU, existing regulations such as GDPR already provide guidelines for using personal data and require projects receiving funding to provide data management plans addressing privacy and data security issues, which is also relevant to AI applications. Given the global nature of many contemporary learning platforms, these policies can also impact developers and researchers outside the EU. AI-driven LA systems must prioritize privacy-preserving approaches, ensuring that sensitive student and institutional data are safeguarded against misuse. Researchers and developers should consider privacy risks at every stage of the LA system development cycle, incorporating privacy-by-design principles and adhering to data protection requirements such as GDPR and other regional laws. Privacy-preserving analytics approaches, such as federated learning and differential privacy, could play a crucial role in ensuring compliance while enabling meaningful analysis. Furthermore, institutions must ensure that AI-based LA tools are transparent and accountable to avoid perpetuating biases and unethical practices in student assessment and monitoring.

Strategic adaptation in LA research and practice: The evolving regulatory environment necessitates strategic adaptation in LA research and practice. Our findings align with prior research, such as Huang et al. (2024), which underscores the growing complexity of AI governance frameworks worldwide. They highlight how AI regulations are increasingly shaped by geopolitical influences and the role of international coordination efforts. This paper highlights the need for researchers to anticipate regulatory shifts and develop methodologies that align with existing and emerging AI policies. Practitioners must stay informed about AI governance developments to ensure their systems remain legally compliant while effectively supporting student learning. Institutions and researchers should engage with policymakers to shape regulations that balance ethical considerations with innovation. Open dialogue between LA stakeholders and regulatory bodies will be critical in ensuring that AI-driven LA

continues to advance in responsible and impactful ways. The evolving regulatory environment necessitates strategic adaptation in LA research and practice. This paper highlights the need for researchers to anticipate regulatory shifts and develop methodologies that align with existing and emerging AI policies. Practitioners must stay informed about AI governance developments to ensure their systems remain legally compliant while effectively supporting student learning. Institutions and researchers should engage with policymakers to shape regulations that balance ethical considerations with innovation. Open dialogue between LA stakeholders and regulatory bodies will be critical in ensuring that AI-driven learning analytics continues to advance in responsible and impactful ways.

Balancing AI Regulations with Potential Benefits for Learning Analytics: One element discussed in many of the regulations is the potential benefit, both economic and social, from AI. While regulations often focus on risk mitigation, it is crucial to acknowledge the transformative potential AI holds for LA and education more broadly. Many governments see the potential educational benefits of AI and are funding research into those benefits with one hand even as they write regulations to limit the use of AI with the other hand. It is our responsibility as ethical experts in LA and AIED to help the makers and implementers of policy to understand the trade-offs of specific regulations as they are proposed, by commenting on draft policies and making ourselves available for conversation and dialogue where possible. Striking a balance between regulation and innovation is necessary to ensure that AI can continue to improve learning experiences while remaining ethically sound and legally compliant. Moreover, Veale et al. (2023) emphasize that AI governance structures are shaped by a complex interplay of national security concerns, corporate influence, and human rights considerations. These competing priorities suggest that policymakers in education must engage proactively with AI regulatory frameworks to ensure that LA remains effective and ethically grounded. The goal of using AI in education is to benefit learners (Slade & Prinsloo, 2013), and that is a focus that we cannot let ourselves forget amidst the challenges and stresses of adapting our practices to changing regulations.

Policy considerations at national and institutional levels: AI and LA policymakers at both national and institutional levels must be mindful of how emerging AI regulations can impact the field of LA Regulations designed for broader AI governance may have unintended consequences for LA research, limiting the types of analyses that can be conducted and the technologies that can be integrated into educational settings. Institutions must proactively develop policies that align with national regulations while ensuring that LA research and practice can continue to provide meaningful insights. For example, the EU AI Act has introduced restrictions on certain AI applications in education, such as emotion recognition, which may impact some LA-driven interventions. As regulations shift, institutions must work closely with researchers and developers to navigate compliance challenges. Additionally, global AI governance is increasingly shaped by regulatory contestation between industry and state actors (Veale et al., 2023). As a result, LA institutions must critically engage with regulatory debates to ensure that AI policies align with educational objectives rather than being dictated solely by commercial interests.

Limitations

While this study provides valuable insights into AI regulations and their implications for AI-driven LA systems, some limitations should be acknowledged. The research attempted to capture a core set of relevant policies at the national and supra-national level based on careful consideration of factors such as the relationship between EU-level policy and individual EU country policies. However, it is possible that some relevant AI regulations were missed during the search process (due to being in languages not found by our search queries), or that an analysis of some individual countries' policies within the EU would have expanded the breadth of types of policy which we could have discussed. For example, Brazil's Estratégia Brasileira de Inteligência Artificial (Brazilian Strategy for Artificial Intelligence) was not captured by the initial search queries and could not be read by the collaborative research pair. Including a more complete selection of policies would provide a more comprehensive understanding of the AI regulation environment. In addition, the Council of Europe (CoE) survey of member states on AI and Education is currently in press. Once published, it will provide detailed insight into CoE member states work on policy and regulation of AI in general and AI and education but will come out too late to be included in this work. In addition, the evolving nature of AI regulation poses a significant challenge to any survey. AI regulations are subject to frequent updates and revisions, reflecting the rapid advancements in AI technologies and changing societal concerns. Consequently, our analysis did not include the most recent regulations enacted after the study's data cut-off date. This limitation underscores the need for ongoing monitoring of regulatory developments.

In addition, while OECD's AI classification supported the categorisation of the different regulations, this framework was developed to assess AI systems in specific, not all aspects of the broader ecosystem influencing the use of AI. In this regard, no dimensions may capture all aspects important to understanding AI regulations. Lastly, we have provided only concise

summaries of the identified regulations. These summaries may not capture the full complexity and nuances of the regulations, which can vary widely in scope, implementation, and legal intricacies. A more detailed examination of individual regulations could yield deeper insights and implications for LA and AI-driven research. Future research efforts should address these limitations by expanding the scope of countries, providing more detailed regulatory analyses, and staying abreast of the dynamic regulatory landscape in the fast-evolving field of AI.

Conclusion

This study has explored AI regulations in selected countries and regional blocs and their implications for developing and using AI-driven LA systems in a rapidly evolving AI landscape. The findings of this research reveal multifaceted insights into the complex interplay between regulatory frameworks, AI technologies, and the educational landscape. One notable revelation is the emergence of distinct regulatory patterns among the countries examined. While China and the European Union have emerged as pioneers with comprehensive AI regulations, potentially impacting practice in other countries as well, the United States, with its comprehensive AI Bill of Rights, offers an alternative approach that hinges on voluntary compliance. These distinctions underscore the nuanced nature of AI governance, wherein clarity, enforcement mechanisms, and flexibility become focal points in shaping the future of AI utilisation. The alignment of these regulations with the OECD's AI system classification framework also showed divergent priorities. Some global leaders in the AI industry, such as the USA and China, prioritise safety and algorithmic discrimination, aiming to protect users from potential harm. Conversely, other countries like Japan, Rwanda, Egypt, and the United Arab Emirates focus on the potential benefits by looking at AI as a catalyst for national development, thus embracing a more flexible and AI-friendly approach.

The implications drawn from this regulatory landscape are significant for the development and use of AI-driven LA systems. A common thread throughout these regulations is emphasising human-centric and trustworthy AI. Stakeholder engagement emerges as a pivotal strategy to ensure that AI tools align with user needs and produce genuine benefits while safeguarding human rights. Privacy emerges as a central concern, resonating across different jurisdictions, necessitating rigorous protection of sensitive data and the need for ongoing assessments of privacy risks – but also consideration of the potential downsides to an overly stringent focus on privacy. Furthermore, the evolving regulatory environment necessitates agile approaches to research and development. Researchers must strategically leverage regulatory sandboxes and open-source licencing (perhaps) to conduct AI and LA research within the confines of existing regulations, promoting innovation while maintaining compliance. We consider this as critical since the best way to design responsible and trustworthy AI systems and to expose the potential risk of AI is through research. However, as stated by Holmes et al. (2022), "Research must go beyond simple metrics like academic progress to consider the broader impact of an AI tool on learners' cognition, mental health and human rights" (Holmes et al., 2022), p. 128. Furthermore, there needs to be greater emphasis on research beyond the most studied groups, to ensure that AI in education is fair for all.

In summary, the global landscape of AI regulations paints a dynamic picture, with diverse strategies and priorities reflecting the differential societal and economic contexts of each country. The impact of these regulations extends to the field of LA, where ethical and equitable AI-driven systems are envisioned but must develop within the constraints that regulation creates. As we navigate this regulatory terrain as a global research field, the imperative is clear: to design and deploy AI technologies that empower education, protect user rights, and ensure privacy in the pursuit of ethical and effective LA. Whilst the evidence provided in this paper is by no means a complete analysis of all the existing AI regulatory regulations in the world, this snapshot of existing strategies yields implications for LA and AI research. We hope this paper will motivate more comprehensive studies on AI regulations in different jurisdictions and their implications for educational and LA research and practice.

Declaration of Conflicting Interest

Funding

Acknowledgments

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