The Challenges Posed by National Artificial Intelligence Strategies and Policies on Higher Education Institutions

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Abstract. This chapter analyzes the impact of national Artificial Intelligence (AI) strategies and policies on higher education institutions. The comparative analysis includes an exhaustive review of the AI regulatory framework of top leading economies, including the U.S., China, Japan, Germany, the U.K., France, South Korea, the U.A.E., Canada, Israel, Netherlands, and Sweden. The chapter also provides an extensive but summarized literature review of the most relevant AI applications in a long list of professional fields and academic majors. Finally, the chapter discusses the implications of the extensive adoption of AI and the need for higher education institutions to adapt to the most compelling challenge of the Fourth Industrial Revolution: AI. The chapter also provides ample evidence of the urgent need for higher education institutions to include AI curriculum content as a critical factor for their long-term survival. The instruction of AI content in almost all academic majors will prepare future alumnae with the abilities and talent they will need to succeed in the job market.

Keywords: Artificial Intelligence, AI, Higher Education, Fourth Industrial Revolution, Government Policies, Digital revolution, Digital education.

1. Introduction.

The inclusion of Artificial Intelligence (AI) curriculum content in most professional majors offered by Higher Education Institutions (HEIs) worldwide will determine the survival of these institutions over the long term. This technological innovation has evolved quickly, so most universities must include it in most of their academic offer curricula. Those universities that can incorporate AI principles, concepts, and tools in their existing courses will equip future graduates with the skills and knowledge they will need to compete in the job market successfully.

The impact of AI in the world of education has been analyzed by most global organizations, such as the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Office of Economic Cooperation and Development (OECD), the World Bank (WB), etcetera. UNESCO [1] acknowledges that AI has the potential to address several critical challenges in education, including innovative pedagogy and learning experiences, and support the progress towards the sustainable development goal (SDG) 4. This goal aims to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all."^1(p. 1). Indeed, in 2015, all United Nations [2] Member States approved the 2030 Agenda for Sustainable Development as a master plan for global peace and prosperity today and into the future.

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In a working paper for the OECD, Vincent-Lancrin and Vlies [3] summarize the primary academic challenges posed by AI in most countries: reaping the AI-based benefits from enhanced learning experiences in the classroom while preparing students with new skills demanded by increasingly automated communities and economies. They assert that while the past decades witnessed innovative computer-based pedagogical approaches and the Internet, the next technological wave with a profound impact in the classroom will be based on AI and its complementing technologies.

The WB has also recognized the value of AI in education. Indeed, the WB [4] reports that the Ecuadorian Ministry of Higher Education, Science, Technology, and Innovation, with the WB funding, began providing AI-based academic support with large-scale, low-cost match remediation programs for Ecuadorian higher education students. The WB-backed program has supported more than 14,000 students since January 2021. The program has assisted in more than 400 courses from different academic study programs. At the beginning of the program, students could only master 25 percent of the matching content they needed to succeed. After using the AI-based platform for 16 consecutive weeks, they could master 68.7 percent of the same content, equivalent to approximately the content material students would learn after a full year of schooling.

The economic and social challenges associated with adopting AI have implications for HEIs worldwide. Indeed, in a working paper for the IMF, Korinek, Schindler, and Stiglitz [5] alerted about AI's potential for labor-saving and the resulting global inequality and poverty. They also warn that this technology may result in a winner-takes-all dynamic that favors highly skilled workers and nations at the forefront of technological AI adoption and innovation. This rationale would explain most developed countries' urgency in adopting AI national strategies and policies, summarized below.

2. Proposed Methodology

2.1 Scoping Review Methodology

In this research, we employ a scoping review approach to delve into the influence of national AI strategies and policies on tertiary educational establishments. A scoping review is a knowledge aggregation tool, targeting preliminary research inquiries to chart pivotal concepts, evidence categories, and research voids in a specific domain by methodically gathering, filtering, and amalgamating extant knowledge [6]. Given the potential applicability of diverse research models, such an approach proves invaluable when dealing with intricate or nascent evidence, like the effects of national AI blueprints on universities.

Our scoping review approach adheres to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) extension for Scoping Reviews (PRISMA-ScR) [7]. This structure ensures a meticulous and transparent scoping review process, guaranteeing the outcomes' repeatability and dependability.

The scoping review is apt for this research, offering a panoramic view of AI national blueprints' repercussions on universities. It facilitates pinpointing primary data sources and evidence types, scrutinizing the research methodologies employed in this domain, and grasping the salient discoveries. Furthermore, it aids in spotting lacunae in current literature, shaping potential research trajectories.

We systematically trawl various databases to collate pertinent literature, ensuring an exhaustive evidence review. Our search blueprint is tailored to address the research query, amalgamating specific keywords and Boolean logic to encompass all relevant research. We scour databases like PubMed, Web of Science, IEEE Xplore, Scopus, Google Scholar, ACM Digital

Library, ScienceDirect, JSTOR, ProQuest, SpringerLink, EBSCOhost, ERIC, and more. Our sources span peer-reviewed papers, official reports, and grey literature.

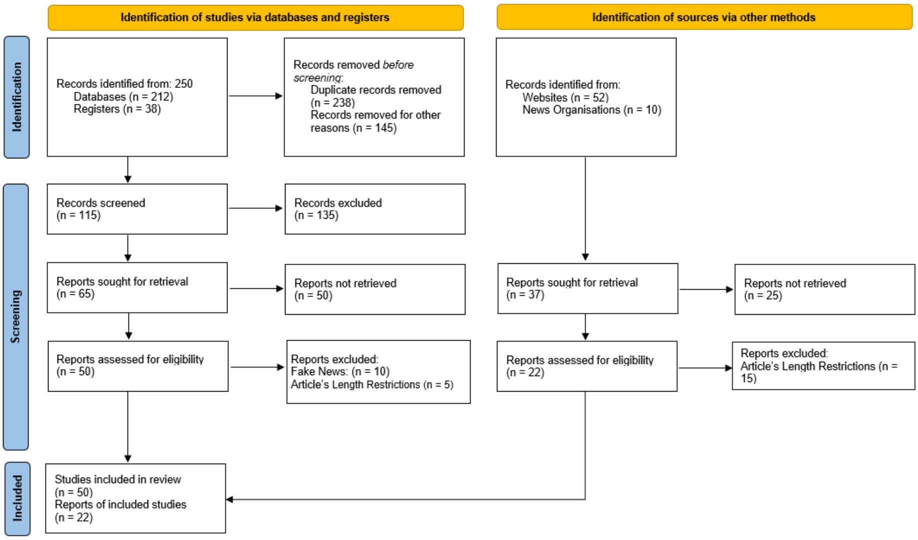
Our search methodology is dynamic, undergoing fine-tuning as new relevant research surfaces. Manually perusing the bibliographies of chosen studies further complements our search, along with relevant reviews, ensuring no pivotal studies slip through the cracks.

Diagram 1 elucidates our article curation process, highlighting initial pinpointing, title and abstract-based omissions, and subsequent exclusions after a comprehensive text review. It also highlights the final tally of articles incorporated into our analysis and the exclusion logic at each juncture.

In the first phase, labeled as 'Identification of sources via other methods,' we identified 80 records, which included 52 from various websites and ten from news organizations. Out of these, we aimed to retrieve 37 papers, while the remaining 25 were disregarded, as they needed to meet the inclusion criteria. We successfully retrieved 37 records, and after assessing their eligibility, we excluded 15 due to the constraints of article length, resulting in 22 articles being incorporated into the review.

In the second phase, 'Identification of studies via databases and registers,' we initially identified 250 sources, with 212 documents from various databases and 38 records from registers. Before the screening process, we eliminated 383 papers: 238 due to duplication and 145 for miscellaneous reasons. This left us with 115 documents for screening and 135 excluded, as they needed to meet the inclusion criteria. We aimed to retrieve 115 papers post-screening, but 50 were not recovered due to the exclusion criteria. We assessed the eligibility of the remaining 65 records, and 15 were excluded: 10 were identified as misinformation, and five were excluded due to the article's length restrictions. This led to the inclusion of 50 articles from the databases & registers and 22 from alternative sources, resulting in 72 secondary sources for our analysis.

Diagram 1: PRISMA flow diagram



Source: [8]. For more information, visit: http://www.prisma-statement.org/

After pinpointing the pertinent literature, it undergoes thorough analysis and amalgamation to address the research inquiry. This step encompasses gleaning information from the selected studies capturing aspects like study attributes, methodologies, and pivotal outcomes. A structured and pre-set data extraction template steers this process, ensuring uniformity.

Subsequently, the collated data is consolidated to present a summary of the evidence. Depending on the evidence's character, this consolidation might encompass a descriptive narrative of the results, thematic scrutiny, or an amalgamation of the two. This unified view sheds light on the ramifications of national AI blueprints on tertiary educational establishments.

The scoping review approach offers a meticulous and structured pathway to probe into greenwashing within sustainable finance. It paves the way for a holistic and profound grasp of the subject, enriching both theoretical and practical dimensions.

2.2 Literature Review

This section intends to provide a brief overview of AI adoption in many professional fields to demonstrate the interdisciplinary nature of AI and its value in almost all academic disciplines. This section provides a summarized list of examples of professional areas where AI has resulted in practical applications. The total of professional fields implementing AI-based solutions is too extensive to be documented in a single chapter. The primary purpose of this chapter is to display several examples of the rapid adoption of AI applications in many professional areas as evidence of the urgent need for HEIs to incorporate IA content into their current curricula. Such examples include Lin *et al.* [9], who describe the value of teaching economics with AI-based robotic players using the Ultimatum Game application. Similarly, Kumar and Tomar [10] describe how AI can support space exploration with applications that can help in every aspect of human space settlement. Likewise, Chan *et al.* [11] explain how AI can help to develop new pharmaceutical products quicker, cheaper, and more effectively.

The benefits of AI in the medical sciences have been documented in numerous academic articles. Examples include Hamet and Tremblay [12], who highlight the application of AI in medical sciences, particularly in the areas of medical diagnosis & statistics. They confirm the value of AI in areas like health management control systems, including digital health records and active support of physicians' treatment decisions. Similarly, Amisha *et al.* [13] explain the value of AI in radiology by assessing abnormal tests and analyzing negative exams in X-rays, computerized tomography, and magnetic resonance images. Likewise, Mintz and Brodie [14] describe the benefits of AI in medical sciences, particularly in radiological & pathology pictures, including the patient's electronic medical records, which constitute a valuable help in the diagnosis & treatment process by enhancing physicians' capabilities.

In the same way, Sit *et al.* [15] studied the attitudes of UK medical students regarding AI by analyzing 484 survey responses from 19 UK medical schools. They found that 80 percent of students considered AI critical in the healthcare industry, and 89 percent believed that learning AI would benefit them professionally. They also found that 78% agreed that students should receive training in AI as an essential part of their medical degree.

AI course content for K-12 students has been implemented in many schools worldwide. Indeed, Williams *et al.* [16] suggest designing and assessing curricula to teach AI aimed at Pre-K and Kindergarten children based on learning companion social robots and programmable artifacts. Similarly, Sabuncuoglu [17] proposed a 36-week open-source AI curriculum for middle school education to provide interdisciplinary connections. Examples of the urgent need for early AI education and training include the University of Florida's [18] K-12 AI education program to train the Floridian youth for the increasing demand for an AI-enabled workforce. This initiative was complemented by the Florida Department of Education's three-year AI Foundations program to be implemented in three Florida school districts during fall 2022 after delivering specialized AI training to schoolteachers. Similarly, Tedre *et al.* [19] summarize IA-related initiatives like Machine Learning (ML) for middle school students using Google's Teachable Machine 2, Wolfram Programming Lab, and the IBM Watson-based ML for Kids.

The use of AI in teaching modern languages has been popularized in both the academic and the corporate world. Namatherdhala *et al.* [20] mention the case of Jasper, an AI-based platform aimed at helping marketers write top-quality content quickly. Similar services include Grammarly, an AI-based application for spelling and grammar checking to improve writing skills.

The branches of engineering are extensive, so analyzing the multiple AI applications in all of them would require a comprehensive effort beyond the scope of this chapter. One of the initial efforts to document the impact of AI in the engineering field includes Pham and Pham [21]. They study some AI tools used in engineering, including fuzzy logic, neural networks, inductive learning, genetic algorithms, and knowledge-based systems. Similarly, Lu *et al.* [22] summarize the most significant AI applications in civil engineering, including expert systems, evolutionary computation, firefly algorithm, chaos theory, simulated annealing, etc. Likewise, Khalid [23] provides information about AI applications in electrical engineering, including swarm intelligence, image processing, fuzzy optimization, etc.

Equally, Patel *et al.* [24] report some technologies used in mechanical engineering, like convolutional neural networks, artificial neural networks, fuzzy logic, etcetera, aimed to control process planning & parameters, machining, optimization, and quality control, among others. Correspondingly, Park *et al.* [25] provide an overview of AI applications in biomedical engineering, including k nearest-neighbors, linear discriminant analysis, regression trees, Naïve Bayes, support vector machine, etcetera. In the same way, Venkatasubramanian [26] provides a review of AI applications in chemical engineering, including organic photovoltaic & crystalline alloy designs [27], nanoparticle assembly & packing [28], shape memory alloy designs [29].

The impact of AI in Accounting and Finance is at its early stages, although leading financial institutions have already obtained significant benefits, particularly in fraud prevention and detection. Indeed, [30] lists some benefits of AI-related technologies in the financial industry sector, including reduced credit score bias, enhanced fraud detection, and improved measurement and monitoring of lending systemic risk and financial markets' risk & volatility. The benefits include compelling client risk profile matching for automated financial advising, enhanced detection of illegal activities in crypto markets like money laundry and deceitful initial coin offerings, superior control of cyber risks, etc. Likewise, Dempere *et al.* [31] show the forecasting value of ML techniques estimating crypto asset values.

The number of AI-based solutions in chemistry has been extensive, particularly in drug design processes. This significant impact is verified by developing a discipline of its own: chemoinformatics. This term was initially proposed by Brown [32], who coined the term to refer to the mix of information resources and molecular design tools to transform chemical data into knowledge for improved decision-making processes to identify the best-fitting compounds for drug identification and optimization. Indeed, Brown *et al.* [33] describe some valuable AI-based technologies in the toolbox of chemoinformatics, like convolutional neural nets, deep neural nets, and recurrent neural nets.

In the same way, Hassoun *et al.* [34] provide a review of the most significant AI-based solutions applied in the biological sciences. These AI applications include statistical learning for analyzing biological imagery [35], genome analysis [36], biomedicine [37], bioacoustics data [38], etcetera.

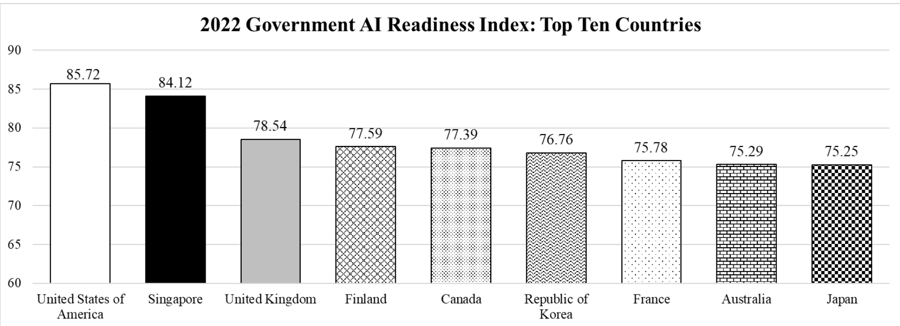
Similarly, Svenmarck *et al.* [39] describe how AI can be implemented for military applications for cyber security, reconnaissance, intelligence analysis, surveillance, command and control, etc. Equally, Shmelova *et al.* [40] explain how AI-based applications like Expert Systems and Decision Support Systems can enhance aviation security by supporting the decisions of crewless and crewed aircraft pilots, air traffic controllers, engineers, etcetera. Correspondingly, Woschank *et al.* [41] analyze the literature review on AI, ML, and deep learning solutions applied to Smart Logistics and conclude that the growing interest from managers and practitioners from logistics companies in these applications face the challenge of lack of knowledge and information of these topics.

Similarly, Yaqiong *et al.* [42] provide a comprehensive literature review on using fuzzy theory in quality management. Additionally, Yussupova *et al.* [43] explain how AI-related techniques like text mining, sentiment analysis, data mining, and ML can assess customer satisfaction in a quality management system. Finally, Marr [44] predicts that AI will bring quantum changes in marketing, forcing practitioners to become knowledgeable on AI and related technologies. Indeed, the significant impact in the marketing field can be verified in the work of Verma *et al.* [45]. They analyzed a comprehensive literature review of 1,580 academic articles on AI in marketing between 1982 and 2020.

The list of examples above is a partial one. Examples of many more disciplines using and adopting AI could not be provided due to the length restrictions of this chapter.

3. Results and Discussions

Chart 1 below shows the top 9 countries in the 2022 Government AI Readiness Index compiled by Oxford Insights [46]. This British consultancy firm advises organizations and governments on digital transformation's strategic, cultural, and leadership opportunities. The index ranks 160 nations by how prepared their governments are to use AI in public services.



The 2022 Government AI Readiness Index shows that 30% of the ranked countries have already published a national AI strategy, while 9% are working on one. This result suggests that

AI has become a top priority for leaders worldwide. The educational component of some of the national AI strategies of leading economies is summarized below.

3.1 United States

Parker [47] discusses the American AI Initiative (AAII) scope. One of the critical policies of the AAII is related to the educational sector. Indeed, the AAII emphasizes the implementation of apprenticeships, skills programs, and education in science, technology, engineering, and mathematics (STEM) disciplines, emphasizing computer science, which will allow American workers to take advantage of those professional opportunities associated with the adoption of AI. Additionally, the National Science Foundation [48] announced the National AI Research Institutes program endowed with $120 million in research funds to advance AI research and develop national nexus points for universities, federal agencies, industries, and non-for-profits organizations.

3.2 China

The Ministry of Education of the People's Republic of China [49] informed about the AI Innovation Action Plan for Chinese HEIs. In the plan, the ministry encourages HEIs to engage in cutting-edge and forward-looking research, provide training in the AI field, and provide strategic support for developing the next AI generation. Similarly, the ministry acknowledges that innovative AI-based applications have been accelerated recently and urges HEIs to adopt intelligent technologies to deliver creative new ways of training, revolutionize teaching methods, enhance academic management, and build an innovative, networked, personalized, lifelong education system. These efforts aim to provide China with a first-mover advantage in the development of AI and put innovation at the center of AI developments in Chinese colleges and universities. The ambitious goals set by the ministry include the following:

- By 2025, a significant improvement in scientific and technological innovation and training quality in the new AI generation will be measured by numerous original achievements of international significance and adequate support for upgrading national industries, transforming the economy, and building an intelligent society.
- By 2030, colleges and universities will provide the scientific and technological support to place China at the forefront of innovation-oriented countries through the world's main AI innovation centers that will lead the development of a new generation of AI human resources.

3.3 Japan

According to Japan's AI 2022 strategy, developed by the Government of Japan's Secretariat of Science, Technology and Innovation Policy Cabinet Office [50], one of the strategic goals to achieve is educational reform through the Mathematics, Data Science, and AI Education Program Certification System. According to the University Journal Online [51], the Japanese National Institute of Technology informs that 33 Japanese national technical colleges will be certified in 2022. According to the Japanese AI strategy, all university and technical college students must acquire a minimum basic knowledge and skills in mathematics, data sciences, and AI regardless of their concentrations in humanities or sciences.

3.4 Germany

In 2018, the Federal Government of Germany [52] launched its National AI Strategy to achieve three strategic goals: making Germany and Europe leading AI centers, ensuring responsible AI development and deployment, and guaranteeing an IA social integration in ethical, legal, cultural, and institutional terms. The German Federal Government estimates to provide financial support of about €3 billion during 2019-2025. The critical component of the strategy comprises policy reforms and programs of formal AI training and education with an emphasis on the formation of teachers. Additionally, the federal government will try to expand and upgrade the AI-related knowledge and skills of the existing German workforce. These efforts comprise the creation of the National Skills Strategy to promote advanced vocational AI-related training, including the Mittelstand 4.0 SMEs centers of excellence, which will have AI trainers' contact for at least 1,000 companies per year. These efforts also include the organization of regional Centers of Excellence for Labor Research studying human labor in an AI working environment.

3.5 United Kingdom

In September 2021, the Government of the United Kingdom [53] launched the first National AI Strategy as a ten-year plan to make the UK a global AI superpower. Indeed, Stacey [54] informs that the program intends to develop the next generation of AI human resources through continuous support for postgraduate learning, existing workforce retraining, and accessibility of specialist courses for children from different backgrounds. The plan also encompasses the development of a national AI research and innovation program aimed at improving collaboration and coordination among UK researchers. The goal is to help transform the UK's AI capabilities while enhancing the adoption of AI technologies in the private and public sectors.

3.6 France

The European Commission [55] informs that in 2018, the Government of France disclosed a French AI strategy to achieve several strategic goals, including enhancing the French AI education and training ecosystem to attract, develop, and retain world-class AI human capital. The strategy contemplates providing financial incentives to higher education and research institutions to improve AI training at all levels, intermediate and expert, dual programs, and retraining or upgrading talent. The country has doubled the number of graduates at the AI Master's level since 2016, with a significant increase in the available AI training courses in full and part-time continuing education on traditional and executive programs. The strategy encourages French citizens to improve their digital literacy skills to understand computers' inner workings and AI's benefits. Similarly, the strategy looks for the organization of a public laboratory on the labor transformation to promote research on how automation will change occupations and suggestions of support for professional transitions.

3.7 Republic of Korea

In December 2019, the Government of Korea [56] launched the National Strategy for AI. The strategy acknowledges that Korea faces a significant shortage of AI human capital compared to other countries. This deficit will expand due to the increasing demand for AI talent in the private sector. The strategy calls for the government to secure an educational system that allows human skills in AI to grow by offering an interdisciplinary AI curriculum. Similarly, the plan contemplates that the government will expand the current Korean education programs by life cycle and job type through a school system reform focused on AI that can provide digital literacy for all people. The strategy also calls for designing channels to nurture AI professionals and talents with short-term intensive academic curricula and industry-specific customized programs. The plan calls for easing academic regulations to foster the creation and offering of interdisciplinary majors between AI and other professional disciplines. The strategy also contemplates including AI essential literacy learning content for all military personnel and the mandatory requirement of AI literacy education for new and promoted public sector officers.

Yea-Ji and Hana [57] assert that the Korean AI Strategy looks to build the most competitive AI chip industry worldwide by securing the advancement of critical semiconductor technologies and investing in processing-in-memory chips. This strategy contemplates adopting software and AI courses as part of the mandatory curriculum in elementary and middle school. Additionally, the plan requires teachers and civil servants to take AI training before hiring. Similarly, the strategy contemplates allowing the public to get the chance to learn about AI through online and offline courses as part of a lifelong learning process. The program also includes an investment of KRM 300 billion in the AI startup sector and organizing an AI Olympics event.

3.8 United Arab Emirates

According to the National Program for AI [58], the UAE National Strategy for AI 2031 encompasses a series of initiatives to attract and train AI talent. The strategy contemplates free AI courses for all UAE residents to enhance awareness and understanding of AI technologies. The plan also considers educational programs like the AI Internship Program in partnership with Dell Technologies, which provides Emirati students with intensive training to obtain a Data Engineering and Cloud diploma from Dell. Another initiative included in the strategy is the AI Summer Camp. According to the Emirates News Agency [59], this program allows high school and university students to complete AI-based practical & theoretical workshops.

The Emirati AI Strategy also aims to upskill STEM graduates with specialized training courses as the optimal short-term alternative to satisfy the increasing demand for AI experts. This upskilling program will allow students to enroll in postgraduate AI training programs and expand the AI pool of Emirati talent in AI systems. The UAE AI strategy also calls for specialized AI training for government employees to have 100% of senior government leaders trained and knowledgeable in AI. In October 2022, McCormick [60] informed that Hewlett Packard Enterprise announced the development of a new supercomputer for the Mohamed bin Zayed University of AI. This university is dedicated solely to AI, advancing AI-driven scientific research projects, and contributing to the UAE's goal of becoming a global AI leader.

3.9 Canada

In 2017, the Canadian Institute for Advanced Research (CIFAR) [61] launched its Pan-Canadian AI Strategy, claiming to be the first in the world. The Canadian AI Strategy has the following vision: "*...by 2030, Canada will have one of the most robust national AI ecosystems in the world, founded upon scientific excellence, high-quality training, and deep talent pools, public-private collaboration, and our strong values of advancing AI technologies to bring positive social, economic and environmental benefits for people and the planet...*"^61(p. 1). Bouchard [62] informed on the Canadian Office of the Minister of Innovation, Science and Industry's launch of the second phase of the Pan-Canadian AI Strategy with a 2021 budget funding including C$60 million for Canada's national AI institutes to support translating AI research into commercial applications. The budget also included C$160 million for CIFAR to fund programs aimed at attracting, retaining, and developing academic research talent to support centers of research, innovation, & education at Canada's AI institutes and C$48 million for CIFAR to finance its advanced research, education, and knowledge mobilization programs.

3.10 Israel

According to Paltieli [63], in May 2018, Israeli Prime Minister Benjamin Netanyahu launched the National Initiative for Secured Intelligent Systems to develop an Israeli National AI strategy. The Initiative led by Prof. Isaac Ben-Israel and Prof. Eviatar Matania resulted in a Special Report to the Prime Minister delivered in 2020. The report includes a layer dedicated to Israel's critical AI infrastructures, with special mention of human talent. At this crucial issue, the strategy suggests investing in academic Data Science and AI, expanding data literacy among K-12 students, implementing AI education in schools, recruiting new faculty members by luring them with more control over intellectual property, and creating new AI research centers. Xinhua [64] informed that Israel launched a national AI and data science program in December 2020 at the cost of 5.26 billion new shekels (1.63 billion U.S. dollars), of which more than 20% will be directed to the Israeli academy.

3.11 Netherlands

In October 2019, the Dutch government launched its strategic action for AI. According to the European Commission [65]. The strategy includes a long list of initiatives to promote AI, notably to support education and AI skills development through AI research and innovation. The Dutch strategy advocates for education and training reforms backed by policies that increase digital literacy in primary and secondary education. Similarly, the strategy advocates providing educational opportunities to learn AI skills and competencies in data science among Dutch HEIs. The strategy also offers national AI online training for government workers in the Netherlands. Similarly, the strategy encompasses vocational training initiatives financed by the Regional Investment Fund to support the digital training needs of the Dutch labor market. Likewise, the strategy includes the STAP scheme: a €200 million fund to finance learning opportunities in AI and digital skills for individuals.

3.12 Sweden

In May 2018, the Government Offices of Sweden [66] launched its National Approach to AI strategy. The strategy identifies several priority areas, considering the first and most critical education and training. Indeed, the Swedish acknowledges a lack of human talent with AI expertise in Sweden and worldwide and that this shortage will likely become more severe over time. As a result, the strategy places educating and training a sufficient number of AI professionals as a paramount priority. As a result, the AI strategy encourages Sweden's HEIs to develop appropriate academic offers to meet the digital challenge posed by AI.

The strategy emphasizes that many AI-based practical applications and solutions justify a broader interdisciplinary approach among academic programs. The Swedish AI Strategy states, "*...Interdisciplinary knowledge is crucial in ensuring ethical, safe, secure, and sustainable use of AI. Relevant AI knowledge is not only essential for technical experts but also for leaders, managers, and other professionals who interact with technology...*" (Government Offices of Sweden, 2018, p. 6). In this regard, the European Commission [67] informs that the Swedish AI strategy calls for incorporating a significant AI component in non-technical programs to enhance a broad and responsible understanding of the use of AI. The strategy also calls for continuous lifelong learning opportunities due to AI's evolving nature and rapid development. Finally, the Swedish AI strategy emphasizes the result of a solid basic and applied AI research environment with the active involvement of the industrial and public sectors, research institutions, and the academic world.

The summary of some national strategies, policies, and plans for AI provided above is intended to demonstrate the strategic importance of this technology for most advanced economies worldwide. Such AI-related government policies and initiatives will profoundly affect academia, and only those HEIs capable of adapting quickly to the new environment will remain competitive.

A clear emphasis placed by most analyzed AI strategies, policies, and plans is a need for more human capital with AI knowledge and experience to satisfy the current and forthcoming labor demands. Indeed, Colvin [68] informs of an SAS Analytics report where 36% of U.S. business leaders felt that their organizations have plenty of AI and ML-skilled employees. In comparison, 63% said their human capital's AI abilities were insufficient. This deficit will increase due to domestic and international competition among private and public employers to attract AI talent. This shortfall of trained labor constitutes a colossal opportunity for HEIs to satisfy the explosive demand for education and training in this technology.

Current and future students' quick and extensive technology adoption represents another reason for embracing AI course content in most academic majors. Indeed, Au-Yong-Oliveira *et al.* [69] analyze the social impact of technology on millennials and its consequences for higher education. They conclude that millennials constitute the generation with the most extensive and meaningful interaction with technology compared with previous generations. This significant characteristic is currently affecting students' expectations about the nature of their learning experiences at HEIs. This trend will increase as future generations' dependency on technology grows. Those colleges and universities relying primarily on tuition-related funds will face the challenge of attracting a technologically well-informed generation of students demanding IT content in general and AI content in particular.

Another potential benefit of AI adoption by HEIs relates to their research efforts and associated potential funding opportunities. Indeed, one prevailing model for funding universities is the performance-based research funding system (PRFS), where national governments allocate research funding to universities according to the country's system of research output assessment. Hicks [70] suggests that PRFSs intend to incentive academic research excellence through a research performance-based competition among HEIs that can enhance their prestige and reputation.

The rapid development of an extensive range of AI solutions for almost all professional disciplines constitutes an opportunity for HEIs relying on government research-based funding schemes. Those colleges and universities with faculty capable of engaging in AI-based research projects will reap the regards from an avalanche of funding opportunities associated with the national AI strategies, policies, and initiatives described above. These AI research engagements will enhance the academic prestige and reputation (e.g., citations, h-indexes, etc.) of those institutions that first embrace and adopt AI applications in their teaching and research endeavors. Additionally, those AI-pioneer institutions will rank at the top of the government preference when allocating national funds for research and education.

Alternatively, one of the main challenges posed by the quick adoption of AI technologies in almost all professional disciplines is that HEIs can only upskill their students in AI if their faculty have the appropriate skills and knowledge to achieve this goal. Indeed, Tanveer *et al.* [71] address this challenge as follows: "*...Faculty training is a vital parameter for motivating them to seek guidance from instructional data to trace pedagogy and encourage pervasive use of AI in the classroom...*"^71(p. 9). Those colleges and universities capable of supporting the AI professional development their faculty and staff need will proactively address the challenges of a lack of human capital with AI-related knowledge, skills, and experience.

Finally, AI will affect the curriculum content of most professional disciplines, the way faculty teach, and managers work at HEIs. Popenici and Ken [72] have described the recent impact of AI on HEIs as follows: "…*The possibility to communicate and command computers through thought and wider applications of AI in teaching and learning represent the real technological revolution that will dramatically change the structure of higher education across the world. Personalized learning with a teacherbot, or 'cloud-lecturer,' can be adopted for blended delivery courses or fully online courses. Teacherbots—computing solutions for the administrative part of teaching, dealing mainly with content delivery, basic and administrative feedback, and supervision—are already presenting as a disruptive alternative to traditional teaching assistants*…"^72(p. 9).

4. Conclusion

There is an ongoing debate surrounding the integration of artificial intelligence into education technology. Proponents argue that the incorporation of AI has the potential to significantly enhance the educational experiences of students. They assert that AI can offer personalized learning pathways, adaptive assessments, and immediate feedback tailored to each student's unique needs. Furthermore, AI has the capacity to assist educators by automating administrative tasks, thereby affording them more time to dedicate to delivering high-quality instruction. On the other hand, there are concerns among some individuals regarding the ethical ramifications of an excessive reliance on AI in the realm of education. They express apprehension that an overreliance on AI could supplant crucial aspects of a well-rounded education, such as human interaction and personalized teaching.

It is essential to establish a balance between utilizing AI as an instrument for educational development and ensuring that human connection and individualized attention remain essential components of the learning process. It is undeniable that technology, including AI, has revolutionized education by making it more accessible and efficient. It has the capability to analyze immense quantities of data and customize learning experiences for each individual. Critics contend, however, that relying solely on AI may impede the development of social and emotional skills, as well as limit critical thinking and creativity. As educators increasingly adopt AI, it is essential to continually evaluate and refine its function in the classroom to ensure that it complements rather than replaces the unique contributions of human instructors. By achieving this equilibrium, we can leverage the power of technology while preserving the essential components of a well-rounded education.

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