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Training and Skills Alignment for the AI Generation

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Abstract

As we enter the third decade of the 21st century, new and powerful forces are driving the direction of innovation in the fields such as science, technology and medicine. Digitalization has the potential to spur economic growth, but risks exacerbating inequalities. Artificial Intelligence (AI), automation and other digital general-purpose technologies can spur economic growth when they generate innovation that complements and enhances human productivity. But they risk worsening economic inequality when innovation simply replaces people. They will make certain occupations obsolete and give rise to new ones that require different sets of skills. While they may create leapfrogging opportunities for some less-developed economies, others may miss out due to a lack of large capital investments and the high-skilled labor force necessary for these technologies to thrive. Current research indicates that many high education institutions have yet to form meaningful or robust responses to the changes occurring in the era of AI. It is imperative that high educational institutions, regardless of the context, understand the current and future importance of AI and begin to incorporate AI into their development and planning processes. Forward thinking and, where possible, preemptive action will position education institutions and their graduates to thrive in the AI era and make a positive contribute to economic, social and individual goals. Failure to do so, will have the opposite effect; graduates will be poorly prepared for the labour market and high education institutions as a whole will lose its status, when precisely the opposite is needed. To achieve this objective regardless of where their country currently stands on the AI adoption curve, the article proposes that education institutions should; Research the available AI tools, Integrate AI and related principles into core requirements, Leverage Open Educational Resources (OERs) to educate staff and students on AI, Guarantee the ethical use of AI and student data in the institutions, Capitalize on and create diversity initiatives in technology and Invest in academia-to-industry pathways.

Keywords: Training, Skills, Artificial Intelligence

Introduction

A 2019 report on AI by the World Intellectual Property Organization (WIPO) shows that there has been a boom in the number of scientific papers in the field since the start of the century, followed by an upsurge in patent applications between 2013 and 2016. This could indicate a

switch from theoretical research to the practical application of AI technologies in commercial products and services. The WIPO reckons that the large number of patents in machine learning shows that this is currently the main application field of AI, while deep learning (used, for example, in speech recognition) and neural networks are the fastest-growing technologies. The OECD also attributes recent progress in AI to the development of deep learning using artificial neural networks (WIPO, 2022)

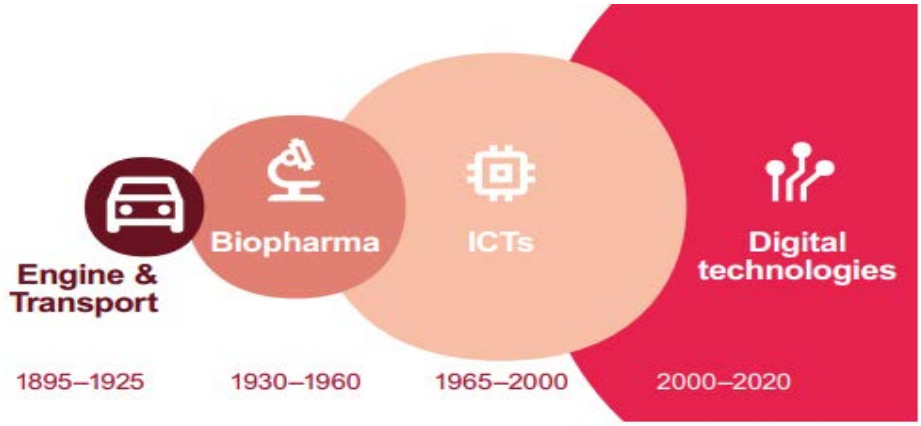

Figure 1: Top growing technological fields in patent filings, 1895-2020

Source: WIPO 2022

The WIPO report 2022 reveals that the largest number of AI-related patents is in areas such as telecommunications, transport, life and medical sciences, and personal devices that compute human–computer interaction. Smart cities, agriculture, e-government, banking and finance are the most dynamically growing areas of AI application. Process industries (such as chemicals) are lagging behind. By 2030 the services industry is to gain the most (21%), with retail and wholesale trade as well as accommodation and food services also expected to see a large boost (15 %).

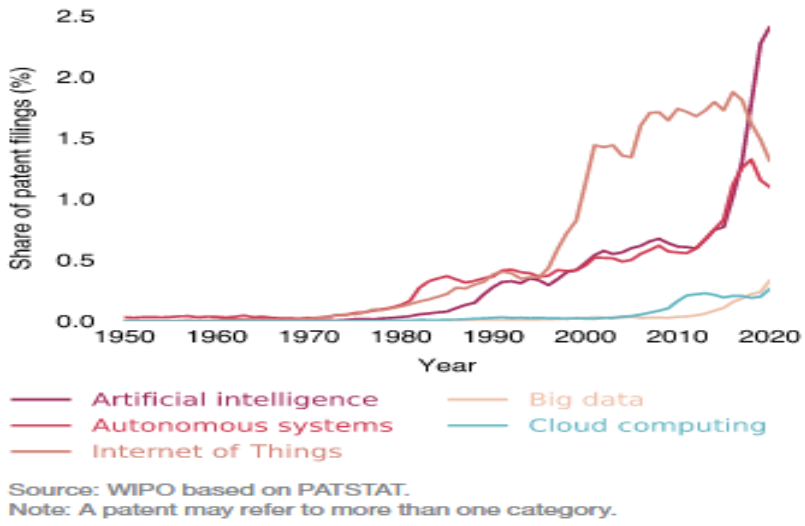

Figure 2: Share of digital general-purpose technologies by category as a percentage of all patent filings

Economic potential of AI

Due to market competition, firms tend to invest in innovation activities that yield the highest payoff in the shortest time. Established firms avoid innovation activities that are risky and uncertain. The majority of studies emphasise that AI will have a significant economic impact. Research launched by consulting company Accenture covering 12 developed economies, which together generate more than 0.5 % of the world's economic output, forecasts that by 2035, AI could double annual global economic growth rates. AI will drive this growth in three important ways;

First, it will lead to a strong increase in labour productivity (by up to 40 %) due to innovative technologies enabling more efficient workforce-related time management. Secondly, AI will create a new virtual workforce – described as 'intelligent automation' – capable of solving problems and self-learning. Third, the economy will also benefit from the diffusion of innovation, which will affect different sectors and create new revenue streams. A study by PricewaterhouseCoopers (PwC) estimates that global GDP may increase by up to 14 % (the equivalent of US$15.7 trillion) by 2030 as a result of the accelerating development and take-up of AI (Szczepanski, 2019). The report anticipates the next wave of digital revolution to be unleashed with the help of the data generated from the Internet of Things (IoT), which is likely to be many times greater than the data generated by the current ‘Internet of People’. It will boost standardisation and consequently automation, as well as enhancing the personalisation of products and services.

PwC sees two main channels through which AI will impact on the global economy; The first involves AI leading to productivity gains in the near term, based on automation of routine tasks, which is likely to affect capital-intensive sectors such as manufacturing and transport. This will include extended use of technologies such as robots and autonomous vehicles. Productivity will also improve due to businesses complementing and assisting their existing workforce with AI technologies.

It will require investing in software, systems and machines based on assisted, autonomous and augmented intelligence; this would not only enable the workforce to perform its tasks better and more efficiently but would also free up time allowing it to focus on more stimulating and higher value-added activities. Automation would partially remove the need for labour input, leading to productivity gains overall. Eventually, the second channel – the availability of personalised and higher-quality AI-enhanced products and services – will become even more important, as this availability is likely to boost consumer demand that would, in turn, generate more data. As PwC puts it: 'in turn, increased consumption creates a virtuous cycle of more data touch points and hence more data, better insights, better products and hence more consumption'. Although the benefits will be felt globally, North America and China are expected to gain the most from AI technology.

The McKinsey Global Institute expects that around 70 % of companies would adopt at least one type of AI technology by 2030, while less than half of large companies would deploy the full range. McKinsey estimates that AI may deliver an additional economic output of around US$13 trillion by 2030, increasing global GDP by about 1.2 % annually. This will mainly come from substitution of labour by automation and increased innovation in products and services. On the other hand, AI is likely to create a shock in labour markets and associated costs needed to manage labour-market transitions; this shock would be incurred as an effect of negative externalities such as loss of domestic consumption due to unemployment.

As a 2018 meta study results shows, there is no consensus among experts, with predictions ranging 'from optimistic to devastating, differing by tens of millions of jobs even when comparing similar time frames'. A forecast by think-tank Bruegel warns that as many as 54% of jobs in the developed countries and abobe 60% in developing countries face the probability or risk of computerisation within 20 years. The effect is likely to be more distincted, and there seems to be a consensus among researchers that there will be significant workforce shifts across sectors of the economy, accompanied by changes in the nature and content of jobs, which would require reskilling.

The disruptive effects of AI may also influence wages, income distribution and economic inequality. Rising demand for high-skilled workers capable of using AI could push their wages up, while many others may face a wage squeeze or unemployment. This could affect even mid-

skilled workers, whose wages may be pushed down by the fact that high-skill workers are not only more productive than them, thanks to the use of AI, but are also able to complete more tasks.

The changes in demand for labour could therefore worsen overall income distribution by affecting overall wages. There are indeed fears that the current trends of shifting the distribution of national income away from labour, which leads to deeper inequality and the concentration of wealth in 'superstar' companies and sectors, will indeed only be exacerbated by AI. AI has significant potential to boost economic growth and productivity, but at the same time it creates equally serious risks of job market polarisation, rising inequality, structural unemployment and emergence of new undesirable industrial structures. A precondition to successfully harness the potential of AI is to develop relevant skills in education and work as well as funding research and pooling resources to deliver true AI added value.

Innovation Ecosystems (Education Players Space)

The direction of innovation is constantly changing. It is influenced by the choices and interactions of public and private stakeholders looking to benefit from innovation. It is this innovation ecosystem that sets the direction of innovation for decades to come. An innovation ecosystem can be defined as the combination of all the stakeholders that make choices influencing innovation-related outcomes and, consequently, the direction of innovation.

Researchers: Curiosity guides researchers to explore new scientific fields and engineers to experiment with new technologies. Scientific institutions can decide to influence the direction of innovation toward given fields by, for example, developing more applied programs to train specialized engineers or by transferring technology to specific industries (Abreu, 2021). Companies: Companies, entrepreneurs, and governments alike identify innovation opportunities based on predictions of potential private and social returns. Industries and companies can decide to invest more intensively in R&D and other innovation generating activities. They do so either to create new technologies or absorb existing ones from other innovation ecosystem stakeholders, such as universities, suppliers, or rival firms (Manyika et al., 2017). Governments: Governments must promote both the social and private returns of innovation. Governments will design policies to influence the provision of public goods related to health, security, or

education. Governments influence the direction of innovation by allocating human and financial resources through a diverse range of public policy instruments (Manyika et al., 2017).

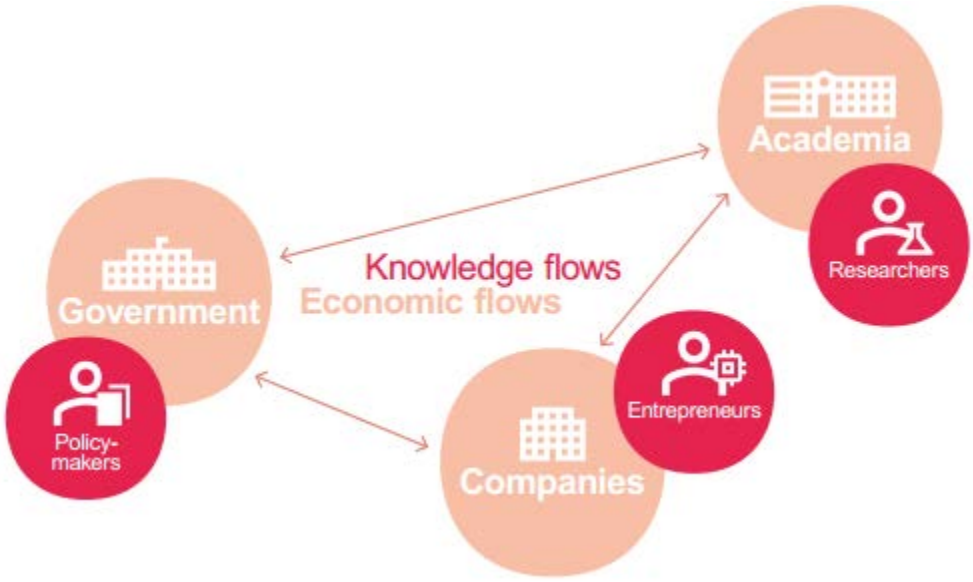

Figure 3: Conceptual summary of interactions between innovation ecosystem stakeholders

Ecosystem stakeholders engage in nonlinear and strongly interdependent flows of knowledge and ideas that ultimately result in innovation. In innovation ecosystems, every stakeholder contributes to and makes use of a knowledge set. Professors train future scientists, technologists and entrepreneurs using this knowledge in university or technical educational programs, while researchers contribute new basic and applied scientific knowledge to the set. Engineers and technologists apply this knowledge when working in a company, university or government agency, and their use of it contributes to an increase in the experimental and technical base. Entrepreneurs make use of this knowledge when creating new companies and add to it when devising a new product or process (Teece, & Al-Aali, 2012).

Economies of scale also apply to the process of innovating. The more people there are with a problem, the more likely it is that an innovative solution will be found. By the same token, the more people there are thinking about a problem, the easier it will be to find the inventive talent needed to solve it. Scarcity of skilled labor can also motivate universities and government agencies into creating new training programs to provide the type of specific skilled workforce needed by specific industries.

Training and Reskilling

Moreover, a growing body of evidence concludes that influences such as technology and globalization are ‘polarizing’ the workforce into high skilled and low-skilled jobs or,

alternatively, phasing out demand for intermediate-level skills. Workers with intermediate skills are at particular risk because of the routine nature of the tasks they often perform and the fact that the technologies that can replace them, such as AI and robotics, can create considerable cost savings for employers (Szczepanski, 2019).

For example University education can offer a range of skills, including high, intermediate, and in some cases, low skills. At the undergraduate level, universities offer a broad range of theoretical and practical skills in a particular field of study, which could be considered intermediate in level. At the graduate level, universities may offer advanced skills and in-depth specialization in a specific field, which could be considered high level. In addition, university education may provide transferable skills that are valuable in a range of professions, such as critical thinking, problem-solving, and communication, which could be considered intermediate or high level. It's important to note that the level of skills offered can vary depending on the specific program and institution. Examples of intermediate skills: Programming, Data analysis, Graphic design, Database management, financial analysis, Digital marketing, Basic project accounting, Basic website development, Customer service, Project management etc.

In this dynamic context, the key to guaranteeing an inclusive society lies in the ability to accurately identify and even predict shifts in skills requirements and systemic 'pressure points', such as demographics with limited access and opportunities, and in providing timely responses along the education value chain. While a number of policy responses have so far focused on developing or attracting the limited pool of high-level talent in AI, there is a need for education and training institutions, particularly those that focus on intermediate skills, to acknowledge and embrace their share of the transformation effort (Shiohira, 2021).

How can education and training institutions harness new technological and procedural developments to improve their own responsiveness to the demands of the labour market and society.

This can be achieved from key recommendations of the Beijing Consensus on Artificial Intelligence and Education 2019 namely:

a) Planning and governance for the AI era;
b) Ethical and inclusive use of AI;
c) Values and skills for the AI era;
d) Empowerment of teaching and learning through AI; and

e) Creation of lifelong learning opportunities through AI

a). Planning and governance for the AI era

the Beijing Consensus on Artificial Intelligence and Education recommends the use of data and new data analysis methods to improve decision-making and planning processes, the identification of innovative new funding mechanisms, and the adoption of intersectoral and multistakeholder approaches to the planning and governance of AI in education. Countries have embarked on all three of these recommendations, through policies focused primarily on skills development and the links between government, industry and academia, most often through the development of research centres, hubs or industrial parks equipped for AI development to pool the expertise of academia and industry (UNESCO, 2019). As crucially important links to AI talent development and workforce transformation, education institutions may be able to establish new links to industry, government and higher education through such initiatives if they are lucky enough to operate close to these hubs (CBInsights, 2018).

b). Ethical and inclusive use of AI

The consensus recommends a concerted effort to reduce the gender gap in digital skills, promote the development of AI tools to empower girls and women through AI skills and ensure that AI applications in education are free from gender bias. The consensus also calls for the ethical, transparent and auditable use of education data and algorithms, given that AI can introduce various types of bias and that access to data must be balanced with privacy and protection. The consensus concludes that data should be available for the public good, but that AI development principles and legal frameworks should take account of issues relating to ethics, privacy and security (UNESCO, 2019).

Frameworks and principles for ethical AI are currently being developed by a wide range of stakeholders, including intergovernmental organizations, governments, research institutions, private companies, non-profit organizations and professional bodies, all with differing approaches and sometimes even differing definitions for concepts (Jobin, Ienca & Vayena, 2019). The development of AI ethics builds on an extensive body of work, including overarching ethical frameworks such as the human rights framework set out in the Universal Declaration of Human Rights (United Nations, 1948) and previous work on the application of human rights in the context of ICT such as the Code of Ethics for the Information Society (UNESCO, 2011).

The Ethical Overarching Principles for AI Frameworks:

Responsibility (human oversight): the need for someone with authority to change an algorithm and redress the situation in a timely manner in the event of adverse effects.

Explainability (Accountability): the need for people affected by an algorithm to understand the outputs or decisions produced by that algorithm. *Accuracy:* The principle of accuracy requires that potential and actual sources of inaccuracy or uncertainty be identified, recorded and used for mitigation procedures. *Auditability (Transparency):* the ability of third parties such as auditors and the public to access and review monitor or criticize an algorithm. *Fairness:* The fairness principle requires that algorithms and their outputs or decisions be evaluated for potential discrimination. *Safety and security:* the need to ensure that AI never causes foreseeable or unintentional harm. Harm includes discrimination, violation of privacy and bodily harm, and can also encompass negative psychological, social, economic and emotional effect. *Privacy:* is a value that must be upheld and a right that must be protected; it is often presented in relation to data protection and data security.

Well-being: the need to promote AI for the good of the public, society, individuals and the economy. *The ethical use of AI involves:* ensuring diversity in the field of AI, upskilling disadvantaged populations, including ethics in skilling programmes, researching the ethical and social implications of AI and establishing institutional and national rules and policies concerning the fair and transparent use of data. These issues provide ample opportunities for both research and advocacy. At the same time, education and training institutions must also reflect on their own use of AI and their own training programmes to ensure that they are ethical, fair, diverse and driven by investment in sustainable development.

c). Values and Skills for the AI era

Values and skills are both crucial for effectively integrating AI into all sectors, but particularly in education. The consensus recognizes the need to develop values and skills that will enable people to participate in life and work in the era of AI. This requires the development and use of tools to quickly identify shifts in the skills required by the labour market and update curricula accordingly, and also reveals the need for AI literacy skills across all levels of society (UNESCO, 2020). The Beijing Consensus promotes a 'humanistic approach to the use of AI with a view towards protecting human rights and preparing all people with the appropriate values and

skills needed for effective human-machine collaboration in life, learning and work, and for sustainable development of AI in the service of people' (UNESCO, 2019c).

It is clear from this quote how values and skills are viewed as interrelated and that the work needed to effectively integrate AI into educational administration, curricula and teaching and learning presents opportunities to influence the values and skills inherent in both AI and the education system into which it will be incorporated, in addition to the values and skills the education system seeks to instil in students. AI is created by technical experts, who are trained within education systems. Traditionally, engineers and technicians are trained with an eye for optimization or to create products that perform using the minimum number of resources. It is clear that, considering the significant impact AI can have on societies and individuals, AI practitioners must bring more to their profession than this clinical detachment; they must incorporate ethical reflection into the design process, a concept termed 'ethically aligned design' (COMEST, 2019). The first level of values engagement must therefore be embedded in the training curricula for AI practitioners.

Distrust of AI: Distrust remains significant as the result of the misuse of AI; Another consideration is the economic consequences of AI, which include a decline in job security and even displacement for many workers; Other contributing factors include a poor understanding of AI and the perceived lack of alignment between AI and social values. In response to the need to upskill populations with a basic understanding of AI, countries such as Finland and the Netherlands have embarked on campaigns to provide training on the basic principles of AI for up to 1 per cent of their population. Such initiatives demonstrate that coursework and required learning outcomes should not only encompass the skills and theoretical knowledge related to physical or labour demands, but must also instil an understanding to create informed consumers of AI products who have basic knowledge of AI and are able to identify and respond to issues such as data privacy, equity, bias and sustainability.

Skills: Concerns about the impact of AI on the labour market are as widespread. There is a great deal of focus on skills development, particularly in high-end jobs such as engineers and researchers. However, AI can be applied to a wide range of sectors and fields, and this scope is set to increase in the future. In the near future, there will be a rise in demand for both core AI professionals and those who are not AI core specialists but who will be required to successfully

integrate AI into functions in the sectors concerned. In fact, high-level skills depend on a wide spectrum of AI-related skills at different levels and in different sectors and areas. These related skills will be needed to work in AI-adjacent roles that involve working with AI rather than developing it at the most complex levels. However, strategies aimed at strengthening jobs requiring lower and intermediate skill levels have received little attention.

d). Empowerment of Teaching and Learning through AI

The Beijing Consensus calls for the use of AI to empower teaching and learning. Suggested target areas include AI to support learning and learning assessments (particularly to assess multiple dimensions of students' competencies), AI tools for interdisciplinary skills and competencies, and AI for adaptive learning processes. The consensus focuses on teachers as the users of AI, and AI as a tool to facilitate more inclusive and effective teaching and learning.

When properly embedded within appropriate and robust values frameworks and ethical guidelines, AI has the potential to empower teaching and learning at classroom level and through administration, enabled in part by the vast amounts of data that pass through individual institutions and their respective systems and networks (Akhtar et al. 2019)

AI has been applied to administration, instruction, identification of at-risk learners, intervention, marking and planning. Open educational resources (OERs) offer a wealth of information, and AI applications such as the Learning Referral Network have been set up to provide personalized curation of digital repositories. Chatbots such as the Digital Intelligence Virtual Assistant (DIVA) have been deployed at tertiary education institutions to respond to student queries and reduce the demands on staff (UNESCO, 2019a).

Resources such as LabXchange and Open Source Physics provide learning experiences in computer modelling and virtual simulations, thereby potentially saving teacher time in experiment preparation and providing learners with digital skills. We can use technology to monitor student engagement levels during different activities, such as problem-based learning and videos. We want to observe students and create teaching methods that are more suited to Gen Z. The research participants also suggested that AI could be used to steer individuals into promising career paths based on historic graduate outcome data, based on inputs such as socioeconomic background, coursework and current jobs, and to determine suitable task allocations for lecturers based on their past performance. This echoes the prominent uses of AI in human relations and particularly recruitment, where 'the ubiquitous interview is being

supplanted (or augmented) by digital interviews that rely on consumer grade equipment to translate candidates vocal and facial behaviours into a psychological profile or an estimate of their potential fit for a role, based on the prediction of their future job performance or employee engagement level' (Akhtar et al. 2019: 178).

e) Creation of Lifelong Learning Opportunities through AI

The Beijing Consensus states a commitment to using AI to build lifelong learning opportunities for all, across formal, non-formal and informal learning sectors. The document positions AI platforms and learning analytics as 'key technologies' for 'integrated lifelong learning systems to enable personalized learning anytime, anywhere and potentially for anyone' and urges that attention be paid to the needs of older people and those facing barriers to digital life. The paradigm shift from a 'corporate ladder' model (in which an individual 'ascends' in a straight line within a particular field) to a 'corporate lattice' model (in which employment pathways require both horizontal and vertical movement) underscores the need for lifelong learning and skills development to ensure individuals' continued relevance in the workplace (Benko & Anderson, 2010). This shift is explicitly acknowledged in current academic conversations concerning skills and training, but there is also an awareness among the current workforce.

Considering the digital transformation in emerging labour markets is not sufficient; the existing workforce must also be continuously upskilled or rapidly and repeatedly replaced. This recognition of the need for continuous skilling to cope with technological change is already giving rise to innovative continuous and lifelong learning models and is perhaps most directly embodied in the calls for a 'human-centred approach to the future of work' and 'effective lifelong learning and quality education for all' expressed in the International Labour Organization Centenary Declaration for the Future of Work (2019). The increasing focus on lifelong learning models, particularly those with ongoing formal or semiformal credentialing, is giving rise to opportunities for education and training institutions to create and deliver study programmes across borders and to target new audiences.

There are both pedagogical and cost implications associated particularly with the initial development of innovative delivery models and their associated platforms. In some cases, seed funding for the development of new platforms and/or staff development related to blended or

distance learning may be provided through government grants, and partnerships with tech based companies can provide an external source of skills to design and maintain platforms and content. Industry is responding to shifting demand and the need to upskill the existing workforce through partnerships with academic institutions and online training providers Royal Dutch Shell has partnered with Udacity, an online training provider, to train its employees in AI, data science, data engineering and other digital fields as part of its professional development initiative. The core identity of education institution has always been characterized by strategic collaborations between institutions, students and enterprises (ILO & UNESCO, 2020). Education institutions engage with industry through research and development, marketing of ideas or prototypes, and industry incubators.

AI has created new opportunities for the decentralized delivery of education and training, and the educational engagements of the future workforce will not be limited to formal degree programmes, but will continue to incorporate independent study that is sometimes unrelated to their immediate professional development needs.

Recommendations to Education Institutions

Education institutions will differ considerably in terms of how they confront, incorporate and respond to AI initiatives, and it is a must they engage in AI regardless of where their country currently stands on the AI adoption curve.

1. Research the available AI tools

There are number of the AI tools and AI-related training programmes that are available. However, more are being created daily and the field of AI is rapidly evolving, based on a body of knowledge that is growing exponentially. Understanding AI and its role in society is a transversal skill that all students should be equipped with. It therefore follows that institutions and lecturers must stay abreast of current developments. For institutions with ICT infrastructure, emerging AI technologies and other ICTs offer opportunities to increase efficiency in both educational administration and teaching and learning. ICT is an area in which no one should rest on their achievements for long, since technology is constantly evolving.

2. Integrate AI and related principles into core requirements

This does not necessarily mean that every student needs to learn to code, or even to use a computer. While it is true that individual institutions' response capacity hinges partly on national priorities and the availability of infrastructure, even education institutions without immediate access to these resources can engage in advocacy and begin implementing elements of design thinking, problem-solving, critical thinking and values for the AI era to develop the transversal skills and common values that are needed. Students can learn about types of AI and learn to identify encounters with AI in their personal and professional lives during routine activities such as banking, shopping and applying for a job. They can examine case studies of legal or ethical challenges posed by AI. Libraries can be expanded to include resources and research related to AI and its implementation from the perspective of sociology, history, law and so on, in addition to industry-specific AI applications and case studies.

3. Leverage Open Educational Resources (OERs) to educate staff and students on AI

Institutions with ICT access can begin developing an awareness of AI among their staff and students, either through professional development and training courses or by providing access to online training programmes such as that offered by Massive Open Online Course (MOOCs) to supplement the coursework offered by institutions. Given the urgency and international attention surrounding AI and the strong movement towards open education and OERs, there is no shortage of training materials on AI and AI-human interactions, even for institutions without the capacity to develop these in-house. These resources could be utilized more widely.

4. Guarantee the ethical use of AI and student data in the institutions

It falls to both institutions and policymakers to ensure that strong value frameworks and ethical guidelines concerning the use of AI are in place. Educational institutions must make judicious decisions about how and when to use data. AI tools to enhance pedagogy should be reviewed to ensure not only that they are fair, accurate, explainable, safe and secure, but also that they are aligned with best-practice pedagogy (Holmes et al., 2021). This is particularly important in a context in which there is an increasing emphasis on complex interpersonal skill sets such as collaboration, leadership and communication.

5. Make continuous efforts to integrate AI into educational administration, teaching and learning

Institutions seeking to build technology and AI into their coursework in a decisive manner must pursue strategies such as sourcing and integrating AI tools into administration and classroom practice and engaging in regular curriculum review and design processes, accompanied by the recruitment of new staff and investments in the professional development of lecturers. Participation in AI-focused conferences and innovation competitions, in addition to regular research, can help lecturers and educational administrators keep abreast of developments and opportunities in the sector; this task, along with disseminating the findings and opportunities at different levels of the institution, should be incorporated into the portfolios of new and existing staff.

6. Capitalize on and create diversity initiatives in technology

Education and training institutions should capitalize on government and industry initiatives to improve participation and diversity in the technology sector such as industry-driven initiatives to increase the share of minority students in technical fields. Outreach activities to connect such learning opportunities to education and training pathways and the development of tailored support systems for minority and female technology students could improve participation, retention and throughput.

7. Invest in academia-to-industry pathways

As seen in other sectors, high education institutions should seek ways to engage innovative and practical learning pathways both in the AI industry itself and in AI-related fields such as robotics, data science and computer science. Such includes internships, apprenticeships, business incubators and integrated learning pathways, including higher education and industry.

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