The Impact of 21ˢᵗ Century Technology in Higher Education: The Role of Artificial Intelligence

Josefina Bengoechea, Alex Bell

Abstract—Higher education, with its brick-and-mortar facilities and credits-based on hours of study, was developed to serve the needs of a national, industrial, analogue economy. However, the ongoing process of globalization on the one hand, and the emergence of ever-changing needs of employers on the other hand, make this type of process-based education obsolete, and exclusive to students who can afford to pay a full-time tuition and dedicate 4 years of their lives exclusively to study. The creative destruction brought about by new technologies in the 21st century will not only reconfigure the labour market, as millions of jobs will be lost to Artificial Intelligence. The purpose of this paper is to consider if the implementation of technology is the solution to the problems faced in higher education. The paper builds upon a constructivist approach, combining a literature review and research on key publications.

Keywords—Artificial intelligence, employability, labour market, new technology in higher education.

I. INTRODUCTION

IT is not only the needs of employers which have dramatically changed, but also the clientele of higher education. While in the past a degree was issued for a straight career path, requiring little or no re- or upskilling, the labour market of the 21st century demands life-long learning, as skills become obsolete with the advent of new technologies. The new markets for higher education include working adults, family caregivers, veterans, college dropouts, immigrants and people from low-income backgrounds who lack the time or the economic resources to attend a college campus full time [6].

The idea defended by LeBlanc [2] is that 21st century education must adapt to the needs of the new clientele by offering asynchronous, self-paced, competency-based online learning as other alternatives have failed to include minorities and underserved groups. While most Higher Education Institutions (HEIs) have equity, diversity, and inclusion as part of their policy, few of them offer affordable alternatives to non-traditional students [6].

Today's Higher Education (HE) system is not sufficiently equipped to adapt to the needs to rapidly growing populations of non-traditional students from low-income backgrounds, who in many cases received a deficient high-school education; can only study part-time due to family responsibilities, and who have formerly dropped out of college [2]. LeBlanc [2] proposes a competency-based approach that, instead of earning credits through hours of study, would emphasize mastery of knowledge and skills.

The advantages of a competency-based education would be many: First, it would allow students to keep their credits even if they decide to transfer to another institution; second, it would validate knowledge and/or skills learned in other settings, e.g., work experience; third, it would enable students to accumulate certifications that can be considered for the obtention of a degree; and fourth, it would assess a student based on his or her competencies and not on his or her grades, i.e. a student either has or does not have a specific competence. A competency-based education would thus require a different educational management, one based on new technologies.

II. MOOCS: MAKING HE MORE ACCESSIBLE

A MOOC is a Massive Open Online Course that can be accessed by anybody, as it has no limit on enrolments. MOOCs are open to anyone, there are no entry qualifications and offer a free online course. India has launched the world's largest online free e-learning platform which is called SWAYAM (Study Webs of Active Learning for Young Aspiring Minds). The aim of this platform is to fulfil the Indian government's educational policy of access, equity, and quality [4].

While MOOCs offer learning possibilities to all adults (and include assessment through an examination and a certificate of completion), one major disadvantage is that participants do not obtain formal academic credits, though some MOOCs may award some type of recognition for course completion based on a computer-marked assessment [4].

Some of the benefits of MOOCs are that they provide opportunities for anyone for lifelong learning through easy access courses. Nevertheless, learners with disabilities cannot participate in MOOCs; digital literacy is a prerequisite, and language may be a barrier. Thus, MOOCs provide limited non-formal learning opportunities for anybody who is digitally literate and has the time and the commitment to participate in an online course. However, MOOCs cannot substitute for formal learning in a HEI.

III. FIVE REALMS OF HE

Jekov et al. [1] have identified five realms which will necessarily change in the education environment in the near future: Knowledge will become more "democratized" as knowledge will increasingly be available online. The implication of this is that the role of the university will change; an increasing competition for students/clients both at the

Josefina Bengoechea is a Professor at Geneva Business School. Geneva Business School Research Center. Rue de, La Voie-Creuse 16, 1202 Genève, Switzerland (e-mail: jbengoechea@gbsge.com).

Dr. Alex Bell Senior Lecturer in Business and Digital Learning at University of Wales Saint Trinity David. College St, Lampeter SA48 7ED, UK. (e-mail: a.bell@uwtsd.ac.uk).

World Academy of Science, Engineering and Technology
International Journal of Educational and Pedagogical Sciences
Vol:16, No:9, 2022

regional and at the global level. This will increase competition for funds among HEIs; digital technologies will transform the way education is delivered to the students/clients, an increase in global mobility, that will bring together students, researchers and universities; and a stronger collaboration with business, as education will become competency-based and satisfy the skills demanded by employers. Two of the most relevant factors affecting HE are blockchain technologies and AI.

IV. THE INTRODUCTION OF BLOCKCHAIN IN HE

The most important feature of blockchain technologies, which are in use in other areas like financial markets, is that business processes are decentralized. Jekov et. al. [1] present eight different ways in which blockchain technologies can be applied in HE settings. However, most of the applications are of administrative nature. The most important of these is that blockchain technologies can be used to secure study certificates. Once a HEI issues a certificate, it can be stored in a blockchain with no need for further validation to third parties, as these can verify the certificates directly on a blockchain.

Another use is for accreditation: A blockchain can guarantee that a HEI issuing a certificate is accredited by either a government, an international or regional organization. This is of great importance as non-accredited institutions and degree mills offer degrees at a very high cost but are often worthless.

Blockchain technologies can also be used for the automatic validation and transfer of academic credits. As Jekov et al. [1] indicate, credit transfer nowadays depends on negotiations between HEIs, and students have reported that often the credits from one institution are not recognized at another institution. Furthermore, blockchain technologies can be used for storing students' learning, both formal and non-formal, e.g., learning at the workplace.

Blockchain technologies can verify the authenticity of the documents. Still another use is for course payment using cryptocurrencies, as students e.g. foreigners or from disadvantaged backgrounds, do not always have bank accounts. Blockchain technologies would also simplify funding thus decreasing the red tape needed to manage grants and scholarships.

The eighth and last use for blockchain technologies proposed by Jekov et al. [1] is for student identification using biometric identification on a smartphone. Students would only need to provide their data to the admissions office of a HEI and receive certification of their identity, thus avoiding the need to identify themselves when using different facilities, like the gym, the cafeteria or the library of a HEI.

Turkanovic et al. [8] propose a HE credit platform called EduCTX, based on the European Credit Transfer and Accumulation System (ECTS) used by European HEIs. Their idea is to expand the ECTS globally, providing a more transparent credit validation and transfer among HEIs.

Nowadays, student credits and transcripts are kept by HEIs. The databases where these transcripts are kept can only be accessed by the institution issuing the transcripts, with no interoperability [8]. Credit transfer is red tape that interferes with student mobility, especially when transferring to a HEI in another country. Moreover, students do not have to request transcripts from their HEI if they lose them, since they are kept in the blockchain.

The blockchain is decentralized, with no one institution or individual having control of the data and the transactions. Turkanovic et al. [8] point out that any accredited institution can join the blockchain. However, skills and competencies can also be acquired through non-accredited actors, e.g., institutes whose programs are not accredited or their courses not assessed by exams, but which can be valuable as a source of non-formal or informal learning. An example of these is language schools that offer courses. A course participant can gain proficiency in a foreign language without obtaining a certification. Turkanovic et al. [8] state that stakeholders can "benefit from a globally trusted, decentralized HE credit and grading system, which is easy to use and is free from any administrative, script and language obstacles…" however, this system can only be used vocational, or "hard skills" as soft skills can hardly be measured in a quantitative manner.

V. THE INCREASING IMPORTANCE OF THE ROLE OF AI IN HE

In its 2021 guidance for policy makers, the UNESCO has proposed 4 areas where AI can be applied in educational settings: These are: 1) Education management and delivery; 2) Learning and assessment; 3) Empowering teachers and facilitating teaching, and 4) Providing lifelong learning possibilities [9].

As illustrated with blockchain technologies, AI will automate the management of educational institutions. These include, but are not limited to admissions, timetables, attendance, and homework monitoring. Furthermore, AI will be used to select relevant learning content across learning platforms for each student, based on his or her personalized needs. A problem educators face is the "one-size-fits-all" approach that does not work with a diverse student population.

AI technologies which are student-facing aim to provide learners wherever they are high-quality and personalized life-long learning possibilities. Some of the uses of student-facing AI are intelligent tutoring systems (ITS), which provide individualized tutorials for students. ITS provides students with the content they need in specific subjects, tracking their progress and adjusting the level of difficulty to each individual's needs. 'Smart' robots can also help students with disabilities or learning hindrances: An example of these are humanoid robots used for teaching children with autism, whose aim is to develop the learner's communication and social skills [9].

One criticism of ITS is that they decrease contact between students and teachers. Moreover, the use of ITS in the classroom forces teachers to monitor their dashboards from their desks, therefore reducing their mobility around the classroom.

Another application of AI in teaching and learning is dialogue-based tutoring systems. These technologies use natural language processing to elicit a dialogue between the student and the system, focusing on helping the students find solutions to problems. The use of AI in exploratory learning

World Academy of Science, Engineering and Technology
International Journal of Educational and Pedagogical Sciences
Vol:16, No:9, 2022

environments, whose aim is to aid students with exploratory learning by providing feedback and guidance, is still in the research phase.

Yet another use of AI in teaching and learning which is now widely used by HEIs is automated writing evaluation (AWE), which is used for feedback (it corrects grammar, spelling and punctuation mistakes) and is also used for automatic scoring. Although providing feedback to the students about their mistakes is helpful in the development of their grammar, spelling and punctuation skills, using AWE for scoring has proven controversial, as it cannot evaluate creativity. It has been also proven that AWE used for scoring gives points for surface features such as sentence length, even if what is written does not make any sense [9, p.16]. The use of AWE for marking assignments has been detrimental for students, as marking assignments is one of the best sources of feedback students can get from their teachers even if it is a time-consuming task.

Other uses where AI has proven to be of great aid is in the use of virtual and augmented reality: Rensselaer Polytechnic Institute in New York offers students courses in Mandarin in an immersion lab which transports language students to China, virtually. The students practice Mandarin with avatars that can recognize words, gestures and expressions, "all against a computer-generated backdrop of Chinese street markets, restaurants and other scenes" [3]. The president of Rensselaer Polytechnic Institute stated that students who participated in the virtual reality immersion course in Mandarin mastered the language about twice as fast as their classmates who participated in traditional courses [3].

Radianti et al. [7] describe immersion as "the involvement of a user in a virtual environment during which his or her awareness of time and the real world often becomes disconnected, thus providing a sense of "being" in the task environment itself". However, there are different qualities of immersion that depend on the attributes of VR technology. Chávez and Bayona (as cited in [7]) have identified 17 positive effects of VR on learning, including better learning outcomes, quasi-real living experiences, intrinsic motivation, a higher level of interest in learning, and better skills.

There seems to be consensus among researchers that the quality of the virtual reality depends on the quality of Head Mounted Displays (HMDs). Radianti et al. [7, p.21] point out that there is a lack of consensus regarding "the equipment that can be considered an immersive technology". However, in their review of 38 articles about the application of immersive VR technologies in different fields, they could identify 18 domains where VR technologies are used, especially engineering and computer science. These researchers stated that, while in some cases the technology was mature enough to be employed in HE, most of the literature reviewed indicated that the application of VR in education is still in an experimental stage. Another problem they mention is that using VR in lectures might imply modifying curricula from teaching declarative knowledge to a more practice-oriented content [7, p.23].

AI can also be used to empower teachers and improve teaching [9]. Teachers in many countries have complained of the administrative tasks they are expected to do besides instructing students. Many AI applications aid teachers by automating tasks as assessment (specifically of multiple-choice tests and quizzes), detecting plagiarism, managing administrative tasks, and providing feedback.

While using AI as a teaching aid might prove useful, especially where there is a lack of teachers, AI can never substitute for teachers altogether.

The introduction of AI into the educational realm will change the roles teachers play. One of the concerns, especially in developing nations, is that teachers will have to acquire new competencies to be able to handle AI [9, p.18].

VI. ETHICAL ISSUES OF USING AI IN EDUCATION

The use of AI in education has been criticized for being both intrusive and dehumanizing: In China, AI is used in schools to monitor students' behaviour using facial recognition features, to check whether they are paying attention. "Every movement of the students is watched by multiple cameras positioned above the blackboard" [9, p.21]. Furthermore, the deployment of AI in classrooms has been called dehumanizing because it forces students to learn with minimal human interaction.

Another issue of great concern is that the already existing divide between the haves and the have-nots will widen: the divide exists between industrialized and developing countries; it exists between the urban and the rural areas within countries, and between those whose jobs are enhanced by AI and those whose jobs are threatened by AI [9].

Digital services remain unaffordable for many who might become even more excluded with its deployment in education. Thus, without an effective policy intervention, the use of AI in education will exacerbate rather than ameliorate inequalities among learners. Another problem is the skills gap between those who can and those who cannot work with AI. While before the 4th industrial revolution the goal was combating illiteracy, today not only does the problem of illiteracy continues, but also of digital illiteracy. Thus, there is a need of a response to help prepare all citizens to live and work in the era of AI [9].

As McKenzie [5] points out, the COVID-19 pandemic not only represented a formidable challenge of HEIs to shift their teaching online, but it also exacerbated the existing inequalities among students.

Although most students in the USA own laptops or smartphones, some of them lack the funds to maintain these devices or cannot afford high-speed internet: Emerging enrolment data reinforced concerns from HE experts that digital access or the lack of it, seems to play a role in many lower-income students' decisions to stay in college or to drop out of college [5]. While, as stated above, most students have access to a laptop (91%) or to a smartphone (95%), the digital divide is no longer an issue of access to technology, but rather of technology maintenance [5]. There are large gaps in the quality and the reliability of the devices owned by the students: "… students of colour and students from low-income families were more likely to rely on older, lower-quality devices," [5, p.10]. However, not all problems can be solved by better technologies: As Professor Kim, who teaches computer engineering at Drexel

World Academy of Science, Engineering and Technology
International Journal of Educational and Pedagogical Sciences
Vol:16, No:9, 2022

University put it, the divide is not a problem that requires a technical solution, but a broad social, cultural, and civic problem [5]. Professor Kim pointed out that not all students have stable housing, and even some who do cannot afford high-speed internet, relying instead on free wi-fi networks. There have also been concerns with the use of digital technology for distance education: As McKenzie describes the problem, there are different student populations with different problems.

Some HEIs require the use of apps by students, staff and faculty, something that could affect the health, privacy, freedom and safety of the users. Thus, there is a need for the anonymization of data, and for its collection to be carried out only for specific and clearly articulated purposes [5].

Still another issue was the learning accessibility for students with disabilities: Some blind students had such a bad experience with online learning that they decided to take a semester off from their university rather than continue participating in online courses.

VII. Conclusion

As discussed earlier, the HE model that served the national, industrial, analogous societies of the 19th and the 20th centuries is no longer viable for various reasons: First, because learning can no longer be limited to the obtention of a college degree for a single-path career in the age of the 4th industrial revolution; second, because the process-based education system of the industrial society does not reflect the competencies of the degree holder; third, because HE is no longer limited to the young, affluent high school graduates who can dedicate 4 years of their lives exclusively to studying; fourth, because to the rapidly changing needs of business, a flexible education system that can provide the workforce with the re-skilling or the upskilling they need, and fifth, because as the labour market becomes globalized, just like other markets, there is a need for a decentralized system of international validation of credentials.

While MOOCs provide an accessible form of non-formal education open to anyone and free of charge, and award some type of recognition for the participants, they cannot substitute for program courses that lead to the obtention of a degree. Moreover, the one-size-fits-all nature of MOOCs automatically excludes learners with special needs, people with limited digital literacy or people who lack the language of instruction of the MOOCs.

The role of HEIs will change just like the society, the economy and the labour market will change with the 4th industrial revolution: While HE was formerly considered a privilege of the affluent, the demand for skills from non-traditional students has modified the modes in which knowledge is offered by HEIs.

If the existence of inequalities was evident before the pandemic, COVID-19 exacerbated the gap between the haves and the have-nots, not just in the sense of who could afford devices for online teaching and who could not, but who could afford a wi-fi connection and who could not, and who had the required digital skills to participate in online instruction and who lacked them.

The adoption of AI in schools, institutes and HEIs is also an economic matter: AI is costly, and underfunded schools do not always have the budget to purchase new technologies which also require the staff to master new digital skills. It has been proven that VR is a great teaching aid, especially for some subjects like languages. But VR needs high quality HMDs to yield the expected learning outcomes, and technology is expensive. Furthermore, AI poses ethical issues that did not exist in the age of analogous education. Some of these are the rights of students to privacy, the decreasing importance of the teacher as a role model, and the minimal human interaction that students will have if AI substitutes human teachers instead of aiding them by performing the non-instructional tasks of the teaching profession, like administration.

REFERENCES

[1] Jekov, B., Petkova, P., Parusheva, Y. & Shoikova, E. (2018) Disruptive Technologies- Artificial Intelligence and Blockchain in Education, Proceedings of the ICERI Conference, Seville, Spain.
[2] LeBlanc, P. (2021) Students First: Equity, Access, and Opportunity in Higher Education, Harvard Education Press.
[3] Marcus, J. (2020, February 20) How Technology Is Changing the Future of Higher Education, in The New York Times.
[4] Mary Queen, V., & Vel Murugan, P. (2020). MOOCs as a Digital Learning Platform. *Sparkling International Journal of Multidisciplinary Research Studies*, 3(1), 28-37.
[5] McKenzie, L. (2021) Bridging the Digital Divide: Lessons from COVID-19, Inside Higher Ed.
[6] Mintz, S. (2022) Is Competency-Based Education and Idea Whose Time Has Come? Retrieved from https://www.insidehighered.com/blogs/higher-ed-gamma/competency-based-education-idea-whose-time-has-come
[7] Radianti, J., Majchrzak, T., Fromm, J. & Wohlgennant, I. (2020) A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda, in Computers & Education, 147 (2020) 103778.
[8] Turkanovic, M., Hölbl, M., Kosic, K., Hericko, M. & Kamisalic, A. (2018) EduCTX: A Blockchain-Based Higher Education Credit Platform, IEEE Access, Vol. 6, doi 10.1109/ACCESS.2018.2789929
[9] UNESCO (2021) AI and Education: Guidance for policy-makers.