Short Commentary

Evolving Higher Education: Challenges and Opportunities on the Horizon

Husam Arman[1*]

[1]Techno-Economics Division, Kuwait Institute for Scientific Research, Safat, Kuwait

[*]**Correspondance to: Husam Arman, PhD, Research Specialist,** Techno-Economics Division, Kuwait Institute for Scientific Research, Safat, 13109, Kuwait; Email: harman@kisr.edu.kw

Abstract
Educators are still contending with the quick rise of ChatGPT as an artificial intelligence (AI) tool that could demolish education or change it for the better. Although it is worth the hype and worry, the big picture is embracing the fourth industrial revolution (Industry 4.0) and dealing with all its ups and downs. This short contribution aims to shed light on potential future challenges in areas where education is the glue to all these issues and what promising solutions we should entertain to address these challenges. It discusses the shape of education in the Industry 4.0 era, the evolving relationship between academia and industry, and the dynamic learning and teaching process.

Keywords: Industry 4.0, AI, education, teaching

1 INTRODUCTION

With the introduction of ChatGPT to the public, educators wondered how such a new technology could disrupt the sector. Conservatives responded by blocking the platform or restricting its usage[1], while others found it helpful in supporting students in advancing specific skills such as critical thinking and problem-solving[2].

Such disruptive innovation is expected to transform many sectors, including education, which has always been the top priority for policy-makers, considering the number of solid pieces of evidence on its essential role in development. Economists see it as one of the critical fundamentals to building solid human capital that can contribute to economic growth[3]. The relationship between human capital and economic growth is well established[4]. However, in education, it is not quantity but quality that matters. For instance, the skills learnt proved to be decisive in contributing to individual earnings, income distribution, and economic growth and not the increase in school attainment[5].

Public education was essential to meet the demand created in the second industrial revolution. It was designed based on the mass systems concept, similar to the industrial objective of mass production, as it was almost inspired by the factory's design at that time. Such a system has been challenged since it emphasizes linearity, conformity and standardization, while practical work and life are organic, adaptable and diverse[6,7]. The challenge is immense in higher education since it is the final stage in education before entering the labor market. Hence, quick catch-up and last-minute preparation of graduates is very tricky.

With the fourth industrial revolution (Industry 4.0) on the horizon, where technologies are diffused, including

robotics, artificial intelligence (AI), 3D printing, and the Internet of Things[8], jobs and skills are changing radically[9]. Therefore, it is essential to revamp the higher education system to meet the future needs of an industry structure that differs from the previous ones.

2 THE FOURTH INDUSTRIAL REVOLUTION

The future is very generic and dynamic, so forecasting it is difficult. According to Peter Drucker's metaphor: "trying to predict the future is like trying to drive down a country road at night with no lights while looking out the back window". This is very challenging for educators since they don't have the luxury of waiting for it to happen[10]. However, the current synchronized developments of technology appear to give us a clue about the future in the context of the fourth industrial revolution.

Every industrial revolution brought with it benefits and socioeconomic challenges. However, the fourth industrial revolution seems to have had the most significant social impact since it has multidimensional effects, including productivity, jobs, privacy, and democracy. As Schwab[11] described, "It is the fusion of these technologies and their interaction across the physical, digital and biological domains that make the fourth industrial revolution fundamentally different from previous revolutions". Therefore, coping with such transformation requires a holistic approach encompassing socially innovative and sustainable system solutions, not just technological ones[12].

Industry 4.0 influences the economy, productivity, employment, skills, the nature of work, business, and collaborative innovations. It combines the digital, physical and biological worlds[11]. Furthermore, this digital transformation contributes to the collaborative commons and crowdsourcing, which is expected to transform the consumer into a co-producer or prosumer when production and consumption are united[13].

As in previous industrial revolutions, Industry 4.0 will improve economic growth and life in general and increase inequality. It has affected the employment and wages of blue-collar collars like its predecessor and is affecting white-collar jobs, mainly routine jobs that lack creativity.

Such changes create winners and losers, but not equally, since it increases productivity and wages in some occupations and negatively affect other workforce groups[14]. The negatively affected jobs are the ones that are usually identified as jobs at risk in the near future. These include jobs such as mortgage brokers, paralegals, accountants, and some back-office staff, according to a study by Manyika et al.[15], which suggests that by 2030, 75 million to 375 million workers will need to switch occupational categories, but varies across countries. The pandemic shock of COVID-19 in 2020 has accelerated

the deployment of technologies and automation[16], and the digital transformation in the public and private sectors was astonishing, even for countries that were slow in adopting such changes.

Hence, such development will continue affecting most sectors. In education, the latest impact of ChatGPT is still rising at the time of writing this paper. It is too early to come up with the right response, considering the rapid technological developments and the additional recent contribution of large tech corporations. However, educators and policy-makers at large are scrutinizing these systems from an ethical perspective[17]. Hopefully, soon regulations will be in place to reap the benefits of this emerging technology without damaging the integrity of academic and research institutions and affecting the learners negatively.

3 ACADEMIC-INDUSTRY RELATIONSHIP

Technology has been changing the game, creating giant techs and disrupting others. There are many stories where the cost of not investing in the future is death, but what about some of our biggest institutions that we do not allow to fail, such as education? Booth asks in his book "The Price of Tomorrow: Why Deflation is the Key to an Abundant Future"[18]. He subsects that if these institutions are still suffering from the blind spots that allowed technology to change the game for leading companies, they would be more stuck in the status quo model of delivery and, therefore, at greater risk.

The current education systems are being criticized for not teaching job skills, even the link between human capital and economic growth is questioned by some, such as Caplan[19]. He argues that the focus should be on the quality and appropriateness of the education outcome. He elaborates that students spend years learning large quantities of irrelevant content they won't use after graduation. In such a system, a university certificate is just a signal to the employer that the new graduates are disciplined, committed to work, and can be trusted. However, they must be extensively trained to acquire the required skills by the employer. Although this concept of signaling is valid and a vital alarm to universities, the consensus on the large return of investing in human capital is well-established empirically, and the contribution of signaling is probably small[20]. However, the reforms being advocated by international organizations such as the World Bank and some governments and private corporations where education only aims to maximize human capital to serve the economy ignore the essential education's role of creating cultural good and social cohesion[21]. Creating a learning ecosystem to support lifelong learning for all through physical and digital means is vital in preparing society to thrive in the dynamic and uncertain future.

Therefore, higher education institutions must optimize

their input and outputs as part of their productive process[22]. Discussing the whole process is beyond this report. However, it is worth mentioning that funds are expected to be squeezed in the future and may pose a considerable challenge to universities[23].

The university's essential contribution is human capital and, most importantly, creative and innovative graduates. Graduates can add value to the firms they work for if they join the industry with the right required skills, start their own business or join any national innovation actors, including academia and research institutions and government.

Considering education in the context of the National Innovation System (NIS) can leverage the value of education and ensure harmony between the main three actors of the NIS: universities, industry and government[24,25]. Universities' role has become even broader than improving their relationship with industry, contributing to innovation, economic development, and sustainability[26]. Therefore, it is imperative to consider NIS while designing or improving the education system and universities.

4 TEACHING AND LEARNING

There is much speculation about the future of capitalism. One relevant thought is the concept of zero marginal cost, which Rifkin has popularised[13], where he expects a paradigm shift from market capitalism to the collaborative commons. At least for now, the near zero marginal cost phenomenon has already affected the publishing, communications, and entertainment industries and, in its way, other vital future industries such as renewable energy, 3D printing in manufacturing, and, most importantly, online higher education.

The systems of higher education institutions have been stable for decades and rarely witness the exit of institutions in the higher education space due to disruptive innovation compared to most industries, from heavy to high-tech industries[23]. This is due to the difficulty of substituting high-quality education, the value of physical campus, keeping the brand supported by alumni, barriers to accreditation, and the lack of truly disruptive innovation. However, with the cheap availability of online learning through platforms such as Coursera and pioneering universities, traditional national universities are now competing with universities globally. Some of the most distinguished professors in the world are delivering courses which are available to enormous audiences for free or small fees. Firms are not seeking graduates with degrees but specific skills that can be acquired through these online platforms[27]. The new millennium learners are surrounded by digital technologies everywhere and learn differently[28]. Hence they don't accept the traditional methods and the current teaching format. Therefore, for higher education institutions to remain competitive in a

very connected world, they need to innovate approaches to learning and understand how students use educational technologies and implement modern technologies into the process of education[29]. Hence, learners can go online and acquire specific skills through these platforms without the need to go to a traditional university and wait for a formal certificate.

Hence, brick-and-mortar universities could be affected significantly, considering the increasing cost of higher education. This has been a real dilemma in the United States since students struggle to pay university fees[23]. Moreover, the new generation of students and learners is interested in collaboration and resists the outdated authoritative approach of the conventional classroom. They have already started using ChatGPT with and without the consent of their teachers and institutions[30]. Hence, there is a need for a revolution in the purpose, pedagogy, and assessment policies in teaching courses in higher education.

The evolving purpose of education, according to Hannon and Peterson[31], is about learning how to thrive in a dynamic world and not just about economic competitiveness, knowledge economy, or digital transformation. This new world resulted in new perspectives and changes of the sought skills. Hence education needs to change, and it has been consistently slow and primarily focuses on "what" not "how", i.e., facts and procedures, not practical skills and competencies. As Alvin Toffler predicted impeccably: "The illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn".

The educational process, perhaps, should focus on producing creative and human graduates since the ability to innovate and emotional intelligence will be essential "survival" skills in the Industry 4.0 context[32]. As Jack Ma, founder of the Alibaba Group, tells us: "We cannot teach our kids to compete with machines".

The discussion in the literature on AI focused on its impact as part of Industry 4.0 and the need to equip learners with the right future skills. However, AI itself will impact education and pedagogy in particular and will be the fourth education revolution. This revolution, according to Seldon and Abidoye[33], will dismantle the current traditional pedagogy system where the lecturers are an authority (i.e., master of the subject) and in authority (i.e., they command the learning environment).

Innovative approaches in teaching and learning are required to equip the students with the necessary practical skills, especially those related to digitization and Industry 4.0. However, these skills should be complemented with more important soft cross-cutting skills that give graduates an edge in a future world where machines can

perform better than humans. These skills include creativity, problem-solving, empathy, and collaboration. However, AI developers will continue to try and get into these fields before they realize that it is best to join forces with humans. Hence, the collaboration mode between humans and machines seems to be the most likely scenario, where new dynamics of complementarity and value enhancement between the two are likely to emerge and rise in importance, even in creativity tasks[34].

Many innovative teaching methods can be helpful if applied effectively in teaching and learning in higher education. These include project-based learning (PBL), cooperative-based learning, community-based Learning, and discovery learning. PBL, in particular, can contribute to addressing some of the above challenges if adopted across programs and subjects, not just STEM in higher education. In PBL, multidisciplinary teams from different specialties can work together to achieve specific goals. These projects are designed to enable hands-on exercises that could involve complex and open-ended tasks but allow the learners to work together to address the problem while teachers are only facilitators[35]. The effectiveness of such an approach can be enlarged if it is coupled with the Design Thinking (DT) concept, which takes a human-centered approach to innovation, according to the famous design company IDEO[36]. The creativity element of DT as an innovation method can enhance PBL and take it to the next level, where students are able to generate innovative solutions while they are learning, aka "learning by doing". DT addresses the aforementioned future skills since it turns students into creative individuals who can solve real-world problems and socially competent team players who can collaborate towards a common goal[37]. Utilizing DT effectively within higher education can help universities to align student learning experiences with professional, personal, and civic needs[38].

5 CONCLUSION

Teaching and learning approaches have evolved from teacher-centered to learner-centered, from memorizing to active participation. The teacher is no longer the sole source of information with ease of access to gigantic online resources. The Digitization reduced the need for long face-to-face hours in the classroom, and hence, teachers need to adapt their pedagogy and teaching methods, such as PBL. With such innovative approaches, several goals can be reached besides fulfilling the intended learning outcomes of the subjects. This learner-centered approach can enhance the learner's creativity and collaborative skills and satisfy the learner's need for autonomy in a very interactive style, which is essential to the new learning experience. The teaching can be designed with high flexibility that goes beyond the traditional physical classroom and lecture-based learning. Perhaps blended learning is the solution in the new normal, which can also reduce the costs, hence reducing the fees and enlarging the students' admission.

At the macro level, the rapid technological and social changes affect every sector, including higher education. The demand for high-quality yet affordable education is increasing due to the funding challenges facing universities. The gap and the mismatch between the skills that universities provide and the required skills and competencies demanded by the employer is widening persistently. The new paradigm shift towards collaborative commons and crowdsourcing is challenging the current authoritative approach of the conventional education system. The new generation of students and learners is interested in collaboration and open-source avenues and is very eager to take advantage of any new platforms, such as ChatGPT. Therefore, there is a need for a new approach to education that embraces collaborative culture and focuses on the practical skills that blend digital and soft skills such as creativity, problem-solving and collaboration.

Rethinking higher education as part of the NIS can contribute to addressing the skills gap and strengthen the academic-industry relationships; hence education is for innovation by design. The countries that made leapfrogs in economic development, such as the Asian Tigers, have designed an effective NIS where universities played a significant role in the STI-based economic development plan.

Author Contribution
Arman H confirmed sole responsibility for the study conception and design, data collection, analysis and interpretation of results, as well as manuscript preparation and submission.

Abbreviation List
AI, Artificial intelligence
DT, Design thinking
NIS, National Innovation System
PBL, Project-based learning

References
[1] Dibble M. Schools Ban ChatGPT Amid Fears of Artificial Intelligence-Assisted Cheating. Accessed 6 August 2023. Available at:[Web]

[2] Kasneci E, Seßler K, Küchemann S et al. ChatGPT for good? On opportunities and challenges of large language models for education. *Learn Individ Differ*, 2023; 103: 102274.[DOI]

[3] McMillan M, Rodrik D, Sepulveda C. Structural change, fundamentals and growth: A framework and case studies. *NBER*, 2017.[DOI]

[4] Barro RJ. Human capital and growth. *Am Econ Rev*, 2001; 91: 12-17.[DOI]

[5] Hanushek EA, Wößmann L. The role of education quality for economic growth. Policy Research Working Paper; No. 4122. © World Bank, Washington, DC. Accessed 6 August 2023. Available at:[Web]

[6] Robinson K, Lee JR. Out of our minds. Wiley Online Library: Hoboken, New Jersey, USA, 2011.[DOI]

[7] Robinson K, Aronica L. Creative schools: The grassroots revolution that's transforming education. Penguin Publishing Group: New York, USA, 2016.

[8] Martinelli A, Mina A, Moggi M. The enabling technologies of industry 4.0: examining the seeds of the fourth industrial revolution. *Ind Corp Change*, 2021; 30: 161-188.[DOI]

[9] World Economic Forum. The Future of Jobs Report 2023. Accessed 6 August 2023. Available at:[Web]

[10] Hoerr TR. The formative five: Fostering grit, empathy, and other success skills every student needs. ASCD: Alexandria, Virginia, USA, 2016.

[11] Schwab K. The fourth industrial revolution. Crown Publishing Group: New York, USA, 2017.

[12] Morrar R, Arman H, Mousa S. The fourth industrial revolution (Industry 4.0): A social innovation perspective. *Technol Innov Manag Rev*, 2017; 7: 12-20.

[13] Rifkin J. The zero marginal cost society: The internet of things, the collaborative commons, and the eclipse of capitalism. St. Martin's Publishing Group: New York, USA, 2014.

[14] Chernoff A, Warman C. COVID-19 and Implications for Automation. *Appl Econ*, 2023; 55: 1939-1957.[DOI]

[15] Manyika J, Lund S, Chui M et al. Jobs lost, jobs gained: Workforce transitions in a time of automation. *McKinsey Global Institute*, 2017: 150: 1-148.

[16] Lund S, Madgavkar A, Manyika J et al. The future of work after COVID-19. *McKinsey Global Institute*, 2021: 18.

[17] Mhlanga D. Open AI in education, the responsible and ethical use of ChatGPT towards lifelong learning. 2023.[DOI]

[18] Booth, J. The Price of Tomorrow: Why Deflation is the Key to an Abundant Future. Stanley Press, 2020.

[19] Caplan B. The case against education: Why the education system is a waste of time and money. Princeton University Press: Princeton, New Jersey, USA, 2018.

[20] Deming DJ. Four Facts about Human Capital. *J Econ Perspect*, 2022; 36: 75-102.[DOI]

[21] Martin GB. Education and the Fourth Industrial Revolution. 2017.

[22] Agasisti T, Pérez-Esparrells C. Comparing efficiency in a cross-country perspective: the case of Italian and Spanish state universities. *High Educ*, 2010; 59: 85-103.[DOI]

[23] Christensen CM, Eyring HJ. The innovative university: Changing the DNA of higher education from the inside out. John Wiley & Sons: Hoboken, New Jersey, USA, 2011.

[24] Nelson RR, Rosenberg N. Technical innovation and national systems. In: National innovation systems: A comparative analysis. Oxford University Press: Oxford, UK, 1993; 1: 3-21.

[25] Mowery DC, Sampat BN. Universities in national innovation systems. 2009; 209-239.[DOI]

[26] Zhou C, Etzkowitz H. Triple helix twins: a framework for achieving innovation and UN sustainable development goals. *Sustainability*, 2021; 13: 6535.[DOI]

[27] Bhaimiya S. Job listings that don't require applicants to have a college degree are surging, with recruiters prioritizing skills over formal education, LinkedIn survey finds. Accessed 7 September 2023, Available at:[Web]

[28] Pedró F. The new millennium learners: Challenging our views on ICT and learning. *OECD Nisan*, 2006; 12: 2021.

[29] Ştefan Ţ. Implications of modern digital technologies in higher education. In: International Scientific and Practical Conference on Digital Economy (ISCDE 2019). Atlantis Press: Amsterdam, The Netherlands, 2019; 271-274.[DOI]

[30] Cu MA, Hochman S. Scores of Stanford students used ChatGPT on final exams, survey suggests. 2023.

[31] Hannon V, Peterson A. Thrive: Schools reinvented for the real challenges we face. Innovation Unit Press: London, UK, 2017.

[32] World Economic Forum. The Future of Jobs Report 2020. Accessed 6 August 2023. Available at:[Web]

[33] Seldon A, Abidoye O. The fourth education revolution. Legend Press: London, UK, 2018.

[34] Pedota M, Piscitello L. A new perspective on technology-driven creativity enhancement in the Fourth Industrial Revolution. *Creat Innov Manag*, 2022; 31: 109-122.[DOI]

[35] Zhong B, Liu X, Xia L et al. A Proposed Taxonomy of Teaching Models in STEM Education: Robotics as an Example. *SAGE Open*, 2022; 12: 21582440221099525.[DOI]

[36] Meadows CJ, Parikh C. The Design Thinking Workbook: Essential Skills for Creativity and Business Growth. Emerald Publishing Limited: Bingley, UK, 2022.

[37] Meinel C, Krohn T. Design Thinking in Education. In: Design Thinking in Education: Innovation Can Be Learned. Springer International Publishing: Cham, 2022; 1-6.

[38] McLaughlin JE, Chen E, Lake D et al. Design thinking teaching and learning in higher education: Experiences across four universities. *PLoS One*, 2022; 17: e0265902.[DOI]