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Towards Education 4.0 and University 4.0 in Algeria

Abdelbasset Dou[1]
University of Mostaganem, Algeria
abdelbasset.dou.etu@univ-mosta.dz

Abstract: The rapid advancements of Industry 4.0, driven by artificial intelligence (AI), the Internet of Things (IoT), and automation, have necessitated a transformation in higher education. This shift towards Education 4.0 and University 4.0 aims to align academic institutions with the demands of a technology-driven world, fostering innovation, digitalization, and knowledge-based economies. This paper examines the transformation of Algerian higher education institutions (HEIs) within this context, analysing the challenges, opportunities, and strategic policies that shape their transition to University 4.0. Algeria has committed to this shift through increased investments in research, digital infrastructure, and entrepreneurship initiatives. Calling for a national committee to oversee the transition further reflects its strategic approach. However, barriers such as rigid curricula, unequal access to technology, outdated pedagogical models, and limited funding frameworks remain significant obstacles. It is important to assess whether Algerian HEIs will radically transform or incrementally adapt to the University 4.0 model by evaluating higher education policies, funding mechanisms, and governance models. The study concludes that the successful implementation of University 4.0 in Algeria requires structural, pedagogical, and policy reforms that bridge the gap between education, industry, and economic development. Algerian universities can become key drivers of national progress, economic growth, and global competitiveness by embracing global trends while addressing local challenges.

Keywords: Education 4.0, University 4.0, higher education institutions, Algeria

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[1] **Corresponding author:** Abdelbasset Dou **ORCID ID:** https://orcid.org/0000-0003-2633-6904

1. Introduction

The global landscape is undergoing a profound transformation driven by the advent of the fourth industrial revolution, commonly referred to as Industry 4.0. This revolution is characterized by the integration of advanced technologies such as artificial intelligence (AI), the Internet of Things (IoT), advanced robotics, and 3D printing. These technologies are not only redefining industrial processes but are also fundamentally altering how individuals live, work, and interact with their surroundings (Akturk et al., 2022; Bonfield et al., 2020). To remain relevant in this rapidly evolving environment, it is imperative for societies and institutions to adapt to these technological advancements and align their practices with the demands of this new era. For developing nations like Algeria, embracing these innovations is essential to remain competitive and responsive to global industrial and economic shifts.

The fourth industrial revolution represents a convergence of physical, digital, and biological systems, powered by disruptive technologies such as AI, IoT, and blockchain. This convergence is reshaping the world with unprecedented speed, creating both opportunities and challenges. While it brings excitement and transformative potential, it also introduces uncertainty, particularly in terms of job displacement and the need for skill enhancement (Borrageiro & Mennega, 2023). In this context, higher education institutions (HEIs) play a pivotal role in preparing graduates to navigate the complexities of this new era. Education 4.0, a framework designed to foster innovation and creativity, has emerged as a critical response to the demands of Industry 4.0 (Vijayalekshmi et al., 2023). This educational paradigm emphasizes flexibility, enabling institutions to adapt to the interconnected and autonomous systems that define modern manufacturing and production processes (Boyd et al., 2023). Education 4.0 envisions a future where learning experiences are enriched by real-world applications, and where human and artificial intelligence collaborate within a symbiotic digital ecosystem to drive research and innovation (Hussin, 2018).

To align with the demands of Industry 4.0, universities must reimagine traditional teaching models and integrate technology into their educational frameworks. This integration is essential to create meaningful connections between students and cutting-edge technologies, fostering a dynamic and intelligent learning environment. By 2040, HEIs may witness a significant shift toward blended learning models, combining online components such as massive open online courses (MOOCs) with in-person lectures. Assessment methods may also evolve, focusing on individualized learning outcomes, micro-credentials, and customized graduation requirements (Gregg et al., 2022). Furthermore, the traditional university model may undergo a radical transformation, transitioning from brick-and-mortar campuses to globally networked digital platforms. In this future scenario, the primary mission of universities may shift from knowledge production to innovation creation, the role of professors may evolve from information providers to certified mentors and web activists, and students may transition from passive learners to active knowledge partners and creative designers (Beloev et al., 2020).

Confronted with significant challenges including rigid curricula, pedagogical inertia, unequal technological access, and funding limitations (Dou, 2021), Algerian HEIs are now navigating the imperative transition towards Education 4.0 and University 4.0 models. Against this backdrop, this paper critically examines the nature and extent of this transformation within the Algerian context. The central problematic is not merely whether this evolution will be radical or incremental, but rather to assess the degree to which Algerian HEIs are genuinely reconfiguring their core functions in alignment with University 4.0 principles, versus making primarily adaptive or superficial adjustments to their existing frameworks. By analysing current strategies, documented investments, stated policies, and the

persistent obstacles discussed herein, this study seeks to evaluate the feasibility and likely trajectory of Algeria's higher education alignment with global technological and educational shifts, contributing a grounded analysis to the ongoing discourse.

2. Evolution of Education 4.0

Harkins (2008) introduced the concept of "Education 4.0" to describe the transition from education systems focused on knowledge creation to those that foster innovation. In his framework, Harkins proposed that the progression from Education 1.0, characterized by centuries of memorization-based learning, to Education 2.0, enabled by the internet, laid the foundation for Education 3.0, where students transition from knowledge consumers to knowledge creators. Education 4.0, the next logical stage, equips learners with the tools and resources necessary to develop and produce innovations. Harkins (2008) argued that nations adopting localized versions of Education 4.0, supported by cutting-edge technology and implemented across primary to higher education, would emerge as leaders in human capital development and creative economies in the 21st century. He emphasized the need for nations to leapfrog traditional educational paradigms by adopting innovative, cost-effective strategies to advance beyond current educational standards (Harkins, 2008).

Harkins (2008) adapted a taxonomy originally developed by his student, John Moravec, at the University of Minnesota, to illustrate the interactive yet distinct nature of the four educational iterations (Himmetoglu et al., 2020). The evolution of educational strategies across generations is demonstrated in Table 1.

Table 1. *Teaching Aspects throughout Generations*

Education	1.0	2.0	3.0	4.0
Teaching Method	Teacher-centred, traditional classroom	Teacher-centred, using internet for resources	Student-centred, collaborative learning	Student-centred, personalized learning, AI-powered
Learning Environment	Classroom-based, teacher-led	Classroom-based, with online resources	Online learning, blended learning, open education	Personalized learning paths, immersive experiences
Role of Technology	Minimal technology use	Basic internet use for resources	Technology integration for collaboration and communication	AI-powered tools for personalized learning, assessment, and feedback
Learner's Role	Passive recipient of information	Active participant in learning, using online resources	Active creator and collaborator, digital citizen	Active learner, problem-solver, innovator, critical thinker
Teacher's Role	Knowledge transmitter	Facilitator, guide, resource provider	Mentor, coach, collaborator	Guide, facilitator, AI assistant, personalized learning designer

In the Harkins-Moravec model, Education 1.0 represents a traditional, teacher-cantered approach, where educators transmit knowledge to passive learners, often referred to as "digital refugees." These students are typically viewed by industries as trainable workers with limited creative expectations. Instruction occurs in physical classrooms, with lectures dominating due to an emphasis on rote learning and memorization, and technology is used sparingly to supplement understanding. In contrast, Education 2.0 reflects the internet-enabled era, where knowledge is widely accessible, and learning is facilitated by both teachers and students, who are still considered "digital immigrants." Educational institutions adopt a "brick-and-click" model, combining physical campuses with online platforms to offer hybrid and fully online courses. Teachers in this phase are professionals who collaborate with students, parents, and stakeholders to create engaging learning environments. While Education 2.0 retains curriculum-based instruction and textbooks, it places greater emphasis on problem-solving and experiential learning, with teachers maintaining a central role in the educational process.

Education 3.0, however, shifts the focus to knowledge production, occurring in a digitally connected world and a "creative society." Teaching becomes a collaborative process of knowledge construction, involving interactions such as teacher-student-teacher and people-technology-people. Industries perceive graduates as knowledge-producing collaborators and entrepreneurs capable of driving focused knowledge creation. Teachers are omnipresent, supported by wireless devices that provide information and resources for knowledge production. In this paradigm, hardware and software are affordable and utilized intentionally to facilitate learning (Kothari & Chatterjee, 2014; Cervantes, 2018).

Education 4.0 builds on this foundation by emphasizing individual and team-driven innovation through targeted practices. It creates a feedback loop where innovation amplifies learning across all phases of life, work, and education, occurring continuously and ubiquitously. Universities operate in a globally interconnected environment, where innovative tools are constantly developed to supplement or replace traditional classroom methods. Teachers are ubiquitous, acting as creative sources of production supported by intelligent software and social partnerships. Industries view graduates as innovation-producing collaborators and entrepreneurs who can sustain focused innovation development, as hardware and software continually evolve. Graduates are integral to the innovation-driven workforce, as software becomes increasingly personalized and reliant on collaborative partnerships (González-Pérez and Ramírez-Montoya, 2022).

Following Schwab's (2016) popularization of the term "fourth industrial revolution", several researchers adopted and adapted the Harkins-Moravec model to align with the concept of Industry 4.0, originally introduced by the German government in 2011. This adaptation further integrated the principles of Education 4.0 into the broader discourse on technological and industrial advancements (Al-Zoubi et al., 2024). The evolution of universities has closely followed industrial and technological advancements, transitioning from traditional, face-to-face education to digital, interactive, and AI-driven learning environments. Figure 1. illustrates the parallel development of Industry, Education, and Universities across four generations, highlighting key milestones and their impact on higher education.

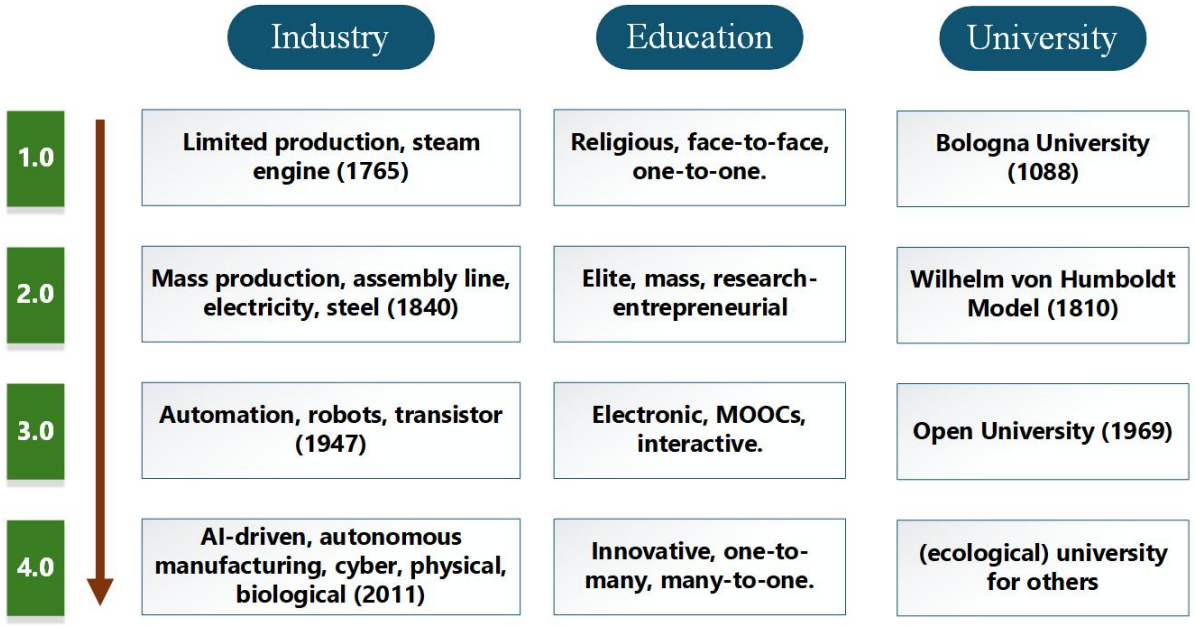

Figure 1. Industry, Education and University across Generations

The shift toward University 4.0 is no longer a distant prospect; it is an urgent, transformative force reshaping the very foundations of higher education in the age of Industry 4.0. No longer confined to traditional teaching models, universities are evolving into dynamic, intelligent ecosystems where innovation, digital integration, and global connectivity converge to redefine the academic experience (Beloev et al., 2020). Yet, this transformation is about more than simply adopting new technologies, it represents, in its nature, a fundamental reconfiguration of learning, research, and institutional governance. In this new paradigm, universities are no longer passive responders to change; they are its architects, shaping the trajectory of technological and societal progress.

However, no structural metamorphosis can thrive without a pedagogical foundation to support it. If University 4.0 reimagines the infrastructure of higher education, Education 4.0 provides the intellectual framework that sustains it. Through AI-driven personalization, immersive digital environments, and competency-based learning, Education 4.0 is not merely refining instruction, it is revolutionizing how knowledge is cultivated, disseminated, and applied (González-Pérez & Ramírez-Montoya, 2022). At the crossroads of institutional progress and educational reinvention, universities are not just adapting to change; they are pioneering the future, shaping learning experiences that are as agile as the world they serve (Koseda et al., 2025; De Souza & Debs, 2024)

3. The Algerian Case

Algeria has demonstrated a growing presence in international university rankings. Notably, it holds a prominent position within the African and Arab regions in the Times Higher Education (THE) World University Rankings 2024, which included 54 Algerian universities. While the Webometrics Ranking featured fewer institutions (13), the upward trend in the THE Young University Rankings (from 1 in 2018 to 21 in 2023) signals increasing visibility for newer Algerian HEIs. However, it is crucial to interpret these rankings cautiously; they represent only one dimension of performance and may not fully capture the diverse quality, socioeconomic contributions, or the internal transformation progress across Algeria's entire higher education system.

Table 2 presents key achievements of the Algerian Ministry of Higher Education and Scientific Research (MHESR) for 2024, highlighting the country's progress in transitioning towards University 4.0. The data reflect significant efforts in innovation, research, and entrepreneurship, including the establishment of incubators, research units, and startup companies, as well as investments in scientific research. These achievements underscore Algeria's commitment to fostering a knowledge-based economy and integrating HEIs into the digital transformation era.

Table 2.

Statistics of Algerian MHESR 2024 Achievements

Category	**Statistic**
Model HEIs chosen to transition to University 4.0	23
New patents registered	33
New startup companies registered	20
New spin-off companies created	14
Projects directly related to economic sectors	14
Incubators in HEIs	102
Laboratories and research units created	58
Research teams created	2
Joint research projects created	2
Student-to-professor ratio	22:1
Budget for scientific research	18 billion dinars
Projected budget for scientific research in 2025	20 billion dinars

While these figures indicate momentum – such as the establishment of incubators marking a significant policy push – their impact relative to the overall size of Algeria's higher education sector and the depth of integration needed for University 4.0 requires further evaluation (Yousefi & Semssoum, 2025). Similarly, the increase in the research budget to 18 billion dinars is noteworthy, though its sufficiency compared to international benchmarks for R&D investment remains a key question. Moreover, although certain projects are increasingly aligned with economic sectors, their contribution to diversifying employment opportunities remains modest, as the job market continues to be predominantly oriented toward the education sector (Noui, 2025). A critical evaluation of the current tangible impact of these achievements on educational quality reveals underlying concerns regarding graduate employability, as they appear to represent primarily infrastructural enhancements rather than substantive pedagogical or systemic transformations.

Recently, in a ministerial decision dated January 19, 2025, the Algerian MHESR (2025) has officially announced the creation of a national committee for monitoring and evaluating HEIs in their transition to University 4.0. This initiative aligns with the global evolution of higher education towards digital transformation, technological integration, and

innovation-driven education models. The committee is tasked with overseeing and guiding the transition process by:

- Developing strategic plans to ensure institutions adapt to new challenges and leverage opportunities presented by technological and scientific advancements.
- Defining a national roadmap for HEIs to align with the University 4.0 model while considering national priorities and institutional specificities.
- Supervising and evaluating projects and programs related to this transformation.
- Assessing educational infrastructures and supporting institutions in implementing the necessary digital and pedagogical reforms.
- Raising awareness and providing training on the core principles of University 4.0.
- Encouraging interdisciplinary collaboration and promoting the integration of technological disciplines.

The committee comprises representatives from leading Algerian universities, research institutions, and specialized higher education schools. It will meet every three months or as needed and has the authority to engage external experts to support its mission. The committee's findings and progress will be regularly reported to MHESR. This decision marks a significant step in modernizing Algeria's higher education system, ensuring its institutions remain competitive and aligned with international standards in digital transformation and smart education. While the establishment of this national committee signifies a crucial step towards coordinated action and high-level political will, its ultimate effectiveness will hinge on several factors. These include its ability to secure sustained funding for initiatives, navigate potential bureaucratic inertia, ensure genuine stakeholder collaboration beyond formal representation, and translate strategic plans into tangible changes within diverse institutional contexts across the country. Thus, monitoring its operational capacity and influence will be critical.

3.1 Drivers of the Shift

The move towards Education 4.0 and University 4.0 in Algeria is a multifaceted process driven by a confluence of internal and external factors. Recognizing these drivers is crucial to understanding the motivations, opportunities, and challenges associated with this educational transformation. Several internal factors contribute to the impetus for educational reform in Algeria, reflecting the country's socioeconomic aspirations and perceived shortcomings in its existing education system.

A significant internal driver stems from the official recognition of challenges within the existing system. The National Commission for the Reform of Education highlighted issues such as low pass rates on national exams and high dropout rates as indicators of a deteriorating educational system in urgent need of revitalization. This recognition fuelled reforms aimed at enhancing quality, relevance, and efficiency. Furthermore, persistent mismatches between graduate skills and labour market needs, coupled with stagnating research outputs in key fields, reinforced the imperative for comprehensive systemic transformation.

Moreover, a central aim of educational reform is to foster economic development and job creation by aligning education with market demands. The Algerian government views education as a crucial vehicle for economic prosperity and sees the need to equip graduates with the skills required for a rapidly changing job market. The emphasis on competency-based education, digital literacy, and entrepreneurship reflects a desire to cultivate a

workforce capable of contributing to a knowledge-based economy. The recent efforts of MHESR consistently portray Education 4.0 as a pathway to producing graduates ready for the demands of a technology-driven world and capable of contributing to national economic growth.

The Algerian government has demonstrated a clear commitment to investing in education and digital infrastructure, which is essential for facilitating the transition to Education 4.0 and University 4.0. This commitment is evidenced by tangible actions such as the expansion of fiber optic networks to universities and the funding of programs focused on digital resource development. These initiatives aim to modernize the educational landscape and enhance access to quality education. Policy documents and public statements by government officials consistently emphasize the prioritization of digitalization as a strategic goal. However, despite these investments, challenges remain concerning the equitable distribution of digital resources and their effective utilization across all HEIs, indicating that implementation gaps still need to be addressed for these reforms to achieve their full potential.

In addition to internal factors, external influences play a significant role in shaping Algeria's educational reforms. These influences reflect the country's integration into the global educational landscape and its responsiveness to international trends and standards. International organizations and their agendas, such as the UN's 2030 Agenda for Sustainable Development, exert pressure on countries to align their educational systems with global goals. The educational transformations in Algeria resonate with these global agendas, emphasizing inclusivity, quality education for all, and the promotion of English Medium Instruction (EMI). These external pressures encourage the adoption of policies and practices that conform to international standards and expectations.

Furthermore, university rankings and international best practices serve as benchmarks, motivating countries to enhance the quality and competitiveness of their higher education systems. Algeria's efforts to improve its standing in global university rankings, such as the Times Higher Education World University Rankings, reflect a desire to be recognized as a hub for quality education and research. The pursuit of excellence and recognition on the global stage drives reforms aimed at aligning Algerian universities with international standards.

It is important to note that these internal and external drivers are intertwined and mutually reinforcing. The desire for economic development, for example, is influenced by global economic trends and competition, while the pressure to improve educational outcomes is shaped by international benchmarks and comparisons. Nevertheless, the tension between embracing global trends and preserving national identity may raise. The debate surrounding language policy in education—specifically the role of French versus Arabic and the introduction of English—illustrates this tension.

The involvement of European, particularly French, experts in shaping educational reforms also raises sensitivities in a post-colonial context. This reliance on foreign expertise can be viewed as a pragmatic approach to accessing global knowledge and best practices. However, it also sparks concerns about the potential imposition of Western-centric models that may not fully align with Algeria's cultural context and decolonization goals. Thus, there is a need for a new approach that balances the adoption of international best practices with the preservation of Algerian identity and the consideration of local needs and priorities. The challenge lies in navigating these complexities to ensure that the shift to Education 4.0 and University 4.0 genuinely benefits Algerian society and contributes to a more equitable, inclusive, and culturally relevant educational system.

3.2 Challenges

The implementation of Education 4.0 and University 4.0 encountered several challenges worldwide (Selamat et al., 2017; Mian et al., 2020). In Algeria, while driven by aspirations for progress, has encountered -and is encountering- significant challenges. The most pressing issue, frequently voiced by educators and reported in educational forums, is curriculum overload, particularly in foundational years. For instance, STEM programs often require students to cover an extensive theoretical base, leaving insufficient time for the project-based learning and experimentation central to Education 4.0. This pressure encourages rote memorization over deep understanding and critical application. Furthermore, teachers struggle to cover the vast content within limited time-frames, resorting to traditional didactic methods due to inadequate training in student-centred pedagogies.

Algeria's adoption of competency-based education, signifying a shift towards learner-centred approaches, has encountered significant implementation challenges. Although policy frameworks emphasize the development of skills and abilities aligned with 21st-century demands, classroom practices frequently lag behind. Traditional teacher-centred methods persist, reinforcing rote learning and impeding the cultivation of critical thinking, creativity, and problem-solving skills. Such a disconnect between policy intent and classroom reality constitutes a critical bottleneck in the reform process (Lahmar, 2024). It is largely attributed to insufficient training and support for educators, many of whom lack the professional development, pedagogical resources, and familiarity with digital assessment tools necessary to facilitate active learning effectively.

In addition, equity and access remain pressing concerns in Algeria’s higher education system, particularly as digitalization accelerates. The rise of private tutoring as a parallel system to formal education has raised serious social justice issues, placing a financial burden on students from lower-income backgrounds and potentially undermining equal opportunity (Benrouina & Malki, 2023; Bouchikhi & Barka, 2017). Ethical concerns, including conflicts of interest and the lack of regulation in the private tutoring sector, further exacerbate these disparities. At the same time, the digital divide presents a major barrier to equitable access. Despite improvements in infrastructure, significant disparities persist in reliable internet connectivity, access to digital devices, and levels of digital literacy—particularly between urban and rural areas and among different socioeconomic groups. As learning environments increasingly rely on digital tools and platforms, these inequalities threaten to deepen existing educational divides within the higher education landscape.

The psychological and emotional toll on students is another significant concern. The pressure to excel within a demanding system has led to a perception of school as a burden or even a "prison" for some students, creating an environment of stress and anxiety rather than fostering a love of learning (Dou & Chouli, 2021). Burnout and disengagement are also prevalent, as an overloaded curriculum, high-stakes exams, and societal pressure can diminish motivation and hinder overall development. Furthermore, the demands of the curriculum often extend beyond the classroom, putting pressure on parents to become heavily involved in their children's schoolwork, which can strain family relationships.

Addressing these challenges requires a holistic approach to implementing Education 4.0 and University 4.0 in Algeria. This involves critically reviewing the curriculum to ensure balance between breadth and depth, prioritize depth of understanding over rote memorization, and align content with students' developmental stages. Transforming pedagogical practices is essential, equipping teachers with the skills and knowledge to embrace student-centred, interactive learning methods that promote critical thinking and problem-solving. Investing in teacher education and professional development is crucial, providing ongoing training,

mentorship, and opportunities for collaboration. Addressing equity concerns is paramount, including regulating private tutoring, providing financial support for disadvantaged students, and bridging the digital divide by ensuring equal access to technology and resources. Prioritizing student well-being by creating a supportive and engaging learning environment that fosters a love of learning and reduces stress is essential. Finally, balancing global and local perspectives is vital, prioritizing local knowledge and context, ensuring cultural relevance, and adapting international best practices to the specific needs of Algerian society. By taking these steps, Algeria can harness the potential of Education 4.0 and University 4.0 to create a more equitable, innovative, and thriving educational system that empowers its citizens.

4. Recommendations and Future Directions

Algeria's aspirations to implement Education 4.0 and University 4.0 present both opportunities and challenges. The sources highlight the need for a holistic and nuanced approach to reform, one that addresses the concerns raised by parents, teachers, and researchers while harnessing the potential of these initiatives to create a more equitable, innovative, and thriving educational system. The following recommendations and future directions draw on the insights from the sources and our conversation history to guide the successful implementation of these reforms in Algeria.

First, to directly address the challenge of curriculum overload and outdated pedagogy identified in Section 3.2, curricula must be rigorously reviewed and redesigned. This involves reducing curriculum overload by prioritizing depth of understanding over the sheer quantity of material, and aligning content with developmental stages, ensuring meaningful learning and avoiding unnecessary stress. The curriculum should emphasize real-world applications, interdisciplinary connections, and student interests to enhance engagement. A balance between breadth and depth is needed, prioritizing core subjects and skills while allowing for in-depth exploration of specific areas of interest. Technology must be integrated meaningfully, enhancing learning, promoting critical thinking, and preparing students for the digital world. Finally, developing clear learning outcomes for each subject and grade level will ensure assessment practices align with desired skills and knowledge.

Second, transforming pedagogical practices is essential, moving from traditional, teacher-centred, rote-learning to interactive, student-centred approaches. This includes active learning through discussions and problem-solving, collaborative learning, inquiry-based learning, and personalized learning that recognizes diverse learning styles. Technology should be integrated effectively by ensuring adequate infrastructure, providing teacher training, and selecting technology that aligns with pedagogical goals.

Third, investing in continuous teacher education is crucial. However, given the scale of the higher education system and potential resource constraints, this requires innovative approaches beyond traditional workshops, such as scalable online training modules, peer-mentoring networks, and incentives for pedagogical innovation, focusing specifically on integrating technology meaningfully and adopting student-centred methods suited to the Algerian context.

Fourth, addressing equity and access concerns in Algerian HEIs necessitates a multifaceted approach. Targeted support measures—such as scholarships, financial aid, and institutional assistance—must be implemented to ensure that students from disadvantaged backgrounds have equal opportunities. Therefore, the feasibility of successful transformation hinges on addressing critical questions of sustainable funding models beyond current budget allocations. Moreover, bridging the digital divide requires sustained public investment in

infrastructure, particularly in under-served regions, alongside subsidized access to devices and internet connectivity. Moreover, promoting student well-being must be a central component of equity strategies. This involves fostering a supportive academic environment, managing performance expectations, and ensuring access to mental health services. Higher education should aim to cultivate the development of the whole individual, nurturing not only academic success but also social-emotional competencies, creativity, resilience, and critical thinking.

Fifth, balancing global trends with local needs requires institutional mechanisms, such as curriculum committees explicitly mandated to incorporate Algerian case studies and knowledge, and fostering research that addresses national priorities (e.g., water management, renewable energy, health challenges) alongside international collaboration. Besides, the linguistic diversity of Algeria must be addressed with sensitivity, supporting Arabic and Amazigh languages while recognizing the role of French and English in a globalized world. Furthermore, colonial sensitivities need to be acknowledged through open dialogue and a commitment to decolonizing the curriculum.

Finally, it is recommended to strengthen university-industry partnerships and to promote research and development. This will create opportunities and align education with workforce needs. Partnerships with civil society organizations are also essential to address equity concerns and leverage their expertise. Moreover, a robust monitoring system must be implemented to track progress, assess impact, and identify areas for improvement. Regular evaluations involving stakeholders at all levels will gather feedback for necessary adjustments, and transparency and accountability must be maintained. By embracing these recommendations and future directions, Algeria can effectively implement Education 4.0 and University 4.0 while honoring its cultural heritage, promoting equity and well-being, and empowering its citizens to thrive in a rapidly evolving world.

5. Conclusion

The University 4.0 model, characterized by innovation, digitalization, and personalized learning, represents the latest phase of transformation, aligning with the broader shift towards Industry 4.0 and the integration of cyber-physical systems, AI, and automation in various domains. In turn, Algerian HEIs attempt to keep pace with global developments in the field of higher education, and seek to transform into smart universities that meet the needs of the labour market in the 21st century. Algeria stands before an opportunity to restructure its strategic sectors by adopting Industry 4.0 technologies which are at the forefront of innovations sought to be integrated into various strategic and vital sectors such as hydrocarbons, agriculture, pharmaceutical industries, manufacturing industries, and business start-ups.

Algeria’s commitment to transitioning towards University 4.0 reflects its broader national strategy to improve key sectors, enhancing economic growth and global competitiveness. However, for this transformation to be fully realized, the current funding and ranking systems must evolve beyond traditional metrics to capture universities' socioeconomic contributions, such as employability, social mobility, digital inclusion, and innovation-driven development. The success of this transition depends not only on technological adaptation but also on a fundamental shift in how universities are assessed and incentivized. By aligning higher education policies with the principles of innovation, inclusion, and knowledge transfer, Algeria can position its universities as engines of national development. Moving forward, the key question should not only be what universities excel at but what they contribute to society. Only through this holistic approach can University 4.0 serve as a transformative force, bridging the gap between education, industry, and sustainable development.

References

Akturk, C., Talan, T., & Cerasi, C. C. (2022). Education 4.0 and University 4.0 from Society 5.0 Perspective. In *2022 12th International conference on advanced computer information technologies (ACIT)* (pp. 577-582). IEEE. https://doi.org/10.1109/ACIT54803.2022.9913099

Al-Zoubi, A., Pozzo, M. I., Ciolacu, M. I., Alves, G. R., & Kist, A. A. (2024). University 4.0: The future of higher education in the Age of Technology. In *International Conference on Smart Technologies & Education* (pp. 122-134). Cham: Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-61891-8_12

Beloev, H., Smrikarov, A., Ivanova, A., Vassilev, T., Georgiev, T., Smrikarova, S., Ivanova, G., Stoykova, V., Ibryamova, E., Aliev, Y., & Zlatarov, P. (2020). A Vision of the University of the Future. In *Proceedings of the 21st International Conference on Computer Systems and Technologies* (pp. 307-312). https://doi.org/10.1145/3407982.3408027

Benrouina, M., & Malki, O. (2023). Assessing the impact of quality of education on the knowledge economy: evidence from Algeria. *SocioEconomic Challenges*, *7*(2), 94-104. https://doi.org/10.21272/sec.7(2).94-104.2023

Bonfield, C. A., Salter, M., Longmuir, A., Benson, M., & Adachi, C. (2020). Transformation or evolution?: Education 4.0, teaching and learning in the digital age. *Higher education pedagogies*, *5*(1), 223-246. https://doi.org/10.1080/23752696.2020.1816847

Borrageiro, K., & Mennega, N. (2023). Essential Skills Needed in the Fourth Industrial Revolution (4IR): A Systematic Literature Review. In *2023 IST-Africa Conference (IST-Africa)* (pp. 1-13). IEEE. https://doi.org/10.23919/IST-Africa60249.2023.10187815

Bouchikhi, F., & Barka, Z. M. (2017). Higher Education in Algeria: Achievements and Challenges 1963 to 2017. *UBT International Conference,* 115 (pp. 46-50). https://doi.org/10.33107/ubt-ic.2017.115

Boyd, L., Lu, Y., & Souppez, J. B. R. (2023). Pedagogy 4.0: Employability skills and computer aided design (CAD) education for Industry 4.0. In *2023 28th International Conference on Automation and Computing (ICAC)* (pp. 1-6). IEEE. https://doi.org/10.1109/ICAC57885.2023.10275222

Cervantes, M. (2018). Higher education institutions in the knowledge triangle. In D. Meissner, E. Erdil, & J. Chataway (Eds), *Innovation and the entrepreneurial university* (pp. 115-142). Springer. https://doi.org/10.1007/978-3-319-62649-9_6

De Souza, A. S. C., & Debs, L. (2024). Concepts, innovative technologies, learning approaches and trend topics in education 4.0: A scoping literature review. *Social Sciences & Humanities Open*, *9*, 100902. https://doi.org/10.1016/j.ssaho.2024.100902

Dou, A. (2021). Adopting Technological Methods in the Algerian Higher Education: Challenges and Recommendations. In S. S. Lobiyed, & C. C. Faller (Eds), *La formation entre problématiques et perspectives* (pp. 221-230). La Nouvelle Publication Universitaire (NPU).

Dou, A., & Chouli, A. (2021). Sources and Levels of Foreign Language Teaching Anxiety among Pre-Service and In-Service Algerian EFL Teachers. *Journal of Studies in Language, Culture and Society (JSLCS), 4*(2), 103-114.

Etzkowitz, H., & Zhou, C. (2017). *The triple helix: University–industry–government innovation and entrepreneurship*. 2nd Ed. Routledge. https://doi.org/10.4324/9781315620183

González-Pérez, L. I., & Ramírez-Montoya, M. S. (2022). Components of Education 4.0 in 21st century skills frameworks: systematic review. *Sustainability, 14*(3), 1493. https://doi.org/10.3390/su14031493

Gregg, A., Park, J., Fenton, C., Lang, D., & Handley, M. (2022). Exploring the "Why" of Micro-Credentials and Digital Badges: Engineering Students' Motivations for and Perceived Utility of Learning Outside of Class. In *2022 IEEE Frontiers in Education Conference (FIE)* (pp. 1-7). IEEE. https://doi.org/10.1109/FIE56618.2022.9962376

Harkins, A. M. (2008). Leapfrog principles and practices: Core components of education 3.0 and 4.0. *Futures Research Quarterly*, *24*(1), 19-31.

Hımmetoglu, B., Aydug, D., & Bayrak, C. (2020). Education 4.0: Defining the teacher, the student, and the school manager aspects of the revolution. *Turkish Online Journal of Distance Education*, *21*(Special Issue-IODL), 12-28. https://doi.org/10.17718/tojde.770896

Hussin, A. A. (2018). Education 4.0 made simple: Ideas for teaching. *International Journal of Education and Literacy Studies*, *6*(3), 92-98. https://doi.org/10.7575/aiac.ijels.v.6n.3p.92

Koseda, E., Cohen, I. K., McIntosh, B., & Cooper, J. (2025). Internationalisation and digital transformation in HEIs: The impact of education 4.0 on teaching, learning and assessment. *Policy Futures in Education*, *23*(1), 1-9. https://doi.org/10.1177/14782103241226531

Kothari, P., & Chatterjee, A. (2014). Education 3.0 and beyond: A learner-led experience of education. In *International Conference on Computers in Education*.

Lahmar, F. (2024). Educational Reform in Algeria: Dilemmas of Globalization, Equity, and Decolonization. In B. Akgün, & Y. Alpaydın (Eds), *Global Agendas and Education Reforms: A Comparative Study* (pp. 3-24). Palgrave Macmillan. https://doi.org/10.1007/978-981-97-3068-1_1

Mian, S. H., Salah, B., Ameen, W., Moiduddin, K., & Alkhalefah, H. (2020). Adapting universities for sustainability education in industry 4.0: Channel of challenges and opportunities. *Sustainability*, *12*(15), 6100. https://doi.org/10.3390/su12156100

Noui, F. (2025). University Graduates in Algeria: What Future Awaits Them Amid Escalating Unemployment?. *Humanization Journal for Researches and Studies, 15*(2), 201-215.

Schwab, K. (2017). *The Fourth Industrial Revolution*. Portfolio Penguin.

Selamat, A., Alias, R. A., Hikmi, S. N., Puteh, M., & Tapsi, S. M. (2017). Higher education 4.0: Current status and readiness in meeting the fourth industrial revolution challenges. *Redesigning higher education towards industry*, *4*, 23-24.

The Algerian MHESR. (2025). *Ministerial decision No 040 on the establishment of a national committee for monitoring and evaluating higher education institutions in their transition to University 4.0* [Official document].

Vijayalekshmi, S., Twetwa-Dube, S., Vinoth-Kumar, D., & Gumbo, S. (2023). The Role of Higher Education Institutions in Enabling the Fourth Industrial Revolution: A Bibliometric Analysis. In *2023 IEEE AFRICON* (pp. 1-3). IEEE. https://doi.org/10.1109/AFRICON55910.2023.10293692

Yousefi, M., & Semssoum, A. (2025). The role of the university incubators in implementing Ministerial Resolution 1275, supporting the fourth-generation university 4.0 - A field study of the University of Blida 2 incubator (2022/2023). *Beam Journal of Economic Studies, 9*(1), 406-423.