

Digital Transformation: Establishing Smart University

Dahmani Nour El Houda¹, Kafi Farida²

¹*Sustainable Local Development Laboratory: Agriculture, Rural Development and Ecotourism, Faculty of Economic, Commercial and Management Sciences; University of Chadli Bendjedid-El Tarf; Algeria;*
dahmani-nourelhouda@univ-eltarf.dz

²*Faculty of Economic, Commercial and Management Sciences; University of Chadli Bendjedid-El Tarf; Algeria;*
kafi.farida@univ-eltarf.dz

Article Information

Article history

Received: 12 January 2025

Accepted: 3 March 2025

Published: 31 March 2025

Corresponding Author

Dahmani Nour El Houda

Email: dahmani-nourelhouda@univ-eltarf.dz

Copyright © 2025, University center of Abdelhafid Bousof, Mila. This is an open access article under the CC BY-NC-ND license.

Suggested Citation

Dahmani, N, E, H. & Kafi, F. (2025). Digital Transformation: Establishing Smart University, Finance and Business Economics Review, Vol.9 , No. 1, pp. 42-50. DOI : 10.58205/fber.v9i1.1934

Abstract: The contemporary global landscape is undergoing a significant transformation characterized by advancements in information technology and digital innovation, which have become increasingly ubiquitous across various sectors, particularly in the aftermath of the fourth industrial revolution. Consequently, the paradigm of smart universities has emerged, presenting a considerable challenge for numerous nations worldwide, particularly those in the developing category, which aspire to position their educational institutions within the context of the globalized higher education framework, as delineated by the concept of the smart university era. This study aims at showcasing how digital transformation contributes to establishing the concept of smart university. Further, it endeavors to shed light on the key features, advantages, and criteria necessary for the establishment of this type of universities. The findings revealed that smart universities have become an inevitable necessity to keep pace with technological development in higher education due to its infinite benefits as long as specific requirements should be maintained, most importantly adequate communications infrastructure and strong technological atmosphere.

Keywords: Digital Transformation; Smart University; Higher Education System.

1. Introduction

FBER

42

The rapid progression of technology has profoundly altered both the methods of education and the structures of professional involvement in the modern milieu of the 21st century. The phenomenon of global interconnectedness has established not merely classrooms devoid of geographical constraints, but has also given rise to virtual environments for professional collaboration. The prevailing dialogue surrounding lifelong education, requisite competencies, and graduates prepared for the future underscores an urgent necessity to reassess the current instructional frameworks within Higher Education (HE) and to reimagine strategies for better equipping and empowering our graduates, thereby enhancing their employability and mobility within the 21st-century labor market (Stracke, 2011).

The shift of our industries from the third to the fourth revolution opened up new avenues, creating numerous opportunities for human progress, as highlighted by the incorporation of impressive technological advancements.

The sophisticated technologies characteristic of the Fourth Industrial Revolution tend to converge within the commercial sphere, facilitated by various technologies including machine learning, big data analytics, the Internet of Things (IoT), and particularly, Artificial Intelligence (AI). The Fourth Industrial Revolution has already altered both the digital and natural environments while presenting exceptional business prospects for aspiring entrepreneurs in the future (Hamdan et al., 2021).

1.1. Research Problematic

How does digital transformation contribute to establishing smart universities?

This research problem leads to several sub-questions:

- What are the benefits of digital transformation in the higher education system?
- What are the characteristics and advantages of smart universities?
- What are the criteria for establishing smart universities?

1.2. Research Aims

This study aims at:

- Highlighting the importance and benefits of digital transformation at the level of the higher education system.
- Shedding light on the characteristics and significance of smart universities.
- Focusing on the requirements for establishing smart universities.
- Showing some international and Arab models of smart universities.

1.3. The Significance of the Study

The importance of the study lies in the necessity of moving to smart universities within the framework of digital transformation keeping pace with technological development in the field of higher education, that is a topic which receiving wide attention at the present time from countries to establish the requirements for a smart universities.

2. The Effect of Digital Transformation on Higher Education System

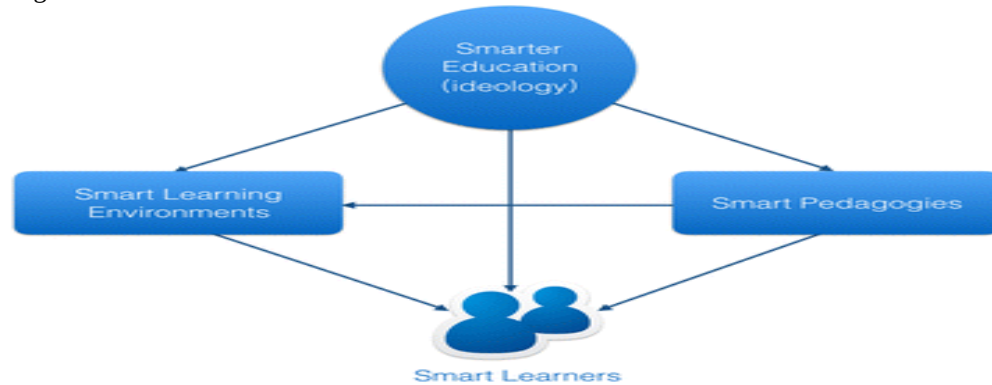
On a global scale, the governance of higher education institutions is actively distributing knowledge concerning the impact of AI on pedagogical and developmental methodologies, augmented by intelligent technologies, innovative classroom configurations, and advanced teaching strategies, thereby augmenting the cognitive competencies of learners and evolving instructors into adept educational facilitators (Mohanachandran et al., 2021).

The conventional paradigm of education within academic institutions such as colleges satisfies the infrastructural prerequisites of a physical classroom through the utilization of traditional tools including blackboards, chalkboards, textbooks, formal assessments, and assignments to be completed at home. Students are required to be present in the classroom, participate in lectures, and the educational framework is predominantly tailored for collective learning. The instructional approach is primarily centered on both the educator and the learner (Copeland, 2016).

Nevertheless, the advent of online and AI-driven educational methodologies promotes adaptive learning that is contingent upon the interests and schedules of the students, thus facilitating a more personalized educational experience. Learners are afforded the flexibility to access educational modules from any geographical location and can engage with a plethora of materials pertinent to their academic pursuits. They have the capability to participate in classes, wherein automated clarifications and ongoing feedback regarding their academic performance are provided. The incorporation of AI platforms consequently augments the competencies of educators while simultaneously broadening the learning opportunities available to students. The utilization of cloud-based infrastructure and online learning, supported by digital textbooks and educational resources, increasingly motivates both regular and working professionals to seize educational opportunities. The expansion of temporal, pedagogical, and spatial dimensions, bolstered by AI and technological applications, has consequently facilitated enhanced opportunities for learning and development on a global scale (Copeland, 2016).

The scenario of smart education started from the 1990s with the Malaysian Smart School that was implemented in 1997 to meet the challenges of the twenty-first century (Mohanachandran et al., 2021).

Figure: 1 Research Framework of Smart Education



Source: Reproduced from "A research framework of smart education", by Z. T. Zhu, M. H. Yu, & P. Riezebos, 2016, *Smart Learning Environments*, 3(4), p. 6 (<https://doi.org/10.1186/s40561-016-0026-2>)

In the context of intelligent educational paradigms, Zhu et al. (2016) asserts that the concept of smart education originates from a sophisticated environment wherein educators and learners are intricately linked to technological innovations. This sophisticated system enhances tailored educational services and empowers students to engage as intelligent learners. The role of the smart pedagogue will profoundly impact the technology-driven educational landscape, thereby advancing the learning objectives aimed at fostering intelligent learners.

Decision-makers at academic institutions need to put into action strategic plans aimed at progressively evolving their universities into smart universities, which provide advanced methods of learning and teaching. This transition is instrumental in optimizing the utilization of time, effort, and financial resources in relation to both the acquisition and dissemination of knowledge. Furthermore, it is imperative to extend this transformation to encompass administrative functionalities, as well as the architectural frameworks and engineering designs of university facilities, thereby rendering them more conducive to this significant evolution. Such advancements are anticipated to yield beneficial outcomes on the educational process and contribute to societal development while serving the broader interests of humanity (Tikhomirov et al., 2015).

3. The Shift towards Smart University

In response to the demands posed by the contemporary educational landscape, universities are perpetually adapting innovative frameworks for the integration of academic infrastructure. Through the inventive synthesis of cutting-edge ideas, proficient software and hardware systems, intelligent learning environments incorporating advanced technologies, and automated platforms, a novel paradigm of higher education is emerging, which is designated as the "Smart University" (Mohanachandran et al., 2021).

Currently, numerous higher education institutions globally aspire to transition into smart universities; this ambition is attributed to various factors, including significant technological progress, the influence of AI, and its crucial role in improving and transforming educational practices, particularly during this era. Consequently, universities are integrating intelligent technologies within their infrastructure to refine educational operations and enhance overall efficacy. Furthermore, the smart university endeavors to elevate the caliber of scholarly output, minimize production expenses, enhance the quality of education, and facilitate students' ability to engage in teaching and learning under diverse conditions and across various locations (Al-Shoqran & Shoeman, 2021).

The idea of a "Smart University" made education accessible from any location. This advancement presents fewer risks and challenges since information can be accessed and refreshed consistently. Smart Universities have made progress in unlocking individuals' potential and improving the quality of education by implementing artificial intelligence (Swartout et al., 2016).

Additionally, the surging enrollment rates in tertiary education, coupled with the enhanced accessibility of sophisticated technologies, are instigating profound

transformations in our educational methodologies. Institutions of higher learning, as pivotal knowledge hubs, are embracing these emergent technologies to evolve into technologically advanced smart cities (Polin et al., 2023). For example, biometric facial recognition systems are supplanting conventional identification cards, while immersive technologies such as augmented reality (A.R.) and virtual reality (V.R.) are augmenting educational prospects. The widespread implementation of fifth-generation (5G) internet is significantly improving connectivity within educational institutions in unparalleled manners, and AI digital assistants are facilitating students in the organization of their academic schedules (Polin et al., 2023).

3.1. Definition of Smart University

Smart universities are adopting Smart Pedagogy-focused academic approaches that utilize artificial intelligence-driven learning and academic analytics, extending beyond engineering fields to include social sciences, arts, and various interdisciplinary domains. (Mohanachandran et al., 2021).

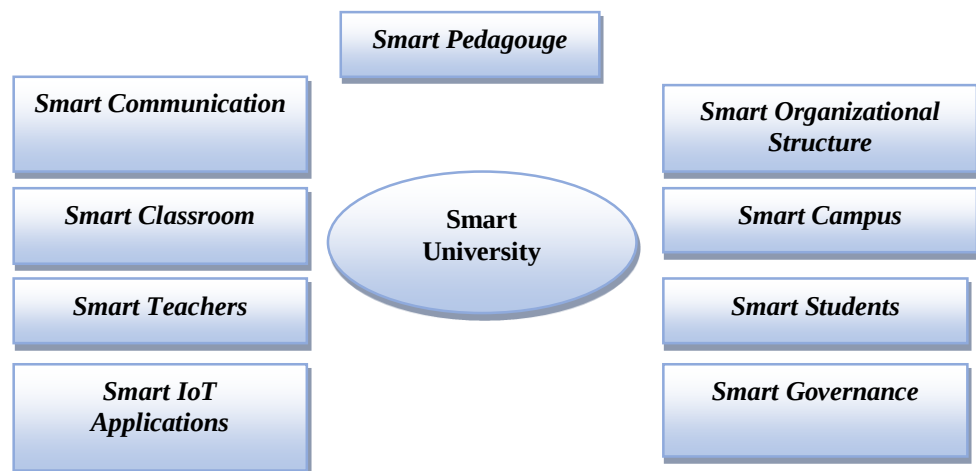
Numerous definitions exist to elucidate the concept of a “Smart University”, which provides a framework for preliminary data to propel the analysis and enable comprehensive quality improvement in instructional and educational settings. The concept of a Smart University is clearly defined by Cambridge Centre for Smart Infrastructure and Construction (CSIC) (2016) as a holistic transformation of educational paradigms that integrate intelligent classrooms, educators, pedagogical methodologies, learners, and cutting-edge technology.

Tikhomirov et al. (2015) introduced the idea of smart universities, describing smart education as a framework that requires a comprehensive improvement of the whole educational system. This definition clarifies that a smart university integrates technologies like interactive whiteboards, digital displays, and widespread wireless Internet access.

Figure2: Conceptual Model—Smart university

FBER

45



Source: *Note.* Reproduced from “Smart university and artificial intelligence”, by D. K. Mohanachandran, C. T. Yap, Z. Ismaili, & N. S. Govindarajo, 2021. In A. Hamdan, A. E., Hassanien, A. Razzaque & B. Alareeni (Eds.), *The fourth industrial revolution: Implementation of artificial intelligence for growing business success*, pp. 255-279. Springer.

Utilizing technology in all aspects of academic administration is the foundation of the smart university concept. By implementing advanced technologies and automated administrative strategies, smart universities will facilitate learning and development alongside typical administrative tasks. Employees at every level of administration will be able to participate in their work and achieve objectives, aided by automated processes. This technological involvement will lower operating costs compared to traditional organizational and operational methods (Diwan, 2017). The students, educators, and supportive staff can utilize networks and automated tools in a technology-enhanced academic and administrative setting (Radhakrishnan & Balasubramanian, 2010).

3.2. Characteristics of Smart University

The characteristics of smart universities are examined to elucidate the distinctions between smart universities and their conventional counterparts (Spector, 2014).

•**Effectiveness:** The outcomes or desirable results associated with smart universities are expected to demonstrate a favorable level of performance when contrasted with traditional universities.

•**Efficiency:** Smart universities are required to exhibit superior performance in terms of cost efficiency and the rapid exchange of data.

•**Scalable:** Smart universities possess the capability to extend their reach without limitations across the campus and beyond external boundaries.

•**Autonomous:** Smart universities are equipped to function autonomously in addressing real-world scenarios involving students and faculty. They possess the capacity to structure learning plans that assist learners in acquiring the appropriate knowledge at the optimal time, thereby reflecting enhancements in their academic outcomes.

•**Engaging:** Smart universities possess the capability to motivate students to actively take part and interact more efficiently with the frameworks of smart universities than traditional institutions.

•**Flexible:** Smart universities exhibit a strong ability to adapt to new developments or modifications, efficiently handling new resources, courses, and goals.

•**Adaptive:** Smart universities are adept at addressing the diverse needs, interests, and learning models of each individual learner.

•**Personalized:** Smart universities take a leading role in recognizing the individual differences among learners, as students who encounter challenges in educational achievement necessitate supportive exercises and specialized assignments. Furthermore, distinguished and rapidly advancing students require opportunities to enhance their experience and elevate their academic standing.

•**Conversational:** Smart universities implement robust systems that facilitate learners in initiating group dialogue sessions to exchange opinions and information regarding pertinent topics.

•**Reflective:** Intelligent universities are capable of performing self-evaluations through their systems to assess the progress of both students and staff, and to propose strategies for improving overall effectiveness.

•**Innovative:** Intelligent universities stay updated with advancements in science and technology as well as foster creativity.

•**Self-Organizing:** Intelligent universities need to reorganize and manage their resources effectively to enhance the productivity of students and staff across various dimensions.

3.3. Advantages of Smart University

Gaffney (2010) summarized some smart academic advantages that can be articulated as follows:

- Conventional universities have the potential to broaden the scope of academia's daily functions and obligations without enhancing the capabilities through advanced communication and machine learning technologies.

- The effective integration of technological platforms enhances efficiency and productivity in academic and administrative tasks by allowing for the ongoing processing, distribution, and management of data.

- Universities that are labeled as smart, utilizing machine learning technologies, offer chances to enhance the understanding and value of academic programs by integrating a variety of teaching methods at different levels of intensity.

- Facilitate collaborative learning among students, whether within the institution or externally, while also offering the opportunity to engage with peers from different countries.

- Promote effective interactions among educators, learners, and administrative personnel, thereby ensuring stability and ease in the management of systems and processes.

- Have the potential to resolve numerous challenges associated with traditional education systems through the empowerment provided by technology.

- Involve the substitution of conventional staff with intelligent staff who possess the ability to integrate their work with appropriate technology and cognitive processes.

- Promote sustainable academic offerings and growth opportunities by collaborating with the community and working together with a group of universities.

4. Criteria for the Effective Establishment of Smart Universities

To establish a smart campus with enhanced efficiency and dependability, an adequate communications infrastructure is necessary to support the needs of tracking educational progress, such as an advanced power grid that features a well-designed electric power infrastructure, monitored through automated systems, energy management, specialized power converters, and long-term network reliability (Gungor et al., 2011). Additionally, smart universities depend on strong systems that facilitate and oversee their evolution into smart institutions. For example, certain universities have started to adopt systems aimed at enhancing student learning, such as the University of Southern California (USC), which has launched a project known as Designing a Personal Assistant for Life-Long Learning (PAL3) to study the methods used in classrooms (Swartout et al., 2016).

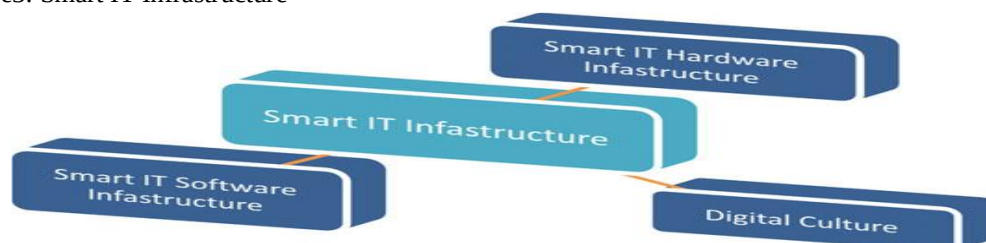
The incremental substitution of conventional pedagogical approaches with digital educational modalities constitutes a fundamental element in the evolution towards intelligent universities. Given the swift advancement of curricular offerings, it is recommended to investigate innovative methodologies grounded in educational instruments and technological advancements (Yu et al., 2021). The incorporation of digital learning modalities, including the utilization of tablets and sophisticated software applications, significantly augments educational experiences within the classroom context. Furthermore, Social media platforms and networking websites facilitate the organization and management of digital tasks and timelines (Uskov et al., 2018).

The expansion of digital learning platforms, propelled by elements such as enhanced internet connectivity and widespread smart phone usage, constitutes a further justification for the transition towards intelligent university frameworks (Farrah & al-Bakry, 2020).

The COVID-19 pandemic has catalyzed this phenomenon, resulting in a pronounced increase in the enrolment of online courses as an effective countermeasure to the cessation of in-person educational activities. The worldwide e-learning industry, which was appraised at US\$18 billion in 2019, is projected to expand, thereby presenting universities with profitable prospects (Moneim, 2020).

The concept of a Smart University relies on multiple interconnected and integral components as it is illustrated in figure 3. To establish a Smart Campus, key elements are necessary, such as Smart IT Infrastructure, Smart Buildings, Smart Individuals, and a Smart Educational System (Swartout et al., 2016).

Figure3: Smart IT Infrastructure



Source: Reproduced from "Artificial intelligence and smart universities", by AlAjmi, A., 2021. In A. Hamdan, A. E., Hassanien, A. Razzaque & B. Alareeni (Eds.), *The fourth industrial revolution: Implementation of artificial intelligence for growing business success*, pp.295-310. Springer.

5. Model of Smart world and Arab Universities

5.1. Hamdan Bin Mohammed Smart University (HBMSU)

Hamdan Bin Mohammed Smart University (HBMSU) is the first smart university in Dubai. It initiated its journey towards smart education in 2008. The university is regarded as

a smart community environment that is equipped with advanced AI technology. As a smart hub, the university has collaborated with prominent smart systems firms such as Signify, previously known as Philips Lighting, Siemens, Smart City, and Trane. The smart lighting and climate control systems are currently operational, utilizing cutting-edge technologies to transform the building into a sustainable structure (AlAjmi, 2021).

Additionally, artificial intelligence is viewed as a key enabler for HBMSU by introducing a new GPS technology to assist learners in navigating this smart campus. Knowledge is being shared to enhance individuals' intellectual and social behaviours by adopting innovative educational approaches. The university provides distinctive educational experiences for students along with career opportunities for educators and researchers. Following the vision of His Highness Sheikh Hamdan Bin Mohammed, the university is fostering innovation and technology by offering a wide range of majors accessible to both local and remote students. This accessibility to education is one of the standout features of HBMSU as a smart university. Another characteristic of this smart university is its commitment to openness and information availability, providing researchers with exceptional online resources and a wealth of recorded lectures to facilitate knowledge sharing. The university is enhancing the quality of education and demonstrating strong leadership by implementing a range of innovative programs, such as the School of Education, School of Health and Smart Studies, and the School of Business and Quality Management. Moreover, the university offers Master's and Ph.D. programs delivered by a diverse faculty from a variety of disciplines to enrich students' learning experiences. The cloud campus represents another area where AI leverages advanced technologies to transform educational perceptions. This cloud campus encompasses both smart undergraduate and postgraduate programs, operating through a sophisticated data portfolio that includes recorded videos, lectures, conferences, and extensive learning resources. The idea of a cloud campus is based on cutting-edge connectivity technologies, intelligent audio and video solutions, virtual learning environments, and real-time messaging features, all overseen by creative and advanced applications (Al Ajmi, 2021).

5.2. *Stanford Smart University*

Stanford was founded almost 150 years ago on bedrock of societal purpose. The official webpage of Stanford University serves as an exemplar of the institution's dedication to the domains of AI research, education, and innovation, which makes it a smart university (<https://www.stanford.edu>).

It has an institute dedicated to the examination of the ethical and social ramifications associated with AI, known as Stanford Institute for Human-Centered Artificial Intelligence (Stanford Human-centered AI –HAI-). Every year, HAI organizes a yearly conference along with a set of seminars focused on a pertinent or emerging AI theme to stimulate new interdisciplinary research partnerships, dialogues, and discussions. Grant programs and research centers that support AI projects, courses and programs pertinent to AI, AI education and trainings for policymakers confirm the institution's willingness and interests in offering the necessary framework for establishing the concept of smart university through the integration of AI (Stanford Human-centered AI –HAI-, 2023).

6. Conclusion

The advancement of cutting-edge technologies has a pivotal role in the higher education system for both teachers and students. It helps learners in achieving more effective, efficient, flexible, and comfortable learning experiences. They will use smart devices to connect to digital resources through wireless networks, enabling them to participate in both tailored and uninterrupted learning experiences. The concept of smart university, which delineates the nature of learning in the digital era, has garnered heightened interest and becomes a crucial component of societal development, particularly in the aftermath of the COVID-19 pandemic. Organizations, encompassing higher education institutions, must integrate advanced technological systems to leverage their potential in revolutionizing operational methodologies and steering them towards innovative organizational frameworks. This can be

achieved through the establishment of a Smart University that is dedicated to enhancing its technological foundation in pursuit of its aspirational educational quality objectives.

7. References:

AlAjmi, A. (2021). Artificial intelligence and smart universities. In A. Hamdan, A. E., Hassanien, A. Razzaque & B. Alareeni (Eds.), *The fourth industrial revolution: Implementation of artificial intelligence for growing business success* (pp. 295–310). Springer.

Al-Shoqran, M., & Shorman, S. (2021). A review on smart Universities and Artificial Intelligence. In A. Hamdan, A. E., Hassanien, A. Razzaque & B. Alareeni (Eds.), *The fourth industrial revolution: Implementation of artificial intelligence for growing business success* (pp. 281-294). Springer.

Cambridge Centre for Smart Infrastructure and Construction (CSIC) (2016). Smart infrastructure: Getting more from strategic assets. *Smart Infrastructure Blog*. <https://www-smartinfrasturcture.eng.cam.ac.uk/system/files/documents/the-smart-infrastrucure-paper.pdf>

Copeland, M. (2016, July 17). The Difference between AI, machine learning, and deep learning? *NVIDIA Blog*. <https://blogs.nvidia.com/blog/whats-difference-artificial-intelligence-machine-learning-deep-learning-ai/>

Diwan, P. (2017). Artificial intelligence: Changing the education paradigm. *Chatbotslife Blog*. <https://blog.chatbotslife.com/artificial-intelligence-changing-the-education-paradigm-fa26fac41dd5>

Farrah, M., & al-Bakry, G. H. (2020). Online learning for EFL students in Palestinian universities during corona pandemic: Advantages, challenges, and solutions. *Indonesian Journal of Learning and Instruction*, 3(2), 65-78. DOI: [10.25134/ijli.v3i2.3677](https://doi.org/10.25134/ijli.v3i2.3677)

Gaffney, M. (2010). *Enhancing teachers' take-up of digital content: Factors and design principles in technology adoption*. Education Services Australia.

Gungor, V. C., Sahin, D., Kocak, T., Ergut, S., Buccella, C., Cecati, C., & Hancke, G. P. (2011). Smart grid technologies: Communication technologies and standards. *IEEE Transactions on Industrial Informatics*, 7 (4), 529-539. <https://doi.org/10.1109/tii.2011.2166794>

Hamdan, A., Hassanien, A. E., Razzaque, E., & Alareeni, E. (2021). *The fourth industrial revolution: Implementation of artificial intelligence for growing business success*. Springer.

Mohanachandran, D. K., Yap, C. T., Ismaili, Z., & Govindarajo, N. S. (2021). Smart University and Artificial Intelligence. In A. Hamdan, A. E., Hassanien, A. Razzaque & B. Alareeni (Eds.), *The fourth industrial revolution: Implementation of artificial intelligence for growing business success* (pp. 255-279). Springer.

Moneim, R. O. (2020). Towards a smart university in the light of 21st century skills. *An – Najah University Journal of Research*, 34(6). 1-24.

https://digitalcommons.aaru.edu.jo/cgi/viewcontent.cgi?article=1048&context=anujr_b

Polin, K., Yigitcanlar, T., Limb, M., & Washington, T. (2023). The making of smart campus: A review and conceptual framework. *Buildings*, 13 (4), 1-22.

DOI: [10.3390/buildings13040891](https://doi.org/10.3390/buildings13040891)

Radhakrishnan, T.K., & Balasubramanian, S. (2010). Modeling and control of multivariable process using intelligent techniques. *Sensors & Transducers*, 121 (10), 68-76.

https://www.sensorsportal.com/HTML/DIGEST/october_2010/P_697.pdf

Spector, J. M. (2014). Conceptualizing the emerging field of smart learning environments. *Smart Learning Environments*, 1 (1), 1-10.

<https://doi.org/10.1186/s40561-014-0002-7>

Stracke, C. M. (2011). Competences and skills in the digital age: Competence development, modelling, and standards for human resources development. *Communications in Computer and Information Science*, 240, (34-46).

Swartout, W., Nye, B. D., Hartholt, A., Reilly, A., Graesser, A. C., VanLehn, K., Wetzell, J., Liewer, M., Morbini, F., Morgan, B., Wang, L., Benn, G., & Rosenberg, M. (2016). Designing a personal assistant for life-long learning (PAL3). In Z. Markov & I.

Russell (Eds.), *Proceedings of the 29th International Florida Artificial Intelligence Research Society Conference, FLAIRS 2016* (pp. 491-496). AAAI press.

Tikhomirov, V., Dneprovskaya, N., & Yankovskaya, E. (2015). Three Dimensions of smart education. In: L. Uskov, V., Howlett, R., Jain, L. (Eds.), *Smart Education and Smart e-Learning. Smart Innovation, Systems and Technologies* (pp. 47-56). Springer.

Uskov, V. L., Bakken, J. P., Howlett, R. J., & Jain, L.C. (2018). Innovations in smart universities. In V. L. Uskov, J. P. Bakken, R. J. Howlett & L. C. Jain (Eds.), *Smart Universities: Concepts, Systems, and Technologies* (pp. 1-7). Springer.

Yu, P., Wei, H., Zhu, X., & Liu, H. (2021). Exploration and practice of smart classrooms in colleges and Universities. *Advances in Social Science, Education and Humanities Research*, 582, 423-427.

DOI: 10.2991/assehr.k.211011.077

Zhu, Z.T., Yu, M. H., & Riezebos, P. (2016). A research framework of smart education. *Smart Learning Environments*, 3(4), 1-17. <https://doi.org/10.1186/s40561-016-0026-2>

Stanford Institute for Human-Centered Artificial Intelligence. (2023). Annual Report 2023 Stanford Institute for HAI.

<https://hai.stanford.edu/#:~:text=At%20Stanford%20HAI%2C%20our%20vision,centered%20AI%20technologies%20and%20applications.%E2%80%9D>

<https://www.stanford.edu>

FBER