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Editorial

E-learning Personalization Systems and Sustainable Education

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In the World Declaration on Higher Education, the concept of higher education is defined as "all types of studies, training or research training at the postsecondary level, provided by universities or other educational establishments that are approved as institutions of higher education by the competent state authorities" [1]. It covers all activities recognized by a country as higher education, such as those that take place at contemporary educational institutions, universities, and polytechnics, as well as short-term training, educational studies, and specialized courses intended for a broad range of student populations.

As a specialized United Nations institution, UNESCO fosters the formulation of empirically based policy in higher education [1] and provides technical assistance to Member States in a process of strategies and policies examination to ensure access to high-quality education for all, academic mobility, and responsibility [2,3]. In accordance with Sustainable Development Goal (SDG) 4, "equal access for all men and women to quality technical, professional and superior training, including university education" can be expected by 2030 [2]. Education is the foundation for enhancing quality of life and achieving global sustainability [4,5]. Additionally, comprehensive and equitable education gives people the skills they need to come up with creative solutions to issues faced in widely observed areas of life and work. Integrating high-quality education with digital technology helps students continue providing information, knowledge, motivation, and skills to grasp the SDGs, motivate the youth, supply academic and professional training to apply SDG solutions, and provide possibilities for students and professionals to build the capacity to address the difficulties associated with the SDGs. [6,7].

Sustainable education development is described as human, cultural, ethical, and ecological principles in the context of higher education with the intention of providing societies with good practices that enable greater competitiveness and better growth of organizations, institutions, and communities, hence confirming awareness of and enhancing social and economic life [8,9]. Stakeholders prioritize transparency of the long-term sustainability of educational institutions' activities [10]. As a result, long-term management will be required to adopt management systems that are based on digital, open, networked, and innovative institutions [11].

Quality education presents one crucial part of the future of the quality of human life and the world's long-term sustainability. New digital technologies are transforming education in both formal and informal learning contexts. Some of the most significant aspects and how they are affecting education should be considered [12]:

1. Educational goals and objectives;
2. Educational ecologies and educational outcomes;
3. Learning process and teaching process;
4. Automatic assessment of gained knowledge;
5. Educational governance and policy.

Social change, technological progress, and globalization bring new challenges that must be overcome through increased individualization and social diversity, though at the same time increasing economic and cultural uniformity, the availability of rapidly increasing amounts of information, and the need to cope with increasing complexity

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and uncertainties [13]. Intelligent systems are being enabled by the growing amount of learning-related data and high-performance computing in the process of supporting sustainable education with a very wide range of advantages, providing learners with personalized guidance [14]. As artificial intelligence research and development is becoming more mature and the corresponding outputs are being deployed at scale in real-world contexts, the importance of using automated systems in long-term education becomes more evident. Current research has greatly expanded our understanding on such artificial intelligence techniques and applications in the area of education. However, more research and many questions remain to be answered to bridge technological, social, pedagogical, and ethical perspectives in these intelligent systems.

The most significant aspects for a sustainable e-learning environment are e-learning and e-teaching principles, applications, technology, and sustainable development. Learning theories, models, and environments are the emphasis of e-learning principles, while e-teaching principles concentrate on syllabus, pedagogy, and program. Good practices; teaching and evaluation methods; and personalized, collaborative, and conditional learning approaches can all help to develop an outstanding pedagogy [15]. Connectivism and pragmatism are two types of learning theories [16]. Connectivism disseminates knowledge through a network of relationships. Pragmatism, on the other hand, establishes links between the information and the user. Learning models make a huge amount of data available over the Internet, with the support of the Semantic Web, web-based services, and ontology-based models [17]. In the educational environment, students interact with huge resource sets, such as the Internet, 3D Environment, 3D software and libraries, virtual communities, immersive worlds, avatar-based worlds, and virtual or augmented reality [18].

Organizations must reinvent themselves and adapt all their operations to take advantage of emerging technologies and their rapid spread into human activities. As a result, digital technologies require a change of focus, which includes technological innovation as well as changes in institutional culture, in order to ensure the advancement of digital technologies.

Artificial intelligence (AI) and big data are being used in new learning spaces, bringing value to complicated issues in higher education, as are the Semantic Web, robotics, automation, intelligent agents, green technology, and other technological learning resources that are transforming the manner in which we live, work, and communicate with others [19,20]. Students can use big data to find patterns in addition to new learning approaches, which provide personalized education based on collected data on students in relation to personal characteristics, habits, or actions [21]. Personalization elements place a strong emphasis on personal growth and learning environments. Learners' personal growth of knowledge and skills gained via Internet communities and online courses is the emphasis of personal development. A personalized learning environment involves a variety of services, learning tools, and applications built tailored to the needs of individuals based on Web 2.0 or Web 3.0 elements, such as lower-cost teaching, enhanced user capabilities, and the creation of a personalized student profile [22]. Higher education institutions are employing AI to customize the student admissions procedure and determine successful students. Furthermore, the AI technologies enable the teacher to assist in identifying the development of students or manage the instruction method if the teacher notices a gap in understanding [19]. Green technology includes restructurings that help to minimize energy consumption by managing many applications running on a virtualized space of shared resources, using algorithms created to enable a full energy-saving system by providing sustainable construction solutions [23]. To facilitate intelligent learning, data in forms such as global databases, metadata, data-driven approaches, and linked data are required [16]. On the other hand, intelligent agents, such as pedagogical agents who support learning activities by interacting with teachers, students, and other agents, can facilitate the flow of information [24].

Considering technological innovations and programming, higher education institutions should maintain a learning system that promotes continuous and interactive learning.

AI promotes practical and innovative education by introducing digital cooperative learning, flipped classroom, gamification, reality, augmented reality, and/or virtual or mixed reality as new instructional approaches for learners to study and educators to teach [25]. Digital technologies and AI in education enable the establishment of learning techniques on the basis of individualized training, personalized information, and achieved abilities in order to attain creativity and entrepreneurship [26].

The information age implies an adaptable education environment that enables innovative abilities, allowing individuals to achieve their best selves and develop in a time of perpetual change [27]. As a result, digital education uses digital technologies in order to acquire learning skills and capabilities in a continuous learning process, providing an opportunity for institutions to expand their educational aims and outcomes [28,29]. Some of the most essential ways that AI tools can alter and shape the learning experience in the future are listed as follows.

Educational Software Can Be Customized to Meet the Needs of Students

Individualized learning from kindergarten to postgraduate study is one of the most significant influences of AI in education. Some forms of such learning are widely used because of the increasing availability of adaptive learning environments, interactive games, and educational software [28]. Adaptive systems are able to adjust to students' requirements, placing more emphasis on specific topics, repeating topics that students have not understood, and generally helping students learn at their own pace [29].

Critical Parts of Courses Could Be Improved

Educators may even be unaware of gaps in their courses and instructional resources that cause students confusion about specific subjects. AI offers a solution to this issue. When the system identifies that many students have submitted incorrect answers to homework, it informs the teacher and sends out a personalized message to the students with tips for the correct answer [30]. This type of method meets the gaps in clarification that could happen in lessons and confirms that each student is developing the appropriate theoretical framework. Instead of waiting for a response from the professor, students receive feedback immediately, which helps them master the course material and remember the appropriate solution next time.

Students and Educators Can Benefit from AI-Driven Tools That Provide Useful Feedback

Students and educators can benefit from AI-driven tools that provide useful feedback. Some higher education institutions, especially those with online programs, use AI systems to monitor student progress and alert teachers when there is a problem with student performance. These AI systems allow students to get the help they need and allow instructors to identify areas where they can improve teaching for students struggling with the subject. These educational institutions' AI initiatives do not merely provide guidance on specific courses; some strive to create systems that can assist students in choosing majors based on their strengths and weaknesses [30,31].

AI Can Aid Instructors and Administrators with Administrative Duties by Automating Basic Educational Operations

Tutors and educators have other responsibilities, such as organizational and administrative responsibilities, that demand just as much effort and attention as teaching (e.g., organizing learning resources, managing paperwork, grading exams, marking assignments, communicating with parents, etc.) [31]. AI can help solve many of the above tasks and facilitate their work. When teachers have to grade thousands of tests, automated grading can be extremely beneficial. Machines can already evaluate multiple-choice tests and are on their way to grading handwritten responses. Other tasks that AI can handle include logistics, keeping paperwork up to date, giving pupils feedback, and serving as a communication conduit for teacher-parent exchanges.

Additionally, AI can be useful in a range of administrative tasks, involving processing application forms for students, budgeting, procuring materials, and managing human resources. The result will be greater administrative efficiency, lower costs, and a clearer whole of the institution's image [31,32].

Basic Educational Tasks, Such as Grading, Can Be Automated Using AI

Grading class activities and homework assignments can be time consuming. While AI cannot be expected to completely replace human grading, it is coming closer. Teachers can mark fill-in-the-blank, multiple-choice, matching and true/false questions automatically, and the automated grading of essay questions is not far behind. Today's software for automatically evaluating essays is still in the early stages and far from perfect, but it has the potential to develop in the future years, allowing professors to concentrate more on interactive activities with students [33].

AI Is Changing the Way We Find and Engage with Data

Intelligent systems affect the use of information in the personal and professional life of every person and have a great influence on how knowledge is found and used in schools, colleges, faculties, or universities. Systems based on artificial intelligence have already significantly influenced how people deal with information over the last few decades, and with newer, more integrated technologies, students may in the future have significantly different experiences in researching and verifying facts than students today [33].

AI Could Personalize Content to the Student

AI educational systems contain knowledge of what learning styles have been defined and what material presentation tactics map to each of them to change how content is given and successfully adapt to the student. A supporting user model is usually in charge of assigning the learner to these various learning styles and tactics on a dynamic basis. A specialized component (e.g., centralized AI managers, content generators, agent organization frameworks) can then generate and provide the individualized content to the learner using the right tactics [34].

AI-Powered Data Has the Potential to Transform How Schools Locate, Teach, and Assist Students

Higher education institutions are already changing how they communicate with potential and current students thanks to smart data collection enabled by clever computer systems. AI systems are assisting in tailoring every aspect of the higher education experience, requirements, and goals of students [35].

This Special Issue, "E-learning Personalization Systems and Sustainable Education", aims to address the research on high-quality, high-impact, original research results reporting on current state-of-the-art online education systems empowered with artificial intelligence, examining elements of personalized e-learning, intelligent and interactive technologies, intelligent web-based and game-based applications, sustainable development, teaching and learning principles, recommendations of teaching materials, learning analytics, educational data mining, and advanced technologies (e.g., virtual reality, augmented reality, or eye-tracking) that contribute toward sustainable education.

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References

1. Elfert, M. Lifelong learning in Sustainable Development Goal 4: What does it mean for UNESCO's rights-based approach to adult learning and education? *Int. Rev. Educ.* **2019**, *65*, 537–556. [CrossRef]
2. Boeren, E. Understanding Sustainable Development Goal (SDG) 4 on "quality education" from micro, meso and macro perspectives. *Int. Rev. Educ.* **2019**, *65*, 277–294. [CrossRef]
3. Fuller, S. Education Diplomacy at the Intersection of Gender Equality and Quality Education. *Child. Educ.* **2019**, *95*, 70–73. [CrossRef]
4. Ghosn-Chelala, M. Exploring sustainable learning and practice of digital citizenship: Education and place-based challenges. *Educ. Citizsh. Soc. Justice* **2018**, *14*, 40–56. [CrossRef]
5. Dybach, I. Institutional aspects of educational quality management in higher educational establishments. *Econ. Dev.* **2019**, *18*, 33–43. [CrossRef]
6. Guijarro, F.; Poyatos, J. Designing a Sustainable Development Goal Index through a Goal Programming Model: The Case of EU-28 Countries. *Sustainability* **2018**, *10*, 3167. [CrossRef]
7. Hanemann, U. Examining the application of the lifelong learning principle to the literacy target in the fourth Sustainable Development Goal (SDG 4). *Int. Rev. Educ.* **2019**, *65*, 251–275. [CrossRef]
8. Bush, T. Research on educational leadership and management. *Educ. Manag. Adm. Leadersh.* **2018**, *46*, 359–361. [CrossRef]
9. Singh, S.K. The human side of management. *Int. J. Educ. Manag.* **2019**, *33*, 2–4. [CrossRef]
10. Hill, C.; Lawton, W. Universities, the digital divide and global inequality. *J. High. Educ. Policy Manag.* **2018**, *40*, 598–610. [CrossRef]
11. Cristina, S.T.; Popescu, D.M.; Stoica, E.; Erculescu, L.M. Managing the Influence of Resources on Educational Performance. *Int. J. Sustain. Econ. Manag.* **2018**, *7*, 37–44.
12. Tejedor, G.; Segalàs, J.; Barrón, A.; Fernández-Morilla, M.; Fuertes, M.T.; Ruiz-Morales, J.; Gutiérrez, I.; García-González, E.; Aramburuzabala, P.; Hernández, A. Didactic Strategies to Promote Competencies in Sustainability. *Sustainability* **2019**, *11*, 2086. [CrossRef]
13. Dan Training, M.E. *Education for a Sustainable Future: A Resource for Curriculum Developers, Teachers, and Administrators*; Minister of Education and Training: Whiteshell, MB, Canada, 2000.
14. Siemens, G. Connectivism: A learning Theory for the Digital Age. 2004. Available online: www.elearnspace.org/Articles/connectivs.htm (accessed on 29 May 2021).
15. Beetham, H.; Sharpe, R. *Rethinking Pedagogy for Digital Age: Designing and Delivering E-Learning*; Routledge: Abingdon, UK, 2007.
16. Rubens, N.; Kaplan, D.; Okamoto, T. E-Learning 3.0: Anyone, anywhere, anytime, and AI. In Proceedings of the International Workshop on Social and Personal Computing for Web-Supported Learning Communities SPeL, Hong Kong, China, 8–10 December 2011.
17. Ghaleb, F.; Daoud, S.; Hasna, A.; Alja'Am, J.M.; El-seoud, S.A.; El-Sofany, H. E-learning model based on semantic web technology. *Int. J. Comput. Inf. Sci.* **2006**, *4*, 63–71.
18. Bidarra, J.; Cardoso, V. The emergence of the exciting new Web 3.0 and the future of open educational resources. In Proceedings of the Annual Conference of the European Association of Distance Teaching Universities, Lisbon, Portugal, 8–9 November 2007.
19. Dennis, M.J. Artificial intelligence, and higher education. *Enroll. Manag. Rep.* **2018**, *22*, 1–3. [CrossRef]
20. Williamson, B. The hidden architecture of higher education: Building a big data infrastructure for the "smarter university". *Int. J. Educ. Technol. High. Educ.* **2018**, *15*, 1–26. [CrossRef]
21. Jeong, S.; Kim, B. Network Analysis of Social Awareness of Media Education for Primary School Students Studied through Big Data. *Comput. Sci. Inf. Syst.* **2021**, *18*, 575–595. [CrossRef]
22. Samah, N.A.; Yahaya, N.; Ali, M.B. Individual differences in online personalized learning Environment. *Educ. Res. Rev.* **2011**, *6*, 516–521.
23. Uddin, M.; Rahman, A.A. Server consolidation: An approach to make data centers energy efficient & green. *Int. J. Sci. Eng. Res.* **2010**, *1*, 1–7.
24. Devedzic, V. *Semantic Web and Education*; Springer: New York, NY, USA, 2006.
25. Türkeli, S.; Schophuizen, M. Decomposing the Complexity of Value: Integration of Digital Transformation of Education with Circular Economy Transition. *Soc. Sci.* **2019**, *8*, 243. [CrossRef]
26. Jahnke, I.; Kumar, S. Digital Didactical Designs: Teachers' Integration of iPads for Learning-Centered Processes. *J. Digit. Learn. Teach. Educ.* **2014**, *30*, 81–88. [CrossRef]
27. Casey, E. What constitutes a proper education? *Digit. Investig.* **2014**, *11*, 79–80. [CrossRef]
28. Pedro, F.; Subosa, M.; Rivas, A.; Valverde, P. *Artificial Intelligence in Education: Challenges and Opportunities for Sustainable Development*; UNESCO: Paris, France, 2019.
29. Bozkurt, A.; Karadeniz, A.; Baneres, D.; Guerrero-Roldán, A.; Rodríguez, E.M. Artificial Intelligence and Reflections from Educational Landscape: A Review of AI Studies in Half a Century. *Sustainability* **2021**, *13*, 800. [CrossRef]

30. Fahimirad, M.; Kotamjani, S.S. A Review on Application of Artificial Intelligence in Teaching and Learning in Educational Contexts. *Int. J. Learn. Dev.* **2018**, *8*, 106–118. [CrossRef]
31. Wenger, E. *Artificial Intelligence and Tutoring Systems: Computational and Cognitive Approaches to the Communication of Knowledge*; Morgan Kaufmann: Los Altos, CA, USA, 2014.
32. Aoun, J.E. *Robot-Proof: Higher Education in the Age of Artificial Intelligence*; MIT Press: Cambridge, MA, USA, 2017.
33. Machicao, J.C. Higher Education Challenge Characterization to Implement Automated Essay Scoring Model for Universities with a Current Traditional Learning Evaluation System. In Proceedings of the International Conference on Information Technology & Systems, Cairo, Egypt, 24–26 March 2019; Springer: Cham, Switzerland, 2019; pp. 835–844.
34. Aguirre, C.C.; González-Castro, N.; Kloos, C.D.; Alario-Hoyos, C.; Muñoz-Merino, P.J. Conversational agent for supporting learners on a MOOC on programming with Java. *Comput. Sci. Inf. Syst.* **2021**, 18. [CrossRef]
35. Savić, M.; Ivanović, M.; Luković, I.; Delibašić, B.; Protić, J.; Janković, D. Students' Preferences in Selection of Computer Science and Informatics Studies—A Comprehensive Empirical Case Study. *Comput. Sci. Inf. Syst.* **2021**, *18*, 251–283. [CrossRef]