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Smart digital education in the context of Industry 4.0 technologies

Madhuri Vangeti [*1], Ramesh Rudrapati [2], Parmod Kumar [3]

[1]*Bule Hora University, Electrical & Computer Engineering Department, Ethiopia, rameshrudrapati@gmail.com*
[2]*Bule Hora University, Industrial Engineering Department, Ethiopia, rameshrudrapati@gmail.com*
[3]*Jiangxi University, Department of Electronics & Information Engineering, China, dr-kumar2019@yandex.com*

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Abstract

Technology advancements in Industry 4.0 (I4.0) tools have the potential to create smart digital education environments (SDE). SDE aims to utilize various digital learning approaches to provide learners with modern skills and advancements quickly. The present study is focused on exploring the advantages of critical digital components of I4.0 technologies like artificial intelligence, augmented reality, Bigdata, cloud computing, internet of things to integrate with different digital learning methods in SDE platforms to explore the possibilities. From the study, interpretation can also be made. Based on the analysis and the results, SDE platforms have been enhanced by integrating digital learning methods with I4.0 tools to improve the teaching & learning process.

Introduction

The fourth industrial revolution has proposed various digital technologies to change modern people's social, economic, and cultural fields [1]. These changes also impacted on the education sector in a significant way. Using industry 4.0 (I4.0) tools to transform traditional education into smart digital education is one way to enhance the efficiency and effectiveness of education in this new millennium. Providing systematic learning support to learners means that the smart environment and learning principles are closely connected, giving learners a seamless experience. The present study is planned to address the importance of integrating digital learning approaches with I4.0 technologies to create smart digital education environments.

Material and Method

In a new education paradigm, many pillars are pushing the education system in a new direction, such as imagination, innovation, inspiration, interactivity, interconnection, and improvement. Netexplo's perspective of smart digital education mentioned by Cathelat, in his study that digital smart education is evolving into a new direction to directorate the various teaching methods to enhance the education levels to the sophisticated stage to reach modern people [2]. Netexplo's perspective of modern learning methods to benefit the learners from functional education is adaptive, blended, continuous, customized, immerse, interactive, and social. The details of various types of modern learning methodologies are described as follows:

i. **Adaptive Learning:** This concept of adaptive learning refers primarily to the process of learning that adapts to an individual's learning style. With the inherent benefits that digital ecosystems provide, leveraging these platforms can be used to create training programs and make sure that they're presented to the right people at the right time. It is a method that integrates data collection in real-time, analysis of learner behavior, analysis of results, and the adjustment, if necessary, of the difficulties of training sequences.

ii. **Blended Learning:** Blended learning is in line with the user experience requirements as far as user experience is concerned. With this method, one can mobilize diverse approaches and types of materials.
iii. **Continuous Learning:** In the digital learning environment, there are technologies available that can monitor the activities that are taking place. The ability to offer the appropriate training and assist in acquiring new skills is a constant characteristic of these consultants. Although this seems self-evident, it is surprising that relatively few people aspire to continue training throughout their lives.
iv. **Customized Learning:** The digital technologies in this learning era facilitate a personalized and localized delivery of content, which enables profiling and assimilation of information. The effectiveness of customized learning seems to be immediately apparent.
v. **Immerse Learning:** Learning using digital innovation allows the learners to experience real-life situations, train in a specific skill or technique, and practice it in various situations. An immersive learning environment creates a more engaging learning experience for learners and instructors.
vi. **Interactive Learning:** For learning and teaching to become more engaging, the interaction between teachers and students is vital. For the teacher to achieve this, greater flexibility and responsiveness are required, as well as adaptation to the changing conditions in real time. In this age of digital era, teachers and their digital aids are more agile than ever before, thanks to the internet.
vii. **Social Learning:** With social learning, learners can create fun games and quizzes to learn and rehearse to better recall what they have learned. There will be a standard screen around which the participants will be grouped, and they will all be able to participate simultaneously.

Industry 4.0 (I4.0) concept

Industry 4.0 (I4.0) is framed by considering the rapid developments in communication and information technologies to make transformation from traditional systems to digital system [1]. The important components of I4.0 are artificial intelligence, augmented reality, Bigdata, cloud computing, internet of things.

i. Artificial Intelligence (AI): Artificial intelligence enhances students' educational experience with various personalized and innovative academic approaches. Artificial intelligence in smart digital education enables students to receive customized feedback on their work. AI is pioneering and applying to digital education in several ways, including text mining, visual search, and more.

ii. Augmented Reality (AR): Real-time integration of digital information into a user's environment is the concept of augmented reality (AR) [3]. With these technologies, students can participate actively in any situation, anywhere. Providing students with the opportunity to gain hands-on experience, practice, experimentation, and training through digital educational ecosystems will enable them to find their learning path.

iii. Big Data: With the advent of Big Data technologies, education is now being improved in a significant way. Bigdata has transformed education from a traditional method to a smarter one. Big data can be used to evaluate learning styles, student performance, and employment success efficiently. An educational system can be improved through Big Data by using it efficiently, effectively, and reliably.

iv. Cloud Computing (CC): Education has been revolutionized by cloud computing. Digital education offers several benefits with the adoption of cloud computing. By creating an open, flexible, and unified learning environment, cloud computing technology can enhance educational environments for many different purposes.

V. Internet of things (IoT): The Internet of Things is a network of connected sensors that collect and store information and transmit it locally or remotely [4]. A key benefit of IoT is that it allows teachers and students to engage in a continuous process of educating students. Consequently, educational institutions can enhance their students' learning experience by creating more agile learning systems, improving the quality of their education, and improving the educational quality of their institutions.

Results and Discussion

Industry 4.0 (I4.0) technologies are expected to play a major role in creating smart digital educational (SDE) environments [5]. Table 1 shows the level of support of I.40 technologies with different digital learning approaches to develop SDE platforms. To achieve better yields, SDE systems require various learning methods such as adaptive, blended, continuous, customized, immerse, interactive, and social learning. For the SDE to use the potential advantages of advanced technologies being proposed through industry 4.0, there may be a requirement for modernized infrastructure like smart digital campus, smart digital classroom, smart digital learning, smart digital learning analytics, [5] etc. The use of digital education, accompanied by good learning techniques, may

increase equality, also apart from gender, race, and background, among students. The emerging trends of I4.0, such as AI, augmented reality, big data, cloud computing, and the internet of things, will make it easier to create digital environments in the future, significantly impacting the SDE system. Learning, teaching, interacting, and collaborating has become easier than ever via modern technology, and obtaining instant information is also more effective and efficient.

Table 1. Industry 4.0 tools and their level of support for various learning approaches

S. No	Parameter / learning method	Adaptive learning	Blended learning	Continuous learning	Customized learning	Immerse learning	Interactive learning	Social learning
1	AI	EH	EH	EH	EH	EH	MH	MH
2	AR	EH	S	MH	EH	EH	EH	MH
3	Big data	EH	EH	EH	MH	EH	MH	S
4	CC	MH	S	MH	S	S	EH	EH
5	IoT	EH	S	EH	EH	MH	MH	EH

EH = Extreme Help; MH = Moderate Help; S = Supportive

Conclusion

This paper proposes integrating digital learning approaches with Industry 4.0 technologies like artificial intelligence, augmented reality, Bigdata, cloud computing, and internet of things to explore sophisticated learning experiences for teachers and students. Creating smart digital education for learners will be possible once smart education and digital content orientations meet. Using smart devices in the education system provides students with more opportunities to choose the type of education they will receive and the profession they will pursue. Additionally, it represents a sort of liberation regarding how time is regarded in education.

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