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Digital Transformation in Higher Education: Education as a Service

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ABSTRACT

Today, education plays a significant role in the economic, social, cultural, and even political growth of every country. As learning is more influenced by modern technologies than ever before, learning and teaching are continuously evolving. Topics such as the Internet of Things, virtual reality, augmented reality, the metaverse, digital twins, generative artificial intelligence, and cloud computing are transforming individual and interactive learning methods. Effective teaching standards provide learners with high-quality and interactive training, such as e-learning courses specifically designed for students and based on smart technology. Nowadays, e-learning and smart learning have become highly popular trends in educational technology. Interactive and smart education is an engaging style that provides digital content and an education-focused environment for both teachers and learners using digital age technologies. The emergence of new concepts in the era of the digital revolution, such as platform universities, has opened up new research fields for scholars in the domains of education and educational technology. This article aims to demonstrate how leveraging modern technologies in the learning domain can foster a shift in approaches and perspectives toward digital higher education as a service provider to its applicants. Thus, this article discusses the concept of "Education as a Service" in smart and interactive learning and examines various aspects of "Education as a Service" through a multi-layer cloud model, addressing the opportunities and challenges of this type of education.

Keywords: *Education as a Service, digital transformation, cloud computing, smart learning, university as a platform, smart higher education, continuous learning.*

1. Introduction

The development of digital technologies and the expansion of internet connectivity, along with advancements in hardware and computers and the generation of vast amounts of data and information, including educational content, have led to studies and research that interpret this as information and communication technology (ICT) transforming education and presenting new capabilities for learners and educators. The digital revolution began with "data centers," where the "cloud" enabled the provision of "Software as a Service" (SaaS), now utilized in many business sectors. The "as a service" model replaces massive investments in hardware and software, previously required by organizations for equipping and maintaining capabilities delivered on-demand via the network (Prifti et al., 2017; Rao, 2020; Vladykina et al., 2019).

Significant research has been conducted globally on digital universities, smart universities, and even smart schools. Smart technologies are one of the main pillars of digital transformation and smart universities (Rico-Bautista et al., 2019). The distinguishing feature of these universities is the role of innovative and smart technologies. Keykha (2022) has attempted to provide a comprehensive review of scientific findings published between 2010 and 2020 in this area and answer several key questions, including: What are the main components of the conceptual framework for a smart university (Keykha, 2022)?

The concept of "Education as a Service" (EaaS) has been defined by various individuals (Hignite et al., 2010). This term refers to a set of architecture, applications, and services for education in the form of lectures, exams, assignments, marking, teaching, discussions, and learner support (Chang & Wills, 2013). They believe that using cloud services for higher education offers significant benefits.

"Education as a Service" is moving away from traditional educational programs and towards an online, demand-driven service model. Therefore, learners can receive timely and on-the-spot education when needed in the workplace or university. This method aligns with continuous learning and is dynamic, interactive, and intelligent. "Education as a Service" provides learners the opportunity to choose modules or educational packages relevant to their job goals and needs, acquiring knowledge only for what they require. Research predicts that many educational institutions will soon shift their roles and missions solely by offering educational content "on-demand." (Fogel, 2010; Rao, 2020)

In recent years, numerous studies have been conducted on "Education as a Service." Some have focused on the impacts of this type of education on learners (Deepa & Sathiyaseelan, 2012), while others have discussed how to implement this type of education using cloud services (Abdullah & Alsharaei, 2016; Hung, 2019).

In this article, we will take a deeper look at "Education as a Service" and its various aspects in higher education. This article examines the theoretical perspective of "Education as a Service" using concepts such as cloud computing and cloud service delivery.

The concept of "Education as a Service," along with related concepts and technologies of artificial intelligence, necessitates a reevaluation of the higher education system. If artificial intelligence is considered the heart of digital transformation, higher education and universities need to be redesigned, focusing on providing services based on the learner's needs and requests. Although most universities understand the necessity of investing in IT and AI infrastructure, identifying coherent missions, actions, and platforms that lead to sustainable success and align with strategic goals requires additional effort and experience, even at a high cost.

The structure of the article is as follows: In the introduction section, the principles and types of "Education as a Service" and the necessity of moving towards it are presented. In the next section, the provision of "Education as a Service" through the use of a cloud model is described, and a layered model sample is explained. Finally, in the conclusion section, the results and future work are presented.

2. Principles and Basic Concepts of "Education as a Service"

Business changes necessitate a change in how education is delivered to human capital. Traditional educational programs with long-term durations, such as 3 to 4 years at the start of a career and using that knowledge for a span of approximately 30 years, are no longer effective. Hence, the need for continuous and effective learning requires an educational style that supports that goal.

The Skills Framework for the Information Age (SFIA) has a continually changing list of skills required for the workforce in the era of digital transformation and ICT, which is constantly evolving. In the next ten years, the requirements for current job skills will be completely different from what we have today. What does this mean for every employee and every business? Completing and obtaining a three-year degree will no longer be effective even for the next ten years of working life.

So, how can we enhance our skills while the list of skills continues to grow? If all the skills cannot be learned at once, yet they will be needed for one's profession, how can the necessary skill be learned just in time?

This is where the discussion of continuous and targeted education comes in, and the concept of "Education as a Service" becomes meaningful. Exactly when the learner faces a task that needs to be accomplished, focused and targeted education is requested. This can be seen in educational platforms like Udemy, Skillshare, and Pluralsight, and similar Iranian platforms like Faradars and Maktab Khone. However, these platforms do not guarantee quality or provide professional certification equivalent to a university degree. Therefore, "Education as a Service" is a framework and plan that offers a new style of education with recognized industry-quality certification and high-quality education.

3. Types of "Education as a Service" Styles

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The following are the types of education as a service styles (Rao, 2020):

3.1. School as a Platform (SaaP):

School as a Service (SaaS): Technological transformation views the school not as a physical environment but as a service. This platform thinking leads to the redesign and new architecture of the educational system, based on the concept of embracing a sharing culture. In this generation of learning, physical schools and classrooms are replaced by educational platforms, providing a flexible and intelligent environment for learning based on the concept of school as a service.

In this educational style, the school is a service on cloud-based educational platforms that offer tools for 3D modeling, simulation, gamification, social and interactive learning, and can be adapted to any global curriculum covering private and public schools. In this type of education, the learner plays the primary role in the learning process and engages in a comprehensive and interactive manner with the educational platform—even with other learners—to enhance their skills and knowledge. This concept was first practically applied in schools in Finland and France (Vladykina et al., 2019).

Research shows that children construct most of their knowledge through active interaction with the real environment, allowing them to relate abstract concepts to observable things (Petrakos & Howe, 1996). Dehghanzadeh and colleagues (2016) investigated a framework for designing computer games for learning various cognitive subjects and examined their effectiveness in learning (Dehghanzadeh et al., 2016). However, most educational software is designed for personal computers, with little physical interaction, and follows the WIMP model (windows, icons, menus, pointer) (Ishii et al., 2006). Consequently, little information is provided on designing new technologies that move out of the virtual realm into the physical classroom or their impact on students' learning, behaviors, and/or perceptions. To overcome this gap, Muldner, Lozano, Girotto, Burleson, & Walker (2013) introduced and implemented the concept of a tangible learning environment (TLE) for geometry-related topics and called it Tangible Activities for Geometry (TAG). Students interact with TAG in a physical space using digitally enhanced devices to solve geometry problems (Muldner et al., 2013). Derani and his colleague (2007) examined factors affecting the acceptance of information technology by smart school teachers, finding that the perceived ease of use of IT significantly affects the perceived usefulness of IT and attitudes towards IT (Dorani & Rashidi, 2007). Tavakol and Larijani (2017) examined the potential of ICT in the educational process of students, revealing that students, with the help of designing and producing technological content, have created innovations and have been able to develop their creativity and gain more motivation to learn educational texts (Tavakkol & Larijani, 2017).

NVIDIA, a multinational company, is one of the pioneers in providing cloud-based educational platforms, utilizing AI technologies and leveraging fast processing tools, simulation, and data science to provide educational materials and conscious, live education, including 3D video games for children, to shape the learning process as an enjoyable experience (Corporation, 2020). John Snyder, a senior data science researcher at the cybersecurity company ThreatConnect, states, "The NVIDIA Deep Learning Institute helps me stay at the forefront of my field, with highly motivated learners and very knowledgeable instructors, making the 'experience' as enjoyable as it is informative," or the Samsung Technology Education and Development Center declares, "NVIDIA has launched a virtual training environment that is directly taught by deep learning/CUDA experts, allowing our teams to not only understand concepts but also how to use codes in practical labs, significantly aiding our understanding of the topic, so much so that team members thoroughly enjoy the class" (NVIDIA, 2020).

3.2. University as a Platform (UaaP)

3.2.1. Educational Academies like Google or Microsoft

Educational institutions affiliated with large corporations can offer educational programs, courses, certifications, professional courses, and other extracurricular activities with distinctive educational models (León et al., 2020).

For over 20 years, Google has set its mission to organize the world's information, making it universally accessible and useful. Today, billions of people turn to Google and YouTube for learning. Google's goal is to provide information, tools, and services that help individuals build knowledge, enhance curiosity, and prepare for the future.

According to Google, more than 170 million learners and educators have used Google's cloud services, tools, and workspace in education. Additionally, 85% of YouTube

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viewers in the United States reported that YouTube videos helped them acquire or improve their needed skills. Google's goal is to double the number of people watching educational videos on YouTube. Daily, more than 100 billion words are translated in Google's translation service into various languages, helping people connect across languages, cultures, and places. One billion people learn something new every day through Google searches.

Seventy million people are acquiring digital skills on Google, and Google helps individuals learn or enhance skills suited to in-demand jobs. Three million children improve their reading skills with Google's Read Along tool, and millions of children gain reading confidence with Read Along every month. Google's motto in this regard is: "Transform yourself and the world with information."

Sundar Pichai, CEO of Google and Alphabet, has presented a new definition of learning: "Learning is what makes information useful; it is what enables people to apply knowledge to improve their conditions, family, and community."

Google offers education in several categories: learning for school and university, learning for job skills, and learning for life skills. Today, large and professional organizations such as IBM, Google, Microsoft, and others no longer seek to hire academically trained individuals. Instead, they look for individuals with specialized skills that fit well into specific jobs. This shift provides a valuable opportunity for institutions that can become "educational institutes" like Google or Microsoft, offering skill-based learning and providing access to high-quality and low-cost education.

Moreover, the concept of project-based learning is well reflected in this skill-oriented world. This learning is also known as experiential learning or discovery learning. Project-based learning is an educational approach that allows learners to enhance their knowledge and skills through projects addressing real-world challenges and problems. Project-based learning goes beyond "doing a project"; here, the learner engages in deeper investigation and research, leading to higher learning retention. In summary, project-based learning is "learning by doing" (ArchForKids, 2015), which aligns with the famous saying: "Knowledge is the result of experience" (Piaget, 2016).

Helping learners gain authentic experiences prepares them for the real world. Project-based learning, in its simplest form, prepares learners to be thoughtful, self-reliant, creative, and critical thinkers, capable of tackling any challenge in their specialty.

In summary, to prepare students for success in life, we must prepare them for a project-based world and always provide real-world application examples. This approach strengthens the learner's perception that they can break down future problems into their components, assemble and lead a diverse team of stakeholders, process the problem, and implement a logical solution. The focus here is on a significant and open-ended question or challenge that the learner can understand based on academic knowledge and provide a solution for, stimulating curiosity and fostering creativity while allowing feedback and revision of the solution.

3.2.2. Virtual Education, from Offline to Online Learning

The experience of virtual education over the past two decades has shown that both offline and online learning styles feature interactive and collaborative learning. Despite its challenges and difficulties, the COVID-19 pandemic demonstrated the efficiency and effectiveness of technology and led to the emergence of new concepts in technology, such as the Internet of Behavior. The Internet of Behavior seeks to understand how, when, and why humans use technology to make purchasing decisions. It is an interdisciplinary field combining at least three study areas: behavioral sciences, edge analytics, and the Internet of Things (IoT). Additionally, Internet of Behavior platforms were developed to collect, aggregate, and analyze data from various sources, including digital devices, wearable digital tools, and human online activities.

4. The Necessity of Moving Towards "Education as a Service"

The shift of educational institutions towards "Education as a Service" is essential not only to adapt to the current and future workplace but also for their long-term sustainability. COVID-19 forced higher education to move towards online and, in better conditions, blended learning, whereas previously, many universities only offered some courses virtually. COVID-19 accelerated digitalization, e-commerce, and overall digital transformation unprecedentedly, becoming a driving force in cultural, educational, social, and commercial changes. Joseph DeVatt, head of the research and development center at Land O'Lakes, states, "The pace of change is now incredible. COVID-19 accelerated all of this. We must increase our pace of adapting to change and strive to reach it" (Impey & Formanek, 2021).

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It's no exaggeration to say that businesses, especially in the financial and banking sectors, have made changes to their business styles to move towards digital transformation faster, driven by the clear goal of investing to earn more revenue and profit. Higher education, as a driver of the nation's science and technology, must not only be influenced but also play an impactful role. Moving away from hierarchical decision-making through centralized and rule-based planning to designing more efficient systems based on decentralized, agile, dynamic, value-based, and highly participatory decision-making, similar to crowdsourcing projects.

The future holds significant advancements and transformations, presenting challenges for learners, educators, and higher education policymakers. How can they prepare learners for jobs that don't yet exist, using technologies that haven't been invented, or solving social problems we can't yet imagine? Whether these transformations manifest as gradually evolving trends or sudden systemic shocks, they will impact behaviors, businesses, jobs, and even people's and communities' belief systems. Thus, expectations for redesigning and reevaluating the educational system will arise, influencing how learning is organized. Education is no longer just about teaching something to learners but helping them navigate a complex and uncertain world (OECD, 2023).

One of these technological advancements is "digital twins" and their role in education. Combining the "real world" and the "virtual world" brings the concept of global digitalization of information to life. Although the definition of digital twins has been known since 1991, its engineering concept was presented 13 years ago (Piascik et al., 2010). The digital twin concept consists of three distinct parts: the physical product, the digital/virtual product, and the communications between the two products. Communications between the physical and digital/virtual products involve data flowing from the physical product to the digital/virtual product and information available from the digital/virtual product in the real environment. A digital twin can be considered a simulated and visualized software style of a primary system that operates in real-time, synchronized with the primary system (Eriksson et al., 2022; Tao & Xu, 2022).

Keeping up with and predicting the impact of technological changes requires the vision, insight, and courage of education policymakers and planners. Artificial intelligence, cloud computing, big data, the Internet of Things, the metaverse, virtual and augmented reality, and other forms of digitalization are changing the educational ecosystem. All these are transforming businesses and markets, the nature of work, the demand for skills, and how people engage in communities, both physically and virtually.

Virtual learning environments have gained special importance in education in recent years (Bogusevschi et al., 2020). These environments are configured to create customizable and motivational learning experiences for learners. The metaverse, or the metaverse, leveraging next-generation technology, is the most pioneering development in virtual environments in the educational field. Using augmented and virtual reality technologies provides a virtual world enriched with digital objects, which can be seen as a digital extension of the physical world (Calongne et al., 2013). When used in educational environments, the metaverse creates flexible, dynamic, and motivational learning situations through interactive and collaborative experiences (Nurhidayah et al., 2020; Zahedi et al., 2023).

Dahan and colleagues (2022) proposed a metaverse-based e-learning environment, a virtual learning environment designed to enhance future educational efficiency by adopting new but challenging technologies to create a gamified, interactive, and experience-sharing enriched e-learning environment (Dahan et al., 2022).

Lee (2021) defined the metaverse as an infinite 3D virtual environment parallel to the physical world, where users can interact using digital avatars, meaning virtual reality is the future dimension of technology (Lee, 2021). Since the metaverse has recently become the hottest topic, academic and industrial journals extensively cover this new subject and continue to do so (Sulema et al., 2023; Suzuki et al., 2020; Wang, 2020).

Radoff divided the metaverse into seven layers, including infrastructure, human interface, decentralization, social computing, creator economy, discovery, and experience (Radoff, 2021). The metaverse can be successfully integrated with e-learning, especially in subjects that depend heavily on the environment and cannot be entirely taught online and remotely, such as medicine and engineering. Although there are various types of e-learning environments, metaverse-based educational systems use virtual reality technologies to provide sustainable, flexible, safe, and effective environments for education. Additionally, the metaverse is not just a virtual reality environment but also integrates the internet, web technologies, and extended reality.

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Figure 1

Metaverse Reference Framework (Krcmar, 2011)

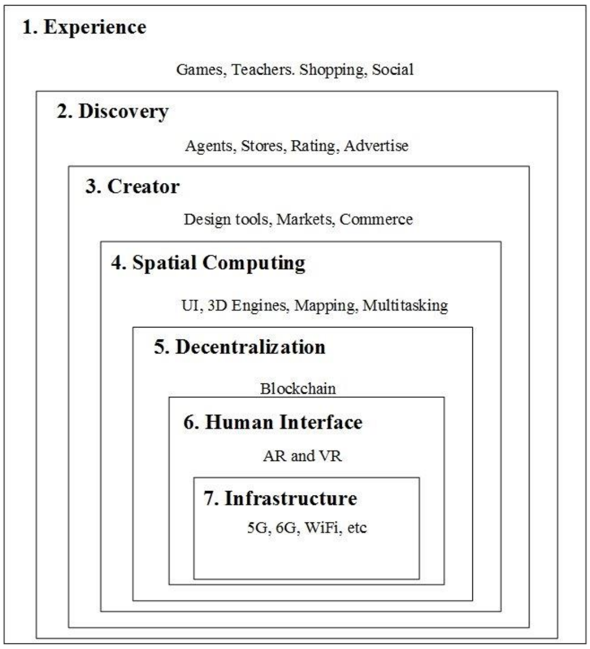
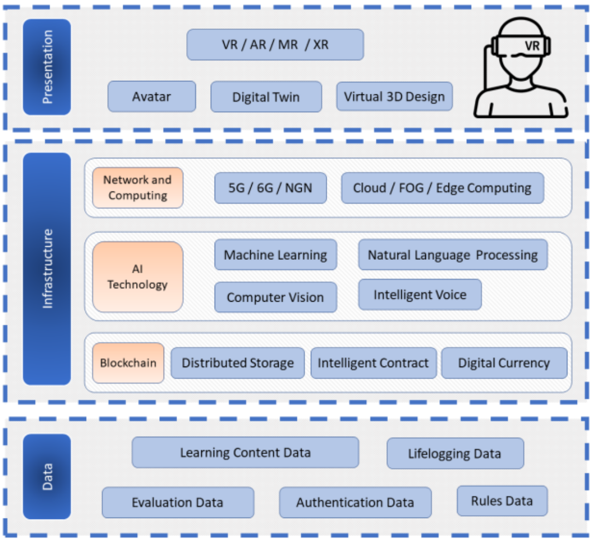


Figure 2

Reference Learning Environment Framework: (Zahedi et al., 2023)



Zahedi and colleagues (2023) introduced a high-level software architecture for a metaverse platform designed to support collaborative learning activities with a virtual learning environment (Zahedi et al., 2023) (Figure 3). The 3D virtual learning environment introduced by Wang (2020) had a theoretical framework consisting of three parts: users, the external environment, and the 3D virtual learning environment. This 3D virtual learning environment comprises a physical, social, and normative environment and a virtual learning community. The virtual learning community includes only avatars that simulate users in the virtual world and interact with other environments using an application program interface (Wang, 2020).

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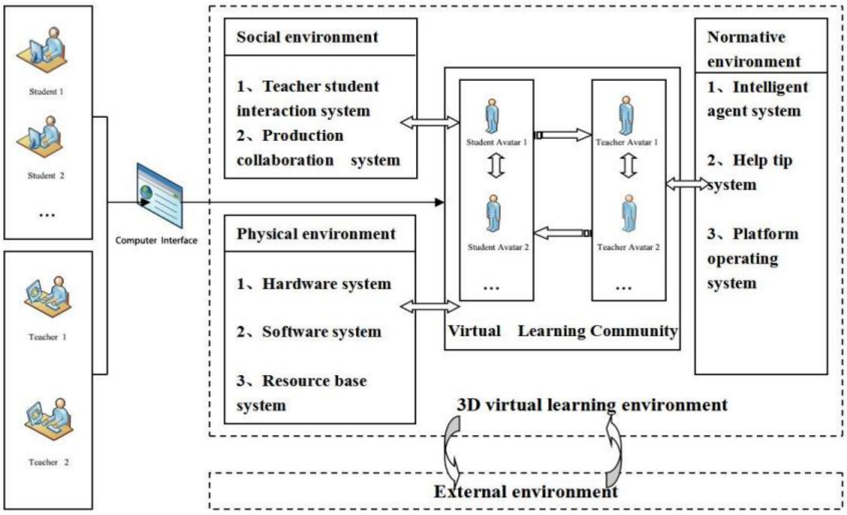
Figure 3

3D Virtual Learning Environment Theoretical Framework, Reference (Wang, 2020)



After the introduction of the Fourth Industrial Revolution by the Germans, the Japanese defined the concept of the Fifth Generation Society. This definition aims to create a society that addresses various social challenges by adopting Fourth Industrial Revolution innovations (such as the Internet of Things, big data, artificial intelligence, robotics, and the sharing economy) in every industry and social life. By doing so, the future society will be one where new values and services are continuously created, and people experience a more peaceful and stable life, which is the Fifth Generation Society, a super-smart society. In this context, Suzuki and colleagues proposed a metaverse-based educational system to transform educational systems into a Fifth Generation Society based on the Internet of Things for knowledge sharing. In the first step, they relied on various 3D objects and the Internet of Things (Suzuki et al., 2020).

Today, organizations and institutions that can adapt to changes are not reliant on buildings and locations; instead, empowering and strengthening the entire community should be the core of any innovation and change. This requires the acceptance of updated social standards. If we consider schools and universities as social institutions, then the definition of a social institution in the report "2018 Deloitte Global Human Capital Trends: The Rise of the Social Enterprise" (Agarwal et al., 2018) becomes clear: "A social enterprise listens to, invests in, and actively manages the trends shaping today's world. A social enterprise is an organization that takes responsibility for being a good citizen (both inside and outside), acts as a role model for its peers, and promotes a high degree of collaboration at every level." In this approach, the concept of skills replaces the definition of a job. A job is a set of predefined functional responsibilities, but this traditional definition and structure have failed to serve today's borderless world. Deloitte's report "2023 Global Human Capital Trends" (Durme et al., 2023) states that a skill-based organizational review shows that only 19% of business managers and 23% of employees say that work is best constructed through jobs. Consequently, an increasing number of organizations have begun to redefine work beyond the job definition and manage the workforce based on skills rather than formal job definitions, titles, or academic degrees. This shift indicates the necessity for educational system reform and the move towards "Education as a Service."

The relationship between smart technology and work has evolved significantly over time. Initially, technology was used as a substitute for workers, automating tasks that were dull, dirty, dangerous, or disrupted. Next, it was used to augment workers, but today, we see the emergence of technologies that not only replace or supplement workers but also help them improve their character and skills, making them more empowered and efficient. These emerging technologies use principles from psychology, anthropology, sociology, and behavioral sciences to redefine and enhance human, team, and organizational performance. Particularly, AI-enhanced smart tools provide increasing amounts of performance-related information to

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enhance human impact in the workplace. Some studies estimate that AI and machine learning will contribute to a 37% increase in workforce productivity by 2025 (Kato et al., 2020; Olcott Jr, 2022; Wang, 2020).

The concept of the workplace as a purely physical location has been changing for some time, as the virtualization of work began before the COVID-19 pandemic, with virtual and hybrid work environments and the adoption of the possibilities of a borderless workplace gaining attention.

If we consider AI the heart of digital transformation, then the necessity of redesigning higher education with the goal of "smart higher education" becomes undeniable. There is a clear need for new research, curriculum development, and changes in educational processes. Moving from a discipline-centered educational system to a curriculum-centered approach is one suggestion. A combination of open university and virtual university concepts, along with the utilization of digital technology tools, methods, and concepts, can lead to smart higher education. However, the question of what requirements and classifications fall under smart, service-oriented higher education needs further investigation. One such classification is the concept of "University as a Platform," where the concept of "Education as a Service" is most evident. A review of the concepts of open universities in this context is very useful, as proposed by Keegan (1980), which includes: separation of learner time and place, use of media as a tool for exchange and interaction, and most importantly, emphasis on learner interests and needs (Keegan, 1980).

Academic degrees are a crucial component of modern educational systems. Today, nearly 40% of workers in OECD countries work in fields unrelated to their degrees. However, employers are starting to devalue academic degrees and give more credit to the skills and attitudes of their employees in solving problems and overcoming challenges. The expansion of modular education, the increase in part-time learning, dual learning experiences - a type of education where the learner works while studying and applies the learned profession in reality - and the emergence of new forms of education, such as micro-credentials - as defined by Oliver (2019), a micro-credential is a certification of assessed learning that is additional, alternate, complementary, or a component of a formal qualification - nano degrees, and digital badges indicate this shift in perspective towards academic degrees (Oliver, 2019). These are digital badges, a type of qualification and competence, digital qualification, nano degree, digital certificates, massive open online courses (MOOCs), or short online courses (Milligan & Kennedy, 2017).

According to a report by Shah (2021), based on 2021 data analysis from Class Central on MOOCs, the number of learners in these courses, excluding China, has reached 220 million (Figure 4). In 2021, educational service providers launched over 3,100 courses and 500 micro-credentials. The top five MOOC providers are Coursera, edX, FutureLearn, and Swayam (Table 1). According to the same report, the vast majority (40%) of courses are in business and technology fields.

Figure 4

Number of Participants, Number of Courses, Number of Micro-Credentials, and Number of Participating Universities in Massive Open Online Courses (MOOCs), Reference: (Shah, 2021)

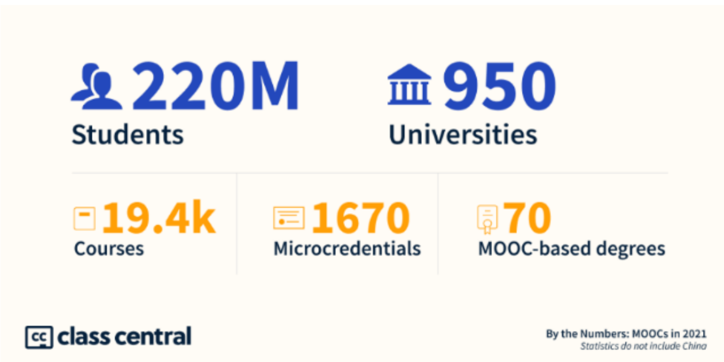

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Table 1

Statistics of Learners in Online Open Courses by Platform (Shah, 2021)

Learners (millions)	Courses	Micro-Credentials	Platform
97	6,000	910	Coursera
42	3,550	480	edX
17	1,400	180	FutureLearn
22	1,465	0	Swayam

In a report published by UNESCO in 2018, the term "micro-credential" is defined as an umbrella term that covers various qualifications, including "nano-degree," "micro-qualification," "certificates," "badges," and "licenses" (McGreal et al., 2022). Additionally, the International Council for Open and Distance Education and the Organization for Economic Co-operation and Development (OECD) use the term "alternative credentials," which includes academic, professional, and digital certificates, as well as badges and micro-credentials (Kato et al., 2020). Thus, learners who wish to obtain micro-credentials can participate in short, modular courses focused on job skills and complete them to receive certificates. However, awarding these micro-credentials presents challenges; the first challenge is the reluctance of institutions to evaluate micro-credentials issued by other entities. Another challenge is the decision-making process regarding the equivalency of micro-credentials and determining whether these courses meet academic requirements (McGreal et al., 2022; Olcott Jr, 2022). The final significant challenge is the integration and accumulation of micro-credentials (Olcott Jr, 2022). One solution is to use blockchain technology to overcome the challenge of combining and accumulating credentials (McArthur, 2018). Therefore, smart universities will focus on developing graduates with skills for the job market and fostering creativity and innovation with a digital entrepreneurship approach (Xiao, 2019).

Modularity and the ability to accumulate certificates and micro-credentials allow learners to select courses based on their needs or interests and stack them to receive a complete degree if necessary. This stacking capability and the ability to combine formal and informal courses into a unified level of knowledge and competence (Olcott Jr, 2022).

For these reasons, the necessity of achieving "Education as a Service" for higher education is evident; learners prefer to acquire the knowledge and skills they need to complete their tasks today and in the future rather than just relying on academic degrees and education at a specific time.

Table 2

Comparison of Traditional Education and Education as a Service

Traditional Educational Programs	Education as a Service Style
Rigid and inflexible	Flexible based on individual work schedules
Focus on ability	Focus on skills
Focus on theory	Focus on experience, implementation, and real-world environment
General	Specialized
Suitable for initial education	Suitable for lifelong learning

To help decide the suitability of Education as a Service, Table 3 summarizes the main advantages and challenges (Ali et al., 2021).

Table 3

Advantages and Challenges of Education as a Service

Advantages	Challenges
Cost savings in creating educational environments	Dependency on internet service providers
Better collaboration	Less control over learners
Easy access and availability of resources	Data security

Scalability	Initial infrastructure setup costs
Modernization of educational environments	Privacy concerns
Utilizing AI robots like ChatGPT	Cheating
Utilizing virtual classes	
Improved collaboration among learners	
Reduced hardware costs	
Preserving and securing valuable data	

Cloud computing represents a new style of delivering IT services (Böhm et al., 2011) and is typically characterized by keywords like on-demand service, broad network access, resource pooling, online service provision, and rapid elasticity (Mell & Grance, 2011). According to the National Institute of Standards and Technology (NIST), cloud computing is defined as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" (Krcmar, 2011; Mell & Grance, 2011). Thus, cloud computing ultimately means consuming IT services in an on-demand style at low cost, without needing to maintain an IT environment and a large team of IT specialists.

Cloud computing services are categorized based on the service they provide. For example, Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), and more service layers (Mell & Grance, 2011). According to Meyer et al. (2015), the concept of cloud computing delivery may even be summarized using the term Everything as a Service (EaaS), *aaS, or XaaS (Meyer et al., 2015).

Extending the EaaS concept to education seems to provide a logical and cost-effective solution to meet the anticipated demands of higher education institutions. Specifically, EaaS entails the provision and supply of infrastructure, applications, platforms, and suitable educational content. Hignite et al. (2010) introduced a four-layer cloud style for "Education as a Service." "Physical hardware services" and "virtual resource services" are grouped under "IT services." "Public services" and "educational services" are categorized under "user services." Chang and Wills (2013) note that "Education as a Service" is not only a new method of delivering education but also a sustainable business model (Chang & Wills, 2013).

An institution using "Education as a Service" can use the provided educational content as a starting point for its offerings and access the necessary software services via the internet. Technical and educational support and the necessary training to use the educational environment and materials are included in the concept of "Education as a Service." Therefore, "Education as a Service" is a combination of the classic IaaS, PaaS, and SaaS layers. This concept can also be applied in academic research, reducing the main barrier to entry, which is the high hardware investment. Based on the four-layer model presented by Fogel (2010), the goal is to introduce a more precise and complete style (Fogel, 2010). Figure 5 shows the various service layers of the "Education as a Service" concept. The proposed layered structure shown in Figure 5 is based on the four basic service layers of IaaS, PaaS, SaaS, and EaaS (each layer including sub-layers) (Meyer et al., 2015). This approach is related to enterprise systems, and other proposed "Education as a Service" methods may consist of fewer layers.

Service layers can be distinguished between service layers visible to the customer (customer view) and service layers hidden from the customer (operational view). However, the service provider must maintain and support both types of service layers in a comprehensive approach. Services of the different layers must be well-coordinated. Therefore, the "Education as a Service" provider must act as a service aggregator, as mentioned in Böhm et al. (2011), and ensure that different services interact regularly, including aspects of security, availability, backup, and recovery, and protection against attacks at all service layers. The service provider must also ensure that customers can use the provided "Education as a Service" effectively, as mentioned previously (Böhm et al., 2011).

From a bottom-up view, the network layer covers all network resources necessary for providing connectivity for any type of cloud-based service. Accordingly, the storage layer represents the total technology and software for offering storage as a service. The server layer signifies computing power, memory, and I/O capacity in terms of IaaS. Virtualization, one of the fundamental concepts of cloud computing, includes introducing an additional abstraction layer between the hardware and operating system, enabling the dynamic management and distribution

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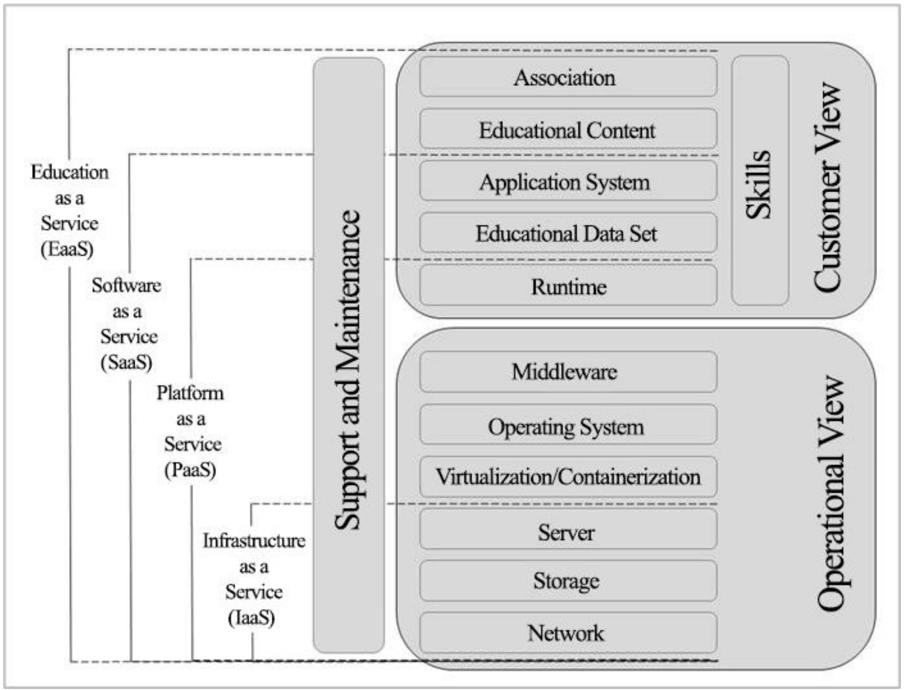
of physical computing resources to software instances running above it and virtual resources for its consumers. The operating system layer involves providing an operating system. The middleware layer offers additional services to software applications beyond those provided by the operating system service layer; particularly in combination with the runtime layer, libraries, services, and tools for using programming languages are provided to the customer (Mell & Grance, 2011). In such a PaaS environment, customers control their deployed applications and configuration settings. The educational dataset layer includes sample data as a general basis for educational materials. For example, a company describing common business processes at the application layer provides software usability and efficiency in terms of SaaS. "The consumer does not manage or control the underlying cloud infrastructure, including network, servers, operating systems, storage, or even individual application capabilities, but only manages user-specific application configurations" (Meyer et al., 2015).

Fogel (2010) lists "content management services" and "online communication services" as educational application-specific services. Accordingly, two additional layers are identified as extensions of the SaaS concept: educational content and communications. Educational content includes slides, case studies, student exercises, information for instructors, and many other materials that may be useful for teaching. Finally, the communications layer of "Education as a Service" provides access to communication platforms and organizes communications; for example, communicating with other instructors and interacting with students (Fogel, 2010).

It is essential to note that services in a higher service layer include all services of their underlying layers. For example, IaaS includes provisioning storage, network, and other fundamental computing resources (Mell & Grance, 2011). Therefore, "Education as a Service" encompasses all service layers shown in Figure 5.

Figure 5

Conceptual Layered Style of "Education as a Service," Reference: (Meyer et al., 2015)



5. Conclusion

This article provided an overview of the impact of digital transformation and emerging technologies in education. "Education as a Service" was introduced as a new concept in the Fourth Industrial Revolution, and all its surrounding aspects were discussed. How "Education as a Service" can lead not only to a degree that can be provided to communities and individuals but also to the realization of the concept of "continuous and effective education." Education that can enhance skill levels alongside knowledge transfer and shift the focus from using a university degree as a decision-making factor for hiring or assigning tasks to personnel to acquired skills. How technological tools serve communities by reducing educational costs and increasing learning levels. How the use of technologies such as virtual reality and augmented reality, alongside newer concepts like digital twins, significantly impacts the transfer of concepts and the level of learner comprehension. How cloud computing services can transform "Education as a Service" from a long-term educational course for skill acquisition to short-term and case-based learning (based on need). In Iran and some other countries, individuals are still employed solely based on their academic degrees, but technological transformations have led many countries, like Germany, to prioritize individual skill credentials at the top of the hiring criteria. This shift in perspective towards jobs and professions requires higher education to adopt new approaches and make intelligent decisions more than ever.

Authors' Contributions

Not applicable.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Ethics Considerations

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