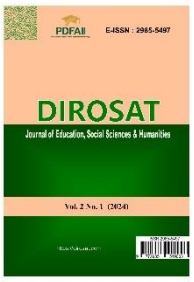

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Research Article

Symbiotic Evolution: The Inextricable Relation between the Web and E-Learning

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Abstract. This article explores the strong relation between the evolution of the Web and that of e-learning. From the modest beginnings of e-learning, the Web has played a key role in widening access to education on a global scale. The emergence of online educational platforms, increased interactivity, adaptability thanks to artificial intelligence, mobility and accessibility have redefined e-learning. However, challenges remain, including online security and unequal access. In conclusion, the symbiosis between the Web and e-learning offers immense potential for the future of education, demonstrating the capacity of technological progress to transform our teaching methods.

Keywords: Web evolution, E-Learning, Interactivity, Artificial Intelligence, Lifelong learning

INTRODUCTION

Education has become the main catalyst for change in a constantly evolving world. The World Wide Web emerged as a transformative force at the dawn of the 21st century, redefining not only the way we interact with information, but also the way we learn. Online learning, also known as e-learning, has been strongly influenced by this evolution.

British scientist Tim Berners-Lee founded the World Wide Web in 1989 while working at CERN (the European Organization for Nuclear Research). The "World Wide Web" project was initially developed to allow scientists working in universities and institutes all over the world to instantly share information (Berners-Lee et al., 2010).

The degree of confusion between the terms Web and Internet that still exists today is impressive, demonstrating the extent to which the Web is both widely known and poorly understood. Too many people still confuse the terms Internet and Web. Rebuild it: Networks of computers and other connected devices can be connected to each other through the Internet. It offers a communications infrastructure that facilitates a variety of applications, including phone, video, and electronic mail (e-mail). It also hosts the Web, a distributed hypermedia that has emerged as the standard software architecture for Internet applications. Furthermore, due to this misunderstanding, the term "Web" is frequently used to refer to both the final product the web created by billions of users and the guiding ideas of this software architecture. Tim observed in 1994 that the phrase "World Wide Web" rapidly expanded to include a number of ideas, such as a framework and a collection of information accessible via the Internet. There are two distinct but connected histories to the architecture and the final product. But each of the two parts has a distinct complexity that calls for further study and creation (Anoir et al., 2023).

E-learning was initially a new concept, limited to specific educational environments. However, the traditional boundaries of learning began to blur with the evolution of the Web. Philosopher and educator John Dewey emphasized that "learning is not preparation for life; it is life itself" (Deway, 1938). Since the 1960s, online education has expanded into a variety of fields, including business, education, training and the armed forces. In schools, Although “e-learning” refers to the use of software to improve online learning, it only refers to a range of online practices in the business, higher education, military, and training sectors (Nicholson, 2007).

The emergence of online educational platforms such as Coursera , edX and Khan Academy has transformed the educational landscape, broadening learners' horizons on a global scale. These platforms, fueled by global connectivity, have made it possible to access previously inaccessible knowledge.

E-learning has changed by integrating interactivity and artificial intelligence. As a result, educational technologies have begun to create almost magical learning experiences, adapted to the needs of each individual learner.

Theoretical background and issues

The evolution of the Web and E-Learning is taking place in a theoretical context where technological advances are fundamentally redefining the way

education is delivered and consumed. Theories related to Information and Communication Technology in Education (ICTE) provide guidance for our understanding of this transformation. The convergence of the Web with concepts such as e-learning, educational artificial intelligence and mobility is creating a dynamic educational ecosystem.

The constructivist perspective on learning, developed by thinkers such as Jean Piaget and Lev Vygotsky, emphasizes the importance of interaction and the active construction of knowledge by the learner. In the context of e-learning, the interactivity of Web 2.0 and the personalized learning approaches of Web 3.0 reflect these constructivist principles (Babakr, 2019; Levykh, 2008).

Another way to approach at e-Learning is as an advancement of distance learning that has made use of the newest technological tools to appear in the field of education, especially Teaching-Learning. E-learning is the term for the use of Internet and multimedia technologies in the classroom to enhance learning quality through easier access to resources and services, as well as remote collaboration and exchanges.

- **E-Learning 1.0:**

The availability of content online was the primary shift brought about by the development of the Web. Learning (Content) Management Systems (LMS or LCMS) were developed to support learners' study management and course organization. The concept of "learning objects" was born out of this need. Compared to hierarchical learning, which employs one-way communication, this style of learning is thought to be more traditional. Under this direct transfer model, educators communicate educational materials and interact with students through a variety of channels. Online education This time frame is referred to as E-Learning 1.0 (Hussain, 2012).

"E-Learning 1.0" describes the initial wave of e-learning systems that appeared along with the development of digital technologies and the Internet. When compared to modern e-learning standards, this phase, which spanned the late 1990s and early 2000s, is distinguished by comparatively simple approaches and limited functionality (Ebner, 2007).

- **E-Learning 2.0 :**

The transition from Web 1.0 to Web 2.0 has also brought with it the transition from e-learning 1.0 to e-learning 2.0. From this perspective, traditional e-learning systems used pedagogical packages to deliver courses to learners via the Internet. Stephen Downes explained how to use technologies to teach and learn, in particular "e-Learning 2.0". For instance, Web 2.0 has altered the social and collaborative nature of the classroom through the use of wikis, blogs, podcasts, and other social media platforms (Hussain, 2012).

E-Learning 2.0 represents an evolution of e-learning towards a more interactive, collaborative and social approach. This phase emphasizes the active participation of learners, the use of social media, and the creation of online learning communities. Unlike E-Learning 1.0, characterized by static content, E-Learning 2.0 favors real-time interaction, peer-to-peer knowledge exchange and the collective creation of educational content.

- **E-Learning 3.0:**

The term "E-Learning 3.0" refers to a later phase in the evolution of e-learning, characterized by the advanced integration of emerging technologies such as artificial intelligence, virtual and augmented reality, as well as more personalized and adaptive learning models. The notion of E-Learning 3.0 suggests a more intelligent and contextual approach to e-learning. It should be noted that the term is not universally defined and may vary according to interpretation.

Research communities are talking about Personal Learning Environments (PLEs, also called mashups) as Web 2.0 technologies transition into Web 3.0.
The key to managing an overabundance of information in the knowledge-based society is perceived to be personalization(Ebner et al., 2011; Lamya et al., 2021).

Currently, the term "E-Learning 4.0" is not yet as widely defined and adopted as the earlier phases of e-learning. However, an evolution towards E-Learning 4.0 could be closely linked to the concept of Web 4.0 or the "Semantic Web", a vision of the Internet that goes beyond the simple interconnection of documents to focus on the meaning of data.

- **E-Learning 4.0**

Could incorporate the technological advances of Web 4.0 to deliver an even more personalized, contextual and adaptive learning experience. It could use technologies such as advanced artificial intelligence (AI), virtual (VR) and augmented reality (AR), as well as sophisticated algorithms to analyze learners' progress in real time, understand their learning preferences, and dynamically adjust content and pedagogical activities accordingly (Kothari & Verma, 2022).

The issue of this article is to explore the opportunities and challenges arising from the intertwining of the evolution of the Web with that of e-learning. While these advances promise increased accessibility, personalized learning and enriching interactivity, crucial questions emerge.

- **Research Question 1 (*RQ1*):** What impact has the evolution of the Web had on e-Learning?
- **Research Question 2 (*RQ2*):** How can we achieve a balance between automation and human involvement? What are the new roles of teachers in this emerging educational environment?

By exploring these issues, this article aims to provide a critical overview of the current dynamics between the evolution of the Web and that of e-Learning, while considering solutions for overcoming the challenges inherent in this educational transformation.

RESULTS AND DISCUSSION

a. **Research Question 1 (*RQ1*):** What impact has the evolution of the Web had on e-Learning?

The development of E-learning is closely related to the development of the Web; if Web 1.0 is a read-only version of the Web, Web 2.0 is a read/write version, and Web 3.0 is a read/write/collaborative version. Therefore, E-Learning 1.0 focuses on giving the learner access to information, whereas E-Learning 2.0 and E-Learning 1.0 combined Next, we discuss e-Learning 3.0, which is enhanced and activated by Web 3.0, also known as the semantic web. This will enable rich, collaborative 3D virtual learning in intelligent environments that will bring learners together for an experience that improves the social and communicative aspect with the various players in a learning situation. E-Learning 2.0 gives learners the ability to create and interact. E-Learning 4.0, an improved version of the previous version, emerged as a result of Web 4.0 Web in read-write-execute-compete, which links intelligence, oriented interaction individuals or objects. They will be a software solution that focuses on performance monitoring and analysis, becoming mobile, personalized approach (Table 1).

Table 1. The relation between the evolution of the Web and the evolution of E-Learning

	Web				**E-Learning**		
	Concepts	**Type**	**Year**	**Technologies**		**Concepts**	**Technologies**
Web 1.0	Read, Connect information	Traditional web	1990	Protocoles HTTP, HTML XML Java & JavaScript **Communication Tools** : email - forums	**E-Learning 1.0**	Facilitating the learning and communication process, this is the era of the static reading web, which does not include human-machine interactivity.	cognitive behavioral therapy (CBT), Learning management system (LMS), eBooks, Virtual learning environment (VLEs)
Web 2.0	Reading and writing, connecting people	Social Web	2000	XML (structured HTML) which consists of describing things with words + RSS (content feeds) **Communication Tools :** social networks - collaborative platforms -SMS - MMS - video-streaming	**E-Learning 2.0**	We are talking about social networks, active collaboration using new technologies such as blogs, podcasts and videos.	Learning Content management system (LCMS) , social networks, videoconference ,VLEs, Mashups Skype, virtual game, wiki

Web 3.0	Read, write and execute, Connecting knowledge	Semantic Web	2010	In addition to XML, new languages are emerging: RDF (Resource Description Framework), i.e. the grammar that defines concepts and establishes relation + OWL (Ontology Web Language), based on relation and logic + SWRL (Semantic Web RuleLanguage), which establishes the rules for understanding what humans are looking for. **Communication Tools :** all previous tools adapted to the mobile Internet (tablets, smart phones) + cross-media tools such as QR codes, RFID (radio frequency identification)	**E-Learning 3.0**	This is the period of the Semantic Web, with the emphasis on learners, their behavior in relation to the system and their response, also known as Mixed E-Learning	PLEs, Social semantic web, second life, personal avatars, mobile learning
Web 4.0	Web read-write-execute-compete, connect intelligence, interaction-oriented individuals or objects		2020	interconnection real|virtual, collective intelligence, OS (operating system) + Cloud, intelligent filters	**E-Learning 4.0**	Will be a superior form of the previous version, they will be a software solution that focuses on monitoring and analyzing performance, become mobile, personalized approach	In progress

In response to the first research question, Table 1 highlights the relation between the Web and E-Learning. Indeed, the evolution of the Web has been a dynamic phenomenon that has transformed the way we interact with information and maintain relation online.

This constant evolution of the Web reflects not only technological advances but also changes in our needs and expectations as connected users. The picture reflects a deep and dynamic relation between the evolution of the web and e-Learning, with each field influencing and shaping the other over time. This symbiosis has played a crucial role in transforming the way education is delivered and consumed.

The evolution of the web has considerably improved accessibility to information. This has opened the door to global e-learning opportunities. e-Learning platforms can now offer courses and educational resources to learners located anywhere in the world, eliminating geographical barriers.

In short, the evolution of the web has created an environment conducive to the growth of e-Learning, providing technologies and infrastructures that have enriched the online learning experience. In return, e-Learning has stimulated innovation and the progression of the web as a dynamic educational platform. This ongoing interaction between the two fields continues to redefine the way education is conceived, delivered and consumed in the digital age.

b. **Research Question 2 (*RQ2*):** How can we achieve a balance between automation and human involvement? What are the new roles of teachers in this emerging educational environment?

The balance between automation and human engagement in online education is crucial to creating enriching and effective learning experiences. New technologies, such as artificial intelligence (AI) and e-learning platforms, can automate certain tasks, but the human role remains essential to delivering quality education.

Figure 1. Balancing Automation and Human Commitment

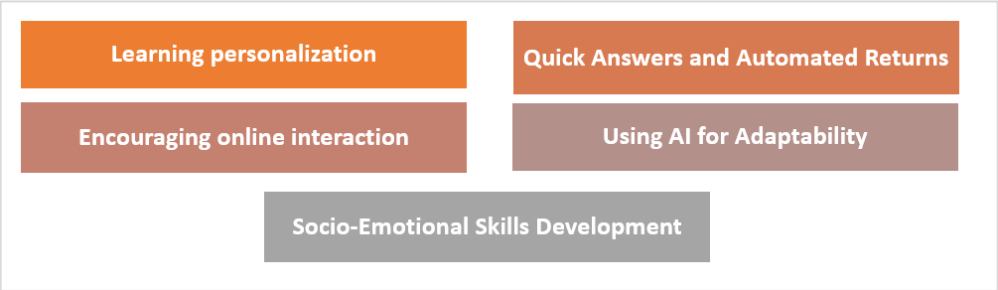

Figure 1 provides an answer to the first part of ***RQ2***. In fact, Figure 1 presents the essential components for balancing automation and human engagement

- **Learning personalization:** Automation can be used to analyze learner performance and recommend personalized content. However, the teacher plays a crucial role in understanding learners' individual needs and providing personalized support.
- **Rapid responses and automated feedback:** Automated systems can offer immediate answers to learners' questions and instant feedback on their

performance. Teachers can complement this by providing more in-depth feedback and guiding students through their progress.

- **Encouraging Online Interaction:** Automated platforms can facilitate interaction between learners, but teachers need to encourage meaningful discussion and step in to guide debates.
- **Using AI for Adaptability:** AI can dynamically adjust content according to each learner's learning style and progress. Teachers can complement this by ensuring that these adjustments correspond to specific educational needs.
- **Developing Social-Emotional Skills:** Human engagement is essential for developing social-emotional skills such as collaboration, communication and critical thinking. Teachers can design activities that encourage these skills.

In the second part of our question (***RQ2***) we focus on: What are the new roles of teachers in this emerging educational environment? The new roles of teachers in an emerging educational environment are profoundly influenced by the increasing integration of information and communication technologies (ICT), the rise of e-Learning, the use of artificial intelligence (AI) and the need to teach relevant skills.

The new roles of teachers in an emerging educational environment are characterized by a transition from traditional teaching to a more dynamic, learner-centered approach. Teachers are taking on expanded responsibilities that go further than the simple transmission of knowledge to encompass the design of innovative learning experiences, personalization mentoring, and the facilitation of essential skills for modern society. These roles include:

- **Learning Facilitator:** Teachers become learning facilitators, guiding learners in discovery rather than simply dispensing knowledge.
- **Content Designer:** Teachers play a central role in designing stimulating and relevant educational content, even if some of the distribution can be automated.
- **Data Manager:** With AI being used to analyze learner data, teachers need to become skilled data managers, using the information to inform their teaching.
- **Mentor and Coach:** Teachers become mentors and coaches, offering emotional, motivational and academic support to learners.
- **Creator of Learning Experiences:** Teachers play a crucial role in creating engaging learning experiences that go beyond simple automated exercises.
- **Collaboration Facilitator:** Teachers facilitate collaboration between learners, encouraging the sharing of ideas and the collective creation of knowledge.
- **Skills Evaluator:** Teachers assess learners' skills, going beyond automated assessments to understand the holistic development of each individual.

The new roles of teachers reflect a more flexible, adaptive and learner-centered approach, where the teacher becomes a guide in the learning process rather than a dispenser of knowledge. This evolution responds to the changing needs of education in an increasingly digital and interconnected world.

In sum, the balance between automation and human engagement requires an integrated approach where the strengths of automation are harnessed to improve

efficiency, while teachers bring a crucial human dimension to support and inspire learners on their educational journey.

CONCLUSION

The combination of e-learning and the evolving Web is creating new prospects for education worldwide. E-learning adapts and evolves in tandem with the evolving Web, offering immense potential for future learning. The ability of technological advances to shape and enhance our teaching methods is illustrated by this dynamic relation, which opens the way to a promising future for online education.

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