

## E-Learning and Web Generations: Towards Web 3.0 and E-Learning 3.0

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**Abstract.** It is widely accepted that the WWW has evolved consistently over the years. Early Web tools were simple, but as information technology and internet speeds evolved, new tools would emerge, creating an interactive, user-centered space where information is shared among all. The next generation of the Web, the Web 3.0, will aim primarily at organizing it through intelligent agents and semantic standards. At the same time, one of the earliest and most popular uses of the Web, e-Learning, is also changing. Thus, much as the Web changed from a “read-only” medium, to “read-write” and to “read-write-collaborate”, so have the concept and methods of e-Learning changed from a simple transposition of educational material to online support, to entirely new approaches to education, centered on student’s active participation, interaction and collaboration. Web 3.0 will further emphasize this revolutionary approach, potentially leading to virtual spaces of collaborative knowledge centered on active learning, student-centered applications, 3D visualization and intelligent agents based on semantic machines to permit students easy, intuitive access to information. By taking note of the parallels between the evolution of the Web and of e-Learning, we can make predictions of how future changes in the Web will eventually bring about changes in e-Learning systems.

**Keywords:** Web 3.0, e-Learning, e-Learning 3.0

### 1. Introduction

Since its widespread acceptance as an ideal platform for working, commercial, entertainment and academic purposes, the World Wide Web has changed, evolving as technology itself permitted, and leading to the currently prevalent standards of Web 2.0, the Social Web, where the basics of collaborative content creation were laid out. But while Web 2.0 standards have generated an explosion of information, due to the amount of authoring tools and sharing platforms that are now available, it also exponentially increased its disorganization and complexity, leading to vast amounts of untapped information which users do not access, because it’s not easily found among the “white noise” – irrelevant data that inefficient search and organization paradigms cannot filter accordingly to the necessities of users.

Web 3.0 is the next generation of WWW standards, aiming precisely at addressing the shortcomings of Web 2.0 and centered around certain fundamental principles: collaborative filtering, cloud computing, big data management, mobility. The ultimate goal is to create an intelligent Web, where users can effectively and quickly be directed to the information that they require, when they require it. In order to achieve this, it is paramount that new tools are developed, tools that can enable a more intuitive, less “blind” organization and

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structuring of the existing information. The idea behind Web 3.0 is that this form of organization can only be achieved if machines are endowed with the same abilities of reading and interpreting data that human beings possess, which is why Web 3.0 is also sometimes referred to as the Semantic Web.

As one of the most popular and sophisticated tools that the internet has made available, e-Learning has naturally evolved side-by-side with the Web, and it's possible to identify e-Learning 1.0 and 2.0 as standards of virtual education that accompany the Web 1.0 and 2.0 standards. Thus, it is reasonable to assume that e-Learning will eventually follow in the footsteps of Web 3.0 as well, adopting its key principles and corresponding technologies to achieve a more efficient and immersive form of education, which has always been the ultimate goal of virtual learning environments.

In this paper, we will first discuss the evolution of the Web, from 1.0 to 2.0 standards, and how 3.0 standards appeared as a natural result of the strengths and challenges of prior approaches. We will also describe and analyze the process of evolution of e-Learning, as it accompanied the evolution of the Web itself, so as to subsequently discuss how Web and e-Learning standards are correlated. Ultimately, it is proposed that this analysis will provide valuable insight into how Web 3.0 can revolutionize e-Learning.

## 2. Evolution of the World Wide Web

The increase in general use of the internet has seen an explosion of available websites and users, generating tremendous amounts of information. In fact, the internet is arguably the fastest, most efficient and cheapest medium for gathering and disseminating information today, and using the Web for anything – from business to academic research to simple entertainment – has become a part of the modern lifestyle, permeating every level of society. Such a fast and widespread dissemination was only possible because of the equally swift evolution of computer technology, not just in processing power but also in regards to the speed of internet connections in itself [1].

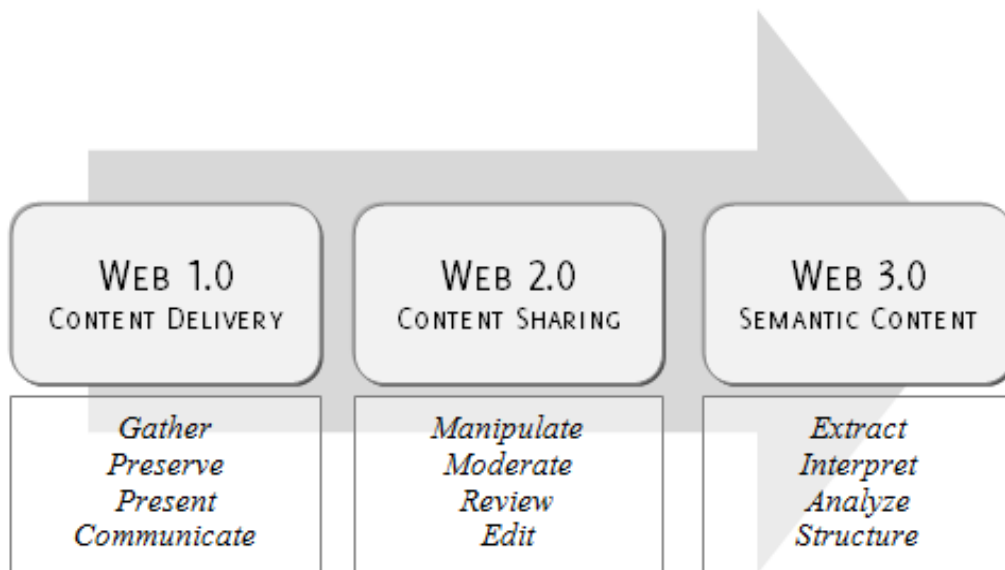


Fig. 1: Evolution of the Web (adapted from [2]).

An inevitable consequence of the fast, dynamic process of the Web's dissemination is that it has become an evolving system, changing as technology itself evolves. [3] observe that this process of evolution is in fact related to three different dimensions of human knowledge, in what they have named the "Theory of the Web". The authors first define the World Wide Web as a "techno-social system, a system where humans interact based on technological networks", emphasizing that, on the one hand, the Web is still primarily a human system, and on the other hand, it is reliant on technology. In this sense, Web 1.0 is defined as a cognitive medium, Web 2.0 as a communicative medium, and Web 3.0 as a collaborative medium [3], thus bringing into focus the three essential traits that have set apart each of the stages of the evolutionary process.

[4] observed that the evolution of the Web has been illustrated essentially by a transition process from a read-only medium to a collaborative one. Researchers and developers who studied the same issue eventually

pinpointed two distinct stages along this process, each displaying its own standards or generalized principles, according to the available technologies. Today they are commonly referred to as Web 1.0 and Web 2.0, and it is asserted that the next set of concepts and technologies will be the Web 3.0.

Figure 1 shows a graphical representation of the evolution from 1.0 to 3.0 standards, and the main ideas behind each stage, according to [2]. In the next sections we will analyze these changes in depth.

## **2.1. Web 1.0**

There is some debate as to whether Web 1.0 can be described as a separate stage of the evolutionary process [5]. “Web 1.0” is an expression conveniently established a posteriori to describe the early stages of the internet, where content was static and websites primarily resorted to the HTML language. In this context, and with limited available tools, there was very little opportunity for users to effectively participate, making them essentially consumers of information, but not creators of it. This leads to the common description of Web 1.0 as “read-only”. Website authors would publish the information that they decided to publish, and allow users to view that information. Users could view it, and eventually contact the author, but there was not a direct link between author and reader, or between the reader and the content itself [6].

Web 1.0 is essentially “a system of interlinked hypertext documents accessed via the Internet” [13], with very limited user participation. The emphasis was placed entirely on the possibility of searching for information, and the goal of website owners and administrators was to bring that information into a public space of global visibility. For many companies, to be present on the internet was in itself a goal, and the website was more of a “business card”, presenting the company, its goals, its products, in a descriptive way, so as to make users interested in contacting them directly. Likewise, non-commercial websites were primarily concerned with making content readily available to visitors and providing an organized, efficient source of information for whatever purposes were deemed necessary, from educational to gaming to governmental.

However, for Tim Berners-Lee, the inventor of the World Wide Web, the intention and vision had always been to make the internet a collaborative space, where individuals physically separated by geographical, cultural and language barriers would come together and collectively contribute to a global information space [7]. Therefore, it can be argued that the main characteristics of Web 1.0 were merely a consequence of technological obstacles, as processing capabilities and internet speeds were very limited.

## **2.2. Web 2.0**

This scenario changed between the late 1990’s and the first decade of the 21st century, and the subsequent generation of internet solutions is what we call the Web 2.0, following Tim O’ Reilly’s coining of the expression [8]. If Web 1.0 can be described as “read-only”, Web 2.0 is often described as “read-write”. Across the existing literature, there have been other, more complex definitions that relate the emergence of Web 2.0 to different perspectives. [5] defines Web 2.0 in relation to the new technologies it has harnessed (such as blogs, wikis, podcasts, etc.), while [8] considers that the revolution in web services was driven by the urgency of the business sector to establish itself within the internet.

The focus of Web 2.0 is on social interactivity, collaboration and information sharing, in its most literal form. Whereas before users could only view content, the emergence of new web-based tools, platforms and applications provided them with the ability to edit that content, and to create and share new content of their own. This new generation of the internet thus saw an explosion of social networking and information sharing spaces, from Blogger, Wikipedia and Livejournal to Facebook, YouTube, Twitter, LinkedIn, etc. Up until the development of Web 2.0, the focus of computer systems had always been on managing data, information and explicit knowledge, but with Web 2.0 the focus shifted towards methods and tools for the development of more implicit knowledge, derived from social interaction and global participation [9].

According to [5], Web 2.0 is a concept that aggregates a number of key ideas. We summarize these principles in Table 1.

Table 1: Key ideas of Web 2.0 (based on [5]).

<i>Concept</i>	<i>Description</i>
<b>User Generated Content</b>	Intuitive tools that allow for the creation of personal content, such as posting one's own images, texts or videos to blogs, wikis, social networks, etc. Highly facilitated by advances in technology (smartphones, tablets, laptops, wifi, etc.), it has led to an exposure culture.
<b>Harness the Power of the Crowd</b>	Group working and collaborating leads to easier solutions to collective problems or issues. Crowdsourcing becomes increasingly popular as a means of getting amateur content and ideas out into the public, through social networking, and letting the public decide their worth or potential.
<b>Data on an Epic Scale</b>	The amount of data that's being generated by user-centered applications leads to data management becoming a core competency of IT companies and corporations such as Google. Data management is one fundamental challenge of Web 2.0. Aggregator services use the data to provide targeted suggestions or advertisements.
<b>Architecture of Participation</b>	The principle by which a service grows and improves the more people use it and participate in it. It is not a mere side effect; the system is designed to use interactions as a means to improve and build itself. Google and BitTorrent are two examples.
<b>Network Effects</b>	Services increase in value as users are able to interact within them, and the more people join in. These services are only useful and valuable to the extent that people are using them, making users a key component of the vary functionality of the service. But this entails a problem, as people might rally towards an inferior product merely because it's got an extensive user-base.
<b>Openness</b>	Working with open standards, using open source software and free data, and working in open, collaborative innovation, are all increasingly popular trends. The prime example is the Firefox browser and its many extensions.

Web 2.0 presents various advantages, particularly the form by which it leads to the creation of complex networks of information by enabling users to participate in the very architecture of the Web, generating large amounts of data with many potential uses. It has also led to the development of increasingly flexible, user-centered applications.

However, there are also shortcomings for the Web 2.0 standard. As observed by [9], the growth of an increasingly user-centered Web is leading to disorganized, confusing data clusters and an overload of irrelevant information. It is also generating more and more issues of security and privacy, with impacts even in government policy, as was clearly demonstrated by the Wikileaks scandal.

[5] points out three essential problems that are already clearly present in the internet today, namely the overload of information, the challenges to intellectual property, and the issues of trust, privacy, and security in online environments. In fact, the use of social networks is changing the very concept of private space, as content that was once a part of the private sphere, where only friends and family could enter, is now being made available for the entire world [10]. Likewise, piracy and free distribution of copyrighted material has been increasingly facilitated by Web 2.0 tools and faster internet speeds. As for the overwhelming amount of data, it is already pointed out by researchers that this is perhaps the biggest challenge for the Web of the future, but also its greatest opportunity [11].

### 2.3. Web 3.0

The next generation of the Web proposes many solutions to such issues, taking one step forward in enabling users to modify information resources by themselves. Through the development of intelligent machines that will be able to understand content (instead of merely displaying it), learn what users require and suggest the adequate information that they are searching for [12], the Web will become far more efficient and powerful. However, this approach requires that semantic content be introduced into the Web, which is why Web 3.0 is also known as the Semantic Web. To introduce semantics is to introducing meaning and relevance into the content.

The Semantic Web is essentially built on databases, instead of documents [1]. The simplistic concepts of website or webpage will become obsolete, as data no longer belongs to particular users, but is shared among them [13]. This evidently requires the adoption of new forms of scripting and programming, and that particular evolution has been made possible with the increasing sophistication of RDF (Resource Description Framework), the language standard that will power the new generation of the Web [14]. Indeed, interpretation and intelligent filtering of content require that machines are endowed with the appropriate language to be able to read, describe and organize content. Because they do not have the human capacity for

language, they will require metadata [15] and the markup of Web services in order to transform them into machine-readable and agent-ready objects [16].

Such tools will need to express logical relationships between semantic meanings, and the information available on the Web [12]. This will lead to an increasingly organized information network, based around logical and intuitive principles that, if correctly implemented, will allow for far more sophisticated search mechanisms than what's currently used by the Google search engine [13]. Computers will then be able to understand what every aspect of a search query inherently means, and what user intentions and needs can be inferred from that query.

One of the most important aspects that will need to be implemented to effectively build a Semantic Web is a set of ontologies. An ontology is “a specification of a representational vocabulary for a shared domain of discourse”, including “definitions of classes, relations, functions and other objects” [17]. In order for computers to understand semantic meanings, those meanings and relationships have to be established through common standards by defining ontologies within different domains. Thus, researchers argue that the success of Web 3.0 will largely depend on how ontologies will proliferate and how sophisticated ontology engineering tools will become [18].

In Table 2, we summarize the main characteristics of the Web 3.0. While some of these concepts are innovative, others are evolutionary ideas stemmed from Web 2.0 principles.

Table 2. Main principles of Web 3.0 (adapted from[19]).

<i>Concept</i>	<i>Description</i>
<b>Intelligent Web</b>	Content described in a form that is readable and understandable by machines, so that they are able to intelligently organize and filter it, as well as efficiently understand user's searches and queries. Natural language processing, machine-based learning and reasoning, and intelligent applications will all be staples of this Intelligent Web.
<b>Organized Information</b>	The interactivity and social nature of Web 2.0 generated an overload of information and chaotic clusters of data. Web 3.0 will allow for the organization of information, leading to more efficient tools.
<b>Openness</b>	Greater openness regarding formats, protocols and Application Programming Interfaces (APIs). It can also refer to greater openness between users, personal information and personal data.
<b>Interoperability</b>	Open sharing and common formats will lead Web 3.0 applications and services to efficiently run across a variety of different platforms and devices, because they will ultimately lie on a common set of ontological principles and languages.
<b>Global Database</b>	The Web will no longer be the sum of many web documents, but a global, massive database, using structured data records, and resorting to Extensive Markup Language (XML) formats such as RDF, OWL, SPARQL, etc.
<b>3D Visualization</b>	Web 3.0 will increasingly resort to 3D visualization and simulation, through use of tools similar to the Second Life virtual world as well as avatars and personalized agents.

### 3. Evolution of e-Learning

E-Learning is essentially teaching through the use of computers, and in this broad sense, it has been described through many different expressions, such as: computer-based training, online teaching, virtual teaching, web-based teaching, etc. The core principle is the use of IT and communication technologies for teaching activities, whether these activities are undertaken individually or within a group, via a personal computer or through other devices, online or offline, synchronous or asynchronously [20]. However, one of the most important potentialities of e-Learning is that it enables students and teachers to interact online, facilitating distance teaching and generating a cheaper, more accessible form of education that could, in theory, be available to all. In that sense, the internet can be e-Learning's greatest weapon.

E-Learning systems require specific tools and skill sets. According to [21], the key differences between traditional forms of education and e-Learning are:

- “Pull” Delivery – students have the power to determine the content
- Reactionary Responsiveness – students can respond to problems as they arise
- Non-Linear Access – students can directly access content in non-sequential ways
- Symmetry – learning develops in integrated form
- Continuous Modality – learning moves parallel to tasks without definite stops
- Distributed Authority – content derives from interaction between participants

- Personalization – content can be determined by individual needs
- Dynamic Adaptivity – content can change through user input and experience

Thus it can be asserted that e-Learning is a much more flexible form of education, and online environments offer tremendous potential for greater participation by users and teachers alike, contrasting with the traditional educational systems where content is predetermined and students are merely guided as it's delivered.

Because the Web has always been regarded as a major tool for the development of e-Learning platforms, e-Learning itself has naturally accompanied the evolution of the Web standards. Moreover, as new technologies are developed, e-Learning platforms attempt to integrate them, and this trend effectively explains why e-Learning has changed over the years.

### **3.1. E-Learning 1.0**

The first stages of e-Learning's evolution process developed as it moved from the mere introduction of digital tools in the educational system, to the use of the internet itself. In this context, it adopted the standards and principles of Web 1.0, in order to provide students with easily accessible and readily available online content, which students could access and learn from at any time – eventually leading to the expression “anytime, anywhere, anybody” [22]. This trend led to the proliferation of Learning Management Systems (LMS), information systems that are centered on the purpose of organizing and storing educational content, as well as analyzing and measuring its utilization for future improvements.

Much like the Web 1.0 in general, e-Learning 1.0 is one-directional [6]. The teacher distributes the content that he/she wishes to teach, placing it on an online platform, and students will consult it, either upon the teacher's indication or by their own means. It is the transposition of traditional educational principles and attitudes to a digital, online environment [23], and in the same vein of traditional teaching, the tutor is concerned with what the students are learning, not specifically with the methods or tools with which they are learning [24].

The goal of e-Learning platforms at this point was mainly to change the way students access educational content, by providing it in a convenient space, outside of the classroom. There were no changes to the actual teaching methodologies.

However, one of the first approaches to e-Learning promoted the goal of perfecting the media that was offered to the learners, by introducing “new media”, such as animations, simulations or interactions, with the purpose of transforming the school book into an interactive book. On the other hand, LMS provided the necessary support for interactive features connecting learners and tutors, namely e-mail, discussion forums and chatrooms. Therefore, it is possible to assert that e-Learning 1.0 wasn't exclusively static: there was the goal of adding interactivity and new media to the traditional educational materials, transforming education itself into a more constructive pedagogical approach [22]. This goal was subjected to the popular technologies and web services of the time.

According to [25], there is an intermediary stage that some researchers have named “e-Learning 1.3”. This stage is characterized by a change in the delivery of learning, which is done more quickly, and incrementally. It is pushed outside the boundaries of the LMS, and increasingly distributed through e-mails and the intranet platforms of organizations. The content itself is more easily created using templates provided by e-Learning tools.

### **3.2. E-Learning 2.0**

In discussing the new trends in internet usage and how it can affect educational systems, [26] pointed out that the users themselves appeared to be changing into what some called the “digital natives”, individuals that absorb information at much faster rates and are used to dealing with multiple sources at once, essentially growing on the Web 2.0's information overload. They are more informed and, thus, more demanding with the quality of that information and how it is presented. Just as websites, networks and applications eventually realized the need to become much more user-centered than before, e-Learning platforms also began to adopt student-centered principles and methods, leading to what is commonly known as e-Learning 2.0.

As we have previously seen, social networks and interactive, collaborative websites form the essence of Web 2.0. In e-Learning, this trend of increasing participation and interactivity led to an informal change in how students, and by extension the teachers, viewed their own learning processes. Resorting to wikis and blogs, students now had access to new forms of information, and could even discuss topics with other students across the globe [26]. Teachers and tutors, on the other hand, discovered podcasting as a new form of disseminating educational content with a less formal, more personalized touch [27]. Numerous other trends of Web 2.0 have been pointed out as having potential for learning systems: user-generated content, crowd-funding, collaborative architectures, networking, openness and transparency [28].

According to [29], the technical dimension of e-Learning 2.0 entails two approaches that can either be used individually or mixed together within the same system. The first approach is the “community of practice”, a constructivist educational strategy where students interact, learning together, through discussion, commenting, collaborative writing, or collaboration on specific projects. Wikis are the best tools here. The second approach places students as the creators of the educational content, and is far more revolutionary in what it implies for education in general, moving further away from object oriented education strategies. Podcasts are the most prominent example for this second approach.

The key aspect of e-Learning 2.0 is interactivity. With 1.0 standards and techniques, interactivity was limited. E-mails, forums and chatrooms existed, but mainly for students to be in touch with their teachers, as there was no implicit encouragement for them to contribute with their own content or views. Researchers have observed that collaborative learning is the adequate means to generate more implicit knowledge, that is more easily retained and absorbed by the students, and e-Learning 2.0 was the first generation of e-Learning that had the tools to achieve this. New educational systems built this way provide students with the means for them to share information, collaborate with each other and obtain feedback [30].

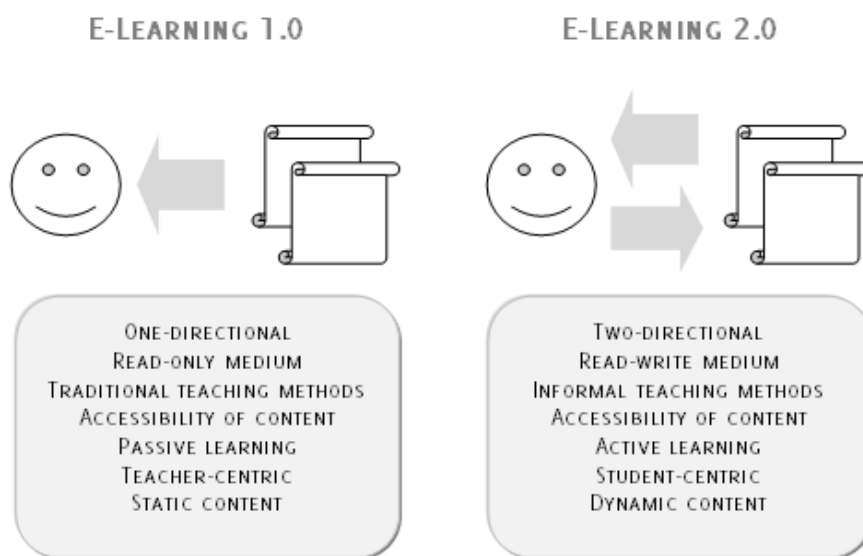


Fig. 2: E-Learning 1.0 vs. 2.0

### 3.3. E-Learning 3.0

Web 3.0 will entail the transformation of the internet from a platform of global interactivity and information sharing, to an intelligent and efficient tool for information management in general. As Web 2.0 tools and principles have reshaped e-Learning systems, so will happen with Web 3.0 tools. Therefore, researchers have already been exploring the possibilities that this reality can bring about, particularly under the influence of powerful Web 3.0 concepts such as distributed computing, extended smart mobile technology, collaborative intelligent filtering and 3D Visualization/Interaction. It has been argued that e-Learning 3.0 will transpose the borders and limitations of traditional, institutional educational systems in a much more complete and revolutionary way, fundamentally because learning will become a personalized activity that individuals can manage by themselves. The key tool in achieving this will be collaborative

filtering, because it will facilitate not only reaching the required information, but also the development of massive multi-user platforms and features, leading to an explosion in collaborative learning. [31].

[21] point out the key advantages of the Semantic Web in e-Learning contexts:

- Delivery – through the established ontologies, learning materials throughout the Web are easily linked and reached through semantic queries
- Responsiveness – the use of intelligent agents to organize and filter information leads to faster and more accurate results for user's requests
- Accessibility – semantic queries lead to easier access to the needed content
- Personalization – ontologies will allow for users to customize their searches and queries for material specifically suited for their needs
- Adaptivity – semantic annotation of content means that it can be easily adjusted
- Symmetry – the possibility of creating an integrated platform for all different learning activities
- Modality – active and quick delivery of content generates a more dynamic learning environment
- Authority – content management becomes cooperative as the Web becomes more decentralized

It has also been suggested that artificial intelligence and data mining will become powerful tools for e-Learning systems, who should develop the ability to filter and classify large amounts of data, providing students with a much more intuitive and easily accessible learning process [6]. Mobility and interactivity in e-Learning 3.0 will also be supported by the use of 3D Environments, where users will be able to interact with virtual spaces and be immersed in a participative, stimulating and engaging educational space [32].

According to [33], the concepts and approaches underlined by Web 3.0 in educational contexts are defined by the tools that Web 3.0 provide. In that sense, the authors analyzed the impact that particular tools will have in the future of education: 3D Wikis/Virtual Encyclopedias, 3D Virtual Worlds/Avatars, Intelligent Search Engines and Online 3D Virtual Labs.

- Wikis already play a significant role in education, generating a free repository of collective knowledge. With the introduction of 3D technology, wikis could provide users with more immersive content descriptions and visualizations that offer greater interactivity, rather than displaying the information entirely in text form. A particular topic in the wiki could be accessed through audio/video and a 3D representation of the subject.
- The ability for students to interact in a virtual world, similar to Second Life, by means of avatars, would allow them to participate in new strategies, such as role-playing, simulations and educational games. On the other hand, teachers could place their classes in a virtual environment that would be relevant to the subject of each class, such as a simulation of a museum, geographical structure or historical setting, generating much more interest and curiosity in the students.
- While current search engines can't effectively determine if a search result is specifically relevant to the user's query, the creation of intelligent search systems could cause students to do research far more effectively and time-efficient. Through agents, semantic structures and ontologies, the Web would easily provide students with all the relevant material for their purposes, without tedious search processes.
- Much like virtual environments, virtual 3D labs would allow to students to perform simulations and experiments in a safe environment, while at the same time participating collectively in a project and sharing concepts, theories and activities.

[34] also observed the impact of cloud computing technologies in e-Learning, suggesting for instance that cloud computing will allow for better security options for teachers; less costs of damaged computers; easier monitoring of data access; and general lower costs and more efficient time spending.

Such tools are examples of the potentials of Web 3.0 when applied to e-Learning. However, this process is yet in its very early conceptual stages, and some researchers have observed that e-Learning systems are only just now adjusting to the new ideas and tools of Web 2.0, while still meeting some resistance [35]. Thus, it will possibly take some time for Web 3.0 standards to truly change the landscape of e-Learning.

#### **4. Relationship between Web and e-Learning Evolutions**



E-Learning is fundamentally a form of education that uses technology, and specifically digital technology, as its support. As such, it is permeated by new technologies and largely dependent on them. As we have seen, from very early on there was a vision for e-Learning systems that aimed at making virtual classrooms more interactive and dynamic, but these concepts were limited by the available Web tools and services. As such, e-Learning was the transposition of traditional teaching methods to digital and Web support, for more convenient access.

As e-Learning moved from offline, computer-based systems into the domains of the internet, it became susceptible to the influence of new Web technologies, and both teachers as well as e-Learning systems developers became more aware of which tools, concepts and methods could be borrowed from the Web as a whole to the specific realm of education. These new technologies enabled them to apply new learning and cognitive theories to e-Learning [6]. Therefore, the evolution of the Web progressed side-by-side with an evolution of the very concept of learning and teaching, reflecting in new forms of e-Learning.

Table 3. Relationship between Web and e-Learning versions (based on [6], [31], [32], [36]).

Version	Web		E-Learning	
	Concept	Tools	Concept	Tools
1.0	Read-Only Document-Based	HTML HTTP URL	Content Management Unilateral	CBT LMS eBooks VLEs
2.0	Read-Write Social Web	Dynamic Tools ASP AJAX Podcasts RSS Feeds Wikis Blogs	Content Sharing Multimedia Dynamic “Blind teaching”	LCMS Video Conferencing VLEs Mashups
3.0	Read-Write-Collaborate Semantic Web	RDF XML OWL 3D	Ubiquitous Collaborative Semantic	PLEs Social Semantic Web Virtual Worlds Avatars Intelligent Agents

As we have seen, Web 1.0 has been described as “read-only”, while Web 2.0 has been described as “read-write” and Web 3.0 “read-write-collaborate”. As a parallel, it can be asserted that e-Learning 1.0 is focused on making content available online; e-Learning 2.0 adds the ability for students to also create content and share it among themselves, and e-Learning 3.0 will introduce proper collaborative methods and spaces. Table 3 provides a panoramic outline of the different concepts and tools that shaped the evolution of both the Web and e-Learning systems.

By harnessing the potentialities of Web 3.0 tools, e-Learning will be centered on intelligent, collaborative environments and virtual learning spaces, where students can come together at any convenient time, in any place (through increased use of mobile devices) and within any learning context. Through ontologies and semantic abilities, the vast amounts of data and information that currently exist throughout the Web will no longer be merely displayed as per user’s request, but effectively organized and filtered so that what the user receives is exactly what he/she needs. For e-Learning, this means that learning processes will be increasingly personalized; both collaborative learning and semantic filtering will influence a reduction on the “white noise” of the information overload, allowing for a greater specificity in search queries and thus, access to content that specifically serves the intended purpose.

Nevertheless, some researchers suggest that the different generations of e-Learning will still coexist for some time, with each generation serving specific purposes [25]. E-Learning 1.0 solutions are ideal for content creation targeted at a uniform audience with easily identifiable needs, while e-Learning 2.0 solutions are appropriate for situations where diffuse needs and potentially large audiences call for a more dynamic process of content creation and management. On the other hand,

## 5. Conclusion

Since the internet became a staple of modern working and entertainment lifestyles, it has changed every so often to accommodate the cycle of changes that technology itself undergoes. From the early days of the Web, when websites consisted of text documents written in HTML, and search engines merely pointed the way to a certain topic, we have seen radical changes not only in how we use the internet, but how it can be used. In fact, the evolution of the Web has created new types of users, and their increasing concern with issues such as information quality or participation directly influences the on-going process of change in the World Wide Web.

E-Learning has accompanied these changes. From early on, the concept of e-Learning has always been to challenge traditional teaching methods by creating a more stimulating learning environment that students can actually feel motivated to join in. But resistance from traditional views and the available technologies at a given time condition this process. During the Web 1.0 stage, when the Web was “read-only” and document-based, e-Learning systems essentially made content available for students to consult it outside of the classroom as an additional tool, and were centered on the so-called Learning Management Systems (LMS) to administer that content. But as the Web became less about reading content and more about social interaction, a profusion of new tools came about, all sharing the same concept: allowing users to participate in the process of content creation. Blogs, wikis, podcasts, social networks and other media have been changing the way we experience e-Learning systems for the past decade, introducing not only interactivity and active participation, but essentially turning into student-centric systems, shifting the focus away from what is being taught and focusing instead on how this is being taught. This process became known as e-Learning 2.0.

If e-Learning has accompanied the evolution of the Web, it is logical to assume that it will continue to do so. The growing concept of Web 3.0 promises even more ambitious opportunities for the panorama of e-Learning. With its focus on intelligent agents, semantic organization of content, 3D visualization and a Web that’s supported by databases rather than documents, online education will have the tools to become a smart, immersive space, where students are able to closely interact with what they are learning, instead of passively receiving descriptions of explicit information to memorize. Although the use of these tools and principles has not yet become widespread, growing research in the field of e-Learning 3.0 shows that it might, eventually, become inevitable.

## 6. References

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