E-Learning 3.0 Framework Adoption: Experts' Views

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Abstract. The pervasiveness of the Semantic Web in educational contexts is acquiring a growing importance also at the level of e-Learning. The improvements it promises to introduce in online education are causing interest and curiosity in terms of its implementation and practical repercussions for learning. Since it is in its early stages it becomes important to explore the conditions that will favor its adoption. In order to delineate its prosperous deployment, this paper presents the outline of a Critical Success Factors framework. The purpose of this paper is to collect the point of view of e-Learning experts with regards to this framework. The experts were presented with the framework via semi-structured interviews and they were asked to review its core elements. The results of the data collection provide a substantial validation of the framework and reiterate its relevance in delimiting the proliferation of e-Learning 3.0.

Keywords: e-Learning 3.0 · Semantic web · Critical success factors · Educational technology

1 Introduction

Web 3.0 comes with a pledge for the revolution of e-Learning, namely via increased personalization and machine understandable content. The affordances of the Semantic Web to online learning are at the origin of a new stage for electronic learning, e-Learning 3.0 (EL 3.0).

EL 3.0 is at the centre of several research ventures and it is inspiring interest among researchers and practitioners. The proliferation of EL 3.0 is dependent on a multiplicity of facilitating conditions that will maximize the positive impact of the Semantic Web. Web 3.0 will represent an improvement of some of the technology that was made available by Web 2.0, but given that the learning process requires a multidisciplinary

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intervention, pedagogy and technology are expected to represent a united front [31]. The application of the Semantic Web to an online learning context has the potential to address some of e-Learning's limitations, specifically the lack of data accuracy, information overload and the fact that content is not prepared to be read by machines [46].

The outline of a framework of Critical Success Factors (CSFs) for EL 3.0 provides a substantial support for framing the evolution and prospective adoption of this third phase of online learning. The framework that this paper proposes derives from the initial work of Miranda et al. [30], who suggested a preliminary CSFs framework specifically for EL 3.0 systems. This framework was composed of five categories: technology, content, students, professors and educational institutions. This paper will provide a reorganisation of this framework that is divided into three domains: technology, content and stakeholders.

The first part of the paper provides a brief examination of what defines EL 3.0 and presents the suggested CSFs framework for EL 3.0. The next section addresses the methods that were used and prefaces the third part of the paper that presents and discusses the results of the semi-structured interviews with e-Learning experts.

2 The Successful Adoption of EL 3.0

Web 3.0 introduces a variety of benefits to e-Learning, more specifically the enhancement of personalised learning environments, a growing interoperability among applications, the employment of semantic annotation, the dissemination of domain ontologies [26], the growing application of 3D visualisation, distributed computing, interaction [43] and more self-organisation [18]. One of the precepts of EL 3.0 is the effective management of information to answer the users' questions. It is similar to a personal assistant who gathers data on the user and accesses and links resources on the internet to better meet their needs [54]. This is also what is at the foundation of customised searches for learning resources, which can through semantic annotation be constantly improved [48]. On the other hand, the main challenges of EL 3.0 include the fact that it requires a significant effort in terms of ontology development, the educational entities' lack of willingness to share data, the need to develop standards for data and content exchange, data privacy and security and trust [26].

2.1 EL 3.0 CSF Framework

The successful adoption of EL 3.0 is dependent on the reunion of a multiplicity of factors that are transversal to diverse domains of e-Learning [13]. The framework that is proposed in this paper intends to depict a fundamental structure of those factors. The general outline of its categories was inspired by the work of Selim [45] who advocated that e-Learning's critical success factors could be divided into four areas: the teacher, the learner, information technology and institutional support. Furthermore, it derives from a reorganisation of the CSFs framework that Miranda et al. [30] proposed for EL 3.0 systems, which was divided into technology, content, students, professors and educational institutions. Thus, in essence, the critical success factors' framework for EL

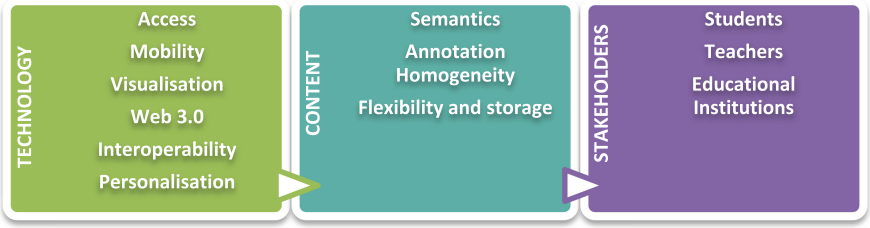

Fig. 1. Outline of EL 3.0 CSFs framework

3.0 encompasses three core categories portrayed in Fig. 1: technology, content and stakeholders.

The technology category includes a series of CSFs that will facilitate the more technical aspects of EL 3.0 and allow the transposition of learning to online scenarios: access, mobility, visualisation, Web 3.0, interoperability and personalization. Access is related to the fundamental premise that technology's unavailability has a negative effect on e-Learning's acceptance [3]. Its core requirements consist in hardware equipment both its availability [38] and its reliability [45], a fast internet connection [38], that can be effective [45] and the existence of user-friendly interfaces and applications [13, 22, 32, 56]. Mobility, in the form of mobile technology, will be essential for ubiquitousness [33] and it will demand mobile apps [5, 35], and smart mobile technology [7, 23, 42]. Visualisation accounts for the sensorial element of EL 3.0 and the variety of formats [7] and it needs visualisation tools [8, 40], 3D and immersive Web [33, 35] and 3D visualisation and interaction [12, 23]. As to Web 3.0 it is a valuable resource to EL 3.0 [56] and it demands semantic features [10, 53], ontology-based tools [19, 21], ontology creation [13] and maintenance [51] and intelligent search engines [47, 52]. Interoperability relates to the challenge of the integration of different applications [19] and to be promoted it requires semantic interoperability [17, 44] and interoperability of web-based educational systems [6, 18]. Finally, personalisation represents a solution for dealing with a vast amount of online materials [23] and it requests the use of user profiling techniques [26, 54], Artificial Intelligence [34, 43, 47] and intelligent e-Learning systems [9, 41].

Content is an essential aspect of EL 3.0 and it subsumes three CSFs, semantics, annotation homogeneity and flexibility and storage. Semantics account for a greater access to significant content [17], requiring big data management [15, 23], machine-understandable learning material [9, 44], semantic web ready content [11, 12], metadata [19, 47] and semantic markup [16, 24]. With respect to annotation homogeneity its value lies in its capacity to enable different computers to understand and exchange data with each other [53] and it demands semantic homogeneity [25, 50] and a widely spread ontology structure [19, 26]. Finally, flexibility and storage relates to the need for content to be dynamic [46] and the need for effective storage capacity. In order to be accomplished, this CSF demands cloud computing [4, 18], open data [39, 54], personalised content [27, 57] and learning objects [29, 57].

The final category, stakeholders, accounts for the human and institutional aspect of EL 3.0 and it comprises three CSFs: the students, the teachers and the educational

institutions. The students' contribution to the success of EL 3.0 relates to their engagement in collaboration [1, 7], active participation [3, 20] and their personal and technical skills [18, 28]. The teachers, on the other hand are required to have ICT training [34, 49] and to be creators of meaning [24, 48]. The educational institutions have a fundamental part in the availability of infrastructures [55] and institutional assistance [45]. Hence, their capacity of being a CSF for EL 3.0 is intrinsically connected with infrastructural development [1, 50], providing training for e-learning [33, 37], the inter-connectedness among institutions [26, 36], the development of learning methods based on real [2, 33] and the provision of large repositories of linked data [7, 54].

3 Methodology

The validation of the proposed framework was done via the use of semi-structured interviews with experts in the field of e-Learning. The interviews were designed to last around 40 min and they were divided into four sections. The first section was comprised of general questions on the definition and reach of EL 3.0, while the remaining parts focused on each of the categories of CSFs, technology, content and stakeholders, respectively. Two pilot interviews were conducted to test and perfect the initial script.

In total 10 experts were interviewed, 3 female and 7 male. The experts were from the USA, Brazil, Australia, Germany, Dubai, Greece and the UK and they were either involved in research, teaching or both. They were invited to participate in the interviews due to their experience with education technology. From the total of 10 interviews, 2 were conducted in person, 2 were done via Skype and 6 were delivered through email.

The main purpose of the interviews was the assessment of the EL 3.0 CSFs framework. The use of semi-structured interviews facilitates the fluidity of a conversation that is framed by an initial alignment of questions. They allow the use of a script to lead the interview, but at the same time they provide the opportunity to more liberally insert different topics or explore subjects that may surface during the interviews [14].

4 Results and Discussion

In general, all the interviewees agreed with the framework and recognized the importance of the CSFs for the proficient development and adoption of EL 3.0 at a wider scale.

4.1 EL 3.0 and Its Reach

The objective of the first part of the interviews was to examine the experts' opinions about the definition of EL 3.0, its reach and the opportunities and challenges that Web 3.0 would introduce in e-Learning. In terms of defining EL 3.0, since it is a recent concept, some of the respondents were hesitant in providing a specific description of

the term. Nonetheless, the majority was able to associate it with learning analytics, extraction of knowledge, seamless learning, the integration of big data, artificial intelligence, Web 3.0 and semantic tools, interactive learning, machine associated meaning, personalization and anytime/anywhere learning. Despite this knowledge of what EL 3.0 stands for, when asked about its current reach, all the respondents stated that it is still at an early age and that it has an experimental and speculative nature, which is in line with other studies [36].

Concerning the benefits that Web 3.0 will represent for e-Learning, the participants mentioned the increase of social interaction, communication and the personalization of learning, namely through artificial intelligence. Also, they reported changes at the level of the relationship between the students and the teachers and the recommendation of more pertinent learning material, brought by the assistance of machines and semantics. Finally, they associated Web 3.0 with data merging and processing, intelligent machines, the acceleration of learning and the mitigation of the workload of the teacher. The fundamental precepts that the experts mentioned were coherent with previous research [26, 43]. While they were quick to see the advantages that Web 3.0 introduces, they were equally able to point out the challenges of the implementation of EL 3.0, namely privacy and security concerns with regards to the access to data sources, just as it's been previously reported [26]; the restrictions of learning analytics and big data; issues of a technological and infrastructural nature; and the adaptation of teachers to this new stage of e-Learning. Other challenges included the extensive creation and development of semantic tools, the lack of close partnerships, the existence of ontologies that cannot be reused, the insufficient training of professionals and good pedagogical proposals.

4.2 Technology

In relation to access, as much as hardware and internet connectivity have become widespread, the respondents still highlighted some problems with the access to sustainable internet connections, mainly in rural areas and also issues with the availability of hardware equipment in schools. Some of the solutions that the participants presented for improving access consist in shared access to technology among students that don't have their own devices, enhance access to mobile technology to simplify internet connection, the integration of tools in the every-day life, top-down promotion and use, inclusion of technology training in the curriculum and making application as intuitive as possible, as advocated also by Ahmud-Boodoo [1].

With respect to mobile technology itself and reiterating the literature [23], all the participants agreed that it is important for EL, with one of the interviewees stating that "It's almost inevitable to think of education of the future without thinking about mobility" (R9). According to the participants mobile technology is important in the sense that it collects more data from more sources for learning analytics and the offering of more personalized solutions, mobile learning is more integrated in the real world, it allows students to have continuous access to the world around them, it enables the students to import what they learn to their everyday life, it broadens the scope of the technology that teachers can use. Furthermore a 24/7 access has become a regular

expectation. One of the aspects that was also mentioned was the necessity of creating learning scenarios that are attuned with mobile learning.

Visualisation was one of the elements that was assessed in the technology category and it was overall validated by the participants. One of the interviewees said that visualization "is the crux of web 3.0 and will to a greater extent differentiate it from its earlier generations of web and or EL" (R6). Some of the tools that the participants underline subsume virtual reality and augmented reality interfaces to assist learning in real-life scenarios, and graphical renderings to provide innovative insight into data. Visualisation offers a stimulus for different parts of the user's cognition. Also, as Banciu and Florea [7] argued it promotes the use of the visual as teaching and learning material which enhances the acquisition of skills, competences and knowledge.

Similarly to what was defended in previous studies [42, 56], the respondents believe that Web 3.0 is an integral part of EL 3.0, but given the more technical requirements of this question, some respondents found it difficult to state which of its main features should be used in e-Learning. The remaining interviewees highlighted the characteristics that they deemed as being important, namely semantics for data merging and processing and for the intelligent processing of data by machines, customized and context-specific help to students in real-life environments, mobile web, data analytics, semantic meaning, knowledge extraction, information visualisation based on annotation, personalisation tools or algorithms and intelligent tutoring systems and intelligence.

The promotion of interoperability for the advancement of EL 3.0, that was argued in previous research [19, 26], was reiterated by the answers of the interviewees. In conformity with the participants, this support of interoperability can be done through common data formats between authoring tools; information repositories and learning management tools; the development of APIs (application programming interfaces); standardization; pertinent organizations to work with tech enterprises; creation of tools that education stakeholders can integrate in their educational practice routines; EU standardization to enable platforms and frameworks for shared practice; good vocabularies and reusable ontologies that can be used across different environments.

Personalisation was the final CSF in the technology category to be reviewed by the participants, who agreed with the literature [23] in term of its importance for EL 3.0. As reported by one of the respondents, some platforms are already offering several personalisation solutions, for example Carnegie Learning, MeuTutor, Grockit and Aleks, but Moodle which is the most widely used system is not able to integrate them. Also, another respondent argued that EL 3.0 will introduce personalization to scale. In accordance to the interviewees, there are several aspects that will contribute to personalization: the monitoring of the progress of learners to tailor content based on their peculiarities, the use of Latent Semantic Analysis, AI, namely algorithm called BKT - Bayesian Knowledge Tracing (Tree); Educational Data Mining; Knowledge Representation; machine learning; and a greater alignment among critical learning design factors such as learning objectives, learning content, pedagogical dimensions and learning assessment.

4.3 Content

In line with previous studies [17], semantically annotated content was deemed as essential to the progress of EL 3.0. Nonetheless not all the respondents were able to identify ways of increasing it. The respondents cited the significance of the interoperability and interconnectedness of tools and the need for an agreement on interoperability and common standards. Also, one of the respondents highlighted the fact that people can learn by themselves by reorganizing material or indexing it on different ways. Semantic annotation of conversations, learning paths, content reviewed, EL systems will be able to identify what information is relevant to be displayed. In that sense it is necessary to develop frameworks to provide this annotation. Another participant, named a few challenges related to semantic annotation: the need for good repositories that allow communication between languages and vocabularies; the lack of good, reusable annotations; the issue of the training of the people who are producing the annotation; and the technology in itself, the need for good authoring tools to assist annotation. Further to this CSF, the participants were asked to provide their viewpoint on the importance of big data management techniques and to suggest the most appropriate ones for educational settings. This was again a question where some of the participants (4) were not comfortable answering. While most agreed with research that argues that big data management techniques are important for EL 3.0 [15, 23], the majority was not able to suggest specific techniques. The few participants that did recommend some techniques, mentioned the management of links, cloud storage, Sequential Data Analysis, Natural Language Processing and Latent Semantic Analysis. Some interviewees recognized that in the future these techniques will be important in managing the information that results from millions of students using LMS, such as Moodle and in sorting all of the information that is available on the Web for learning. Moreover, the data that was previously regarded as being trivial or too extensive to be used, pertaining to user activity on the web is now seen as valuable.

With respect to annotation homogeneity, three of the interviewees did not answer this question. Overall the respondents conveyed its importance for creating common ground, enabling exchange, interoperability, the reusability of data and e-Learning systems' analysis and process, which corroborated the work of Vera et al. [53]. Furthermore, standardization was deemed an important condition to promote the widespread use. One of the experts stated that the issue with annotation is the definition of context. In situations where there is knowledge about the context under which an annotation was made, then the semantics will not be lost. Hence, it is not about homogeneity, but knowing the foundational ontology and describing the context. Another participant believed that annotation homogeneity was only important for subjects which are very specific and have enormous amounts of data.

The flexibility of content and the importance of having suitable storage capacity were the two last aspects to be reviewed in the content category. The respondents focused more on the storage perspective and with relation to flexibility they only mentioned open data, the fact that content should be readily available, compact and affordable and that indexing strategies are necessary to ensure the flexibility of content across different systems and platforms. Generally speaking they all agreed that the existence of good storage solutions is crucial and provided some suggestions:

combining hard drive storage with cloud computing, increasing bandwidth on both wired and wireless networks, real-time streaming media, cloud computing and triple stores tools. In the context of this CSF, the experts were also questioned as to the importance of cloud computing and if they (or their students) used it. The majority stated that they did use cloud computing, namely Google Drive and Dropbox and that it is important, which is also supported by the literature [4, 18]. A fundamental aspect of using cloud computing seemed to be security, thus backups should be ensured. Also, one of the participants said that contrary to what is advertised, cloud computing is not unlimited. Some of the advantages of cloud computing that participants highlighted have to do with the possibility of having a few storage locations that can be access from anywhere and the fact that it enables interoperability, reusability and scalability.

4.4 Stakeholders

The stakeholders' category was comprised of students, teachers and educational institutions.

With respect to the students, it was important to assess the viewpoints of the experts in terms of their role in this new stage of e-Learning. An essential perspective for the part that students are expected to play has to do with participation: "So actually I think that the only thing that should be expected of the student is interacting. Their interaction, nothing more than that, this is my view. So basically you must have those interactions so that EL3.0 can indeed happen." (R9). According to the interviewees, besides their participation, in order to thrive in EL 3.0, students need to have more interaction; to innovate, engage in problem solving and to collaborate; to connect with anywhere/anytime learning; to be interested in using technology for the purpose of learning; to be creative and willing to generate content; and to be digitally literate as defended by some researchers [18, 28].

The participants' views on the expectations for the teachers portray a multifaceted and polyvalent position. Overall, the interviewees stated that the teachers should act as knowledge facilitators, as co-learners and as collaborators. They should be open to using digital tools and to present them to the students, to engage in the creation of different learning materials, as was argued by [24, 48], to use flipped, blended and constructivist teaching methodologies and to be ready to embrace, learn and integrate new technologies. Moreover, it is crucial that they are capable of being both pedagogical and technical experts. One of the respondents also underlined the fact that some teachers do not have the necessary ICT skills to engage with technology and while there are some teacher that are very enthusiastic about technology in learning, there are others that create difficulties. This need for ICT training had already been mentioned by previous studies [34, 49].

Finally, when looking at stakeholders it is crucial to examine the role of the educational institutions. Some of the respondents mentioned the insufficient support that the institutions provide, namely in terms of offering appropriate technological conditions and ensuring their quality and adequacy, which is one the main responsibilities that researchers [1, 50, 55] attribute to them. According to the interviewees, educational entities need to embrace the era of digitalization, to guarantee students access to

hardware, software and connectivity, to provide both technical and administrative infrastructures, to assist the teachers in the development of their competences and methodologies and practice openness and collaboration rather than competitiveness.

5 Conclusion

With EL 3.0 still in its early stages it becomes imperative to examine how its adoption should be guided and by which means it should be accomplished. The delimitation of a framework to define its CSFs will assist the contextualization of this phenomenon and it will provide a framing structure to encourage its development.

The results of the semi-structured interviews with e-Learning experts demonstrated that while there is a general notion of the importance of Web 3.0 for e-Learning, the specific contours of EL 3.0 are still unknown for some researchers and practitioners. There was a higher difficulty for the respondents to answers technology related questions or to offer very detailed information about certain CSFs, especially if they were mainly technical. Generally speaking all the CSFs were validated by the experts in their interviews, which reiterates the significance of the CSF framework.

Prospective research ventures are to focus on a further validation of these CSFs and to concentrate on using this validation to explore interdependence relations between the CSFs. Also, future studies would be required to extend this validation to other stakeholders namely the students and the educational institutions.

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