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# VALIDATION OF AN E-LEARNING 3.0 CRITICAL SUCCESS FACTORS FRAMEWORK: A QUALITATIVE RESEARCH

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## ABSTRACT

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| Aim/Purpose | As e-Learning 3.0 evolves from a theoretical construct into an actual solution for online learning, it becomes crucial to accompany this progress by scrutinising the elements that are at the origin of its success. |
| Background | This paper outlines a framework of e-Learning 3.0's critical success factors and its empirical validation. |
| Methodology | The framework is the result of an extensive literature review and its empirical substantiation derives from semi-structured interviews with e-Learning experts. |
| Contribution | The viewpoints of the experts enable the confirmation and the refinement of the original framework and serve as a foundation for the prospective implementation of e-Learning 3.0. |
| Findings | The analysis of the interviews demonstrates that e-Learning 3.0 remains in its early stages with a reticent dissemination. Nonetheless, the interviewees invoked factors related to technology, content and stakeholders as being critical for the success of this new phase of e-Learning. |
| Recommendations for Practitioners | Practitioners can use the framework as a guide for promoting and implementing effective e-Learning 3.0 initiatives. |

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| Recommendation for Researchers | As a new phenomenon with uncharted potential, e-Learning 3.0 should be placed at the centre of educational research. |
| Impact on Society | The understanding of what drives the success of e-Learning 3.0 is fundamental for its implementation and for the progress of online education in this new stage of its evolution. |
| Future Research | Future research ventures can include the design of quantitative and self-administered data collection instruments that can provide further insight into the elements of the framework. |
| Keywords | e-Learning 3.0, critical success factors, semantic web |

## INTRODUCTION

As the Web evolves into different versions (Web 1.0, Web 2.0, Web 3.0), e-Learning accompanies these changes and tries to incorporate the technological innovations they promise. While under the era of Web 1.0, e-Learning adopted its "read-only" nature that focused mainly on a one-directional delivery of information. E-Learning 1.0 offered educational content in a more convenient manner, but it was a teacher-centred approach in which content was static and the students were passive learners. With the emergence of Web 2.0, also designated the "read-write" Web, and its support of user collaboration, social interactivity, and content creation and exchange, e-Learning harnessed the possibilities that it introduced. Hence, in a transformed student-centred version, e-Learning 2.0 becomes a two-directional approach, in which content is dynamic and the students can be active learners (Miranda, Isaias, & Costa, 2014a). Web 3.0 (also known as Semantic Web), similarly to its predecessors, has precipitated a new form of e-Learning, e-Learning 3.0 (EL 3.0).

According to Berners-Lee, Hendler, and Lassila (2001), Web 3.0's main components are meaning expression, knowledge representation, ontologies, software agents, and evolution of knowledge. Web 3.0 attributes meaning to data, by converting it into machine understandable formats (Ohler, 2008). This enables people and machines to communicate in an unprecedented manner (Dwivedi & Bawankan, 2013) and improves the creation and reusability of content (Ahmud-Boodoo, 2015). Virtič (2012) compares Web 3.0 "to a giant database. While Web 2.0 uses the Internet to make connections between people, Web 3.0 will use the Internet to make connections with information. Linking databases of resources will allow the user to use the information, adapted to his previous knowledge" (p.246).

Despite the fact that EL 3.0 is a relatively new concept it is important to factor in the reasons that will allow its successful adoption and proliferation (Miranda, Isaias, Costa, & Pifano, 2016). The proficiency of EL 3.0 is intrinsically connected with Web 3.0's capacity of matching Web 1.0's ubiquitousness (Devedžić, 2006). Web 3.0 is expected to address some of e-Learning emerging predicaments such as the absence of machine-understandable content, the scarcity of data accuracy, and data overload (Shah, 2012). The Semantic Web has the potential to contribute to e-Learning's independence, institutional decentralisation, self-organisation (Goroshko & Samoilenko, 2011), and growing interaction (Simon, 2016). Also, it is due to be responsible for personalised learning (Rubens, Kaplan, & Okamoto, 2011), information management (Miranda et al., 2014a), heightened communication between humans and machines (Stanescu, 2016), and more interoperability (Kaur & Chaudhary, 2015). At the same time, the inclusion of Web 3.0 in the online learning milieu is not exempt from challenges. More specifically, the achievement of EL 3.0 must account for issues deriving from data security, interoperability concerns (Rego, Moreira, Morales, & Garcia, 2010), privacy (Alkhateeb, AlMaghayreh, Aljawarneh, Muhsin, & Nsour, 2010) and the experimental nature of Web 3.0 (Ohler, 2008). Furthermore it is vital to assess the quality of information (Banciu & Florea, 2011), to be aware of institutional reluctance with data sharing (Kaur & Chaudhary, 2015), and to consider the complexity of ontology creation and maintenance (Gladun, Rogushina, García-Sanchez, Martínez-Béjar, & Fernández-Breis, 2009; Karadimce, 2013).

EL 3.0's success is the result of the impact of a variety of factors that combine elements of traditional e-Learning with Web 3.0. The framework that is proposed in this paper uses previous research (Miranda, Isaias, & Costa, 2014b; Selim, 2007) to provide a threefold structure of EL 3.0's Critical Success Factors (CSF) encompassing technology, content, and stakeholders. In order to assess the validity of the CSFs, e-Learning experts were consulted via semi-structured interviews and the analysis of their responses enabled the refinement of the initial CSFs.

This paper begins by providing a theoretical foundation for the EL 3.0's CSFs framework it proposes. It then presents the methodology, which maps the design of the empirical research. The last sections explore and discuss the results of the data collection and their repercussions in the framework.

## EL 3.0 CSFs: The Theoretical Framework

Probing the success of EL 3.0 might seem premature, given that educational institutions remain far from the full adoption of Web 2.0 tools (Oakes, 2011) and Web 3.0 is still on the rise (Ohler, 2008). Nevertheless, the use of Web 3.0 for educational purposes has already been documented by some authors. Cabada, Estrada, Hernández, Bustillos, and Reyes-García (2017) described their work on the design and implementation of a recommender system that is an e-Learning 3.0 software component to assist students to learn Java programming by delivering customised instruction. They concluded that the students who used their system had higher learning benefits that those who used the conventional learning method. Yi (2017) examined a method for employing an Augmented Reality system that is based on Web 3.0 in the context of language learning. The author argues that this user-friendly system has the capacity to address information overload issues and to provide a personalised delivery of learning content that is adjusted to the individual needs of the learners.

When examining the aspects that constitute the successful deployment of Web 3.0 in the context of e-Learning, there is a plethora of domains that needs to be considered. There are CSFs in EL 3.0 that are common to all forms of e-Learning. When discussing the elements for the success of e-Learning within a higher education context, Selim (2007) concluded that they could be allocated into eight distinct categories: "(1) instructor's attitude towards and control of the technology, (2) instructor's teaching style, (3) student motivation and technical competency, (4) student interactive collaboration, (5) e-learning course content and structure, (6) ease of on-campus internet access, (7) effectiveness of information technology infrastructure, and (8) university support of e-learning activities" (Selim, 2007, pp. 408,409).

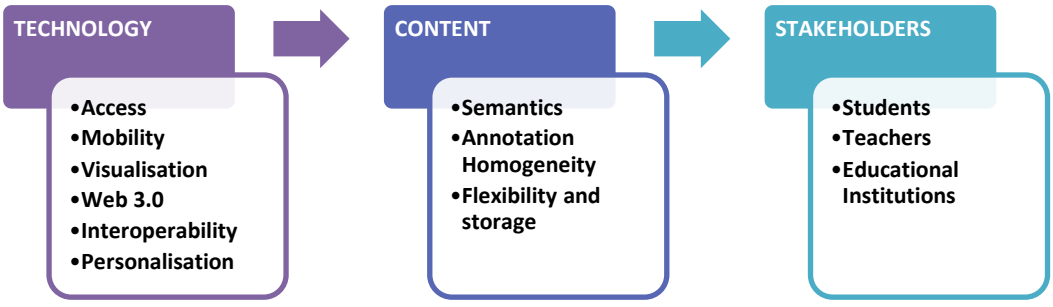


**Figure 1. EL 3.0 CSFs Framework**

On the other hand, some elements of EL 3.0 success need to account for the specificities of this version of e-Learning. Miranda et al. (2014b) have proposed a CSF framework for EL 3.0 systems that encompasses technology, content, students, professors, and educational institutions. This paper reduces the categories that have been outlined by Selim (2007) and reorganises the categories that have been presented by Miranda et al. (2014b) into a threefold framework: technology, content, and stakeholders (Figure 1). Since the categories concerning the students, the professors, and the educational institutions basically represent EL 3.0's stakeholders, they were merged into a single group. While the framework that is proposed in this paper intends to mirror the diversity of factors that is

involved in the success of EL 3.0, it also has the goal of simplifying its core structure into easily identifiable units.

The group pertaining to technology consists of access, mobility, visualisation, Web 3.0, interoperability, and personalisation. Content concerns semantics, annotation homogeneity, flexibility, and storage. The stakeholders group refers to students, teachers, and educational institutions.

## *Technology*

Access is included as a CSF due to its key importance in the acceptance of online learning (Amit, 2015). In order to maximise access to technology to promote EL 3.0 it is important to guarantee the existence of hardware equipment, such as computers (Pocatilu, Alecu, & Vetrici, 2009); to ensure it is trustworthy (Selim, 2007), to facilitate a fast internet connection (Pocatilu et al., 2009; Selim, 2007), and to have interfaces and applications that are user-friendly (Ahmud-Boodoo, 2015; Devedžić, 2006; Hsu, 2012; Naeve, Lytras, Nejdl, Balacheff, & Hardin, 2006).

Also, EL 3.0 is expected to be ubiquitous, hence mobility is an essential aspect. The ubiquitous access that Web 3.0 grants to learning resources is one of its most important benefits for education (García-Pérez, Santos-Delgado, & Buzón-García, 2016). Mobile technology will promote collaboration (Norman, Din, & Nordin, 2011) and it will make learning constantly available (Garavaglia & Gaiotto, 2012). Smart mobile technology allows a widespread access to materials, it facilitates EL 3.0's omnipresence (Hussain, 2012), and it is one of its main drivers (Rego et al., 2010). Mobile intelligent technologies improve access to content anywhere and anytime (Banciu & Florea, 2011).

The inclusion of visualisation as a CSF has to do with the sensorial experience that Web 3.0 adds to e-Learning through a variety of formats, namely graphics, animation, and video (Banciu & Florea, 2011). Visualisation tools include video games (Bidarra & Cardoso, 2007), high power graphics (Rajiv, 2011), virtual reality, immersive Web for authenticity (Amit, 2015; Norman et al., 2011; Oakes, 2011), augmented reality and 3D (Riera, Redondo, & Fonseca, 2015), and virtual 3D worlds (Hussain, 2012).

The transposition of Web 3.0 to the education sphere demands a profound knowledge of both its benefits and its weaknesses (Miranda, Isaias, & Costa, 2014c). Web 3.0 originated the concept of EL 3.0 and as such this new version of e-Learning has the goal of using the fullest potential of its resources (Rego et al., 2010). Web 3.0 offers machine understandable content (David, Ginev, Kohlhase, & Corneli, 2010; Ohler, 2008), which enables people and machines to communicate in an unprecedented manner (Dwivedi & Bawankan, 2013), student empowerment (Giannakos & Lapatas, 2010), enriched social interaction (Halimi, Seridi-Bouchelaghem, & Faron-Zucker, 2014), personalisation, and intelligent agents (Kurilovas, Kubilinskiene, & Dagiene, 2014). Additionally, ontologies are the core of Web 3.0 (Holohan, Melia, McMullen, & Pahl, 2005; Kaur & Chaudhary, 2015) as they are at the origin of the intelligent processing of data that minimises information overload and directs the right information to the right user (Ahmud-Boodoo, 2015). They are reusable and can be shared (Castellanos-Nieves, Fernández-Breis, Valencia-García, Martínez-Béjar, & Iniesta-Moreno, 2011; Holohan et al., 2005) and they are essential for content annotation (Devedžić, 2006; Torniai, Jovanovic, Gasevic, Bateman, & Hatala, 2008).

Interoperability is one of the technological challenges for the personalisation of e-Learning (O'Donnell, Lawless, Sharp, & Wade, 2015). The semantic coding of knowledge enables its accessibility and its permeability (Ivanova & Ivanova, 2009). Semantically annotated content can be reused (Gladun et al., 2009), shared (Rajiv, 2011) and it can be interoperable (Dzbor, Stutt, Motta, & Collins, 2007). Also, the interoperability of Web-based educational systems potentiates reusability and cooperation (Aroyo & Dicheva, 2004) and it provides independence and decentralisation (Goroshko & Samoilenko, 2011).

Personalisation addresses the overload of online resources (Hussain, 2012), and it is an obligatory feature of the design and the creation of advanced learning systems (Kaur & Chaudhary, 2015). Also,

for today's learners the provision of personalised learning plans is fundamental (Watson, Watson, & Reigeluth, 2015). Personalisation is dependent of three core aspects: user profiling (Kaur & Chaudhary, 2015; Virtič, 2012), artificial intelligence (AI) (Noskova, Pavlova, & Iakovleva, 2015; Pattnayak & Pattnaik, 2016; Shaltout & Salamah, 2013), and intelligent e-Learning systems (Bucos, Dragulescu, & Veltan, 2010).

## *Content*

In the context of this category, semantics is included because content that is semantically annotated represents more access to pertinent content (Gladun et al., 2009). Since Web 3.0 involves dealing with an abundant volume of datasets, big data management is crucial (Hussain, 2012). Also big data techniques can be helpful to retrieve course material (Pattnayak & Pattnaik, 2016). Without a structure, the task of finding the relevant material becomes much more complex (Bucos et al., 2010). Machine-understandable learning material is a more efficient form of content; not only it can be easily used with software (Bucos et al., 2010), it can also be adaptable and responsive to the peculiar needs of learners (Rubens et al., 2011) and assist more advanced search and recommend learning resources (Poore, 2014).

Annotation homogeneity relates to the importance of using a homogenous language when semantically annotating content. The lack of homogeneity causes different computer agents to be unable to understand and communicate data (Vera, Breis, Serrano, Sánchez, & Espinosa, 2013). Semantic homogeneity prevents the scarcity of consensual ontologies, which hinders the evolution of EL 3.0 and prevents the interoperability of semantic metadata (Tiropanis, Davis, Millard, & Weal, 2009).

Flexibility and storage concern the demands for the dynamic nature of content, which allows users to edit it (Shah, 2012), and the existence of robust storage solutions. Using cloud computing as a storage solution not only facilitates the deposit and recovery of great volumes of data (Banciu & Florea, 2011), but it also assists EL 3.0 in its quest for decentralisation from institutional websites (Goroshko & Samoilenko, 2011). Also, because cloud computing is web based, it is always reachable (Amit, 2015), it facilitates system integration (Garavaglia & Gaiotto, 2012), and it supports learning systems (Pocatilu et al., 2009). With relation to content, it is equally important to mention learning objects. Their reusability and scalability endow teachers with the capacity of adapting them to their specific purposes (Watson et al., 2015). To maximise their value and to make them easily findable it is crucial that learning objects possess a description to facilitate their search. To that purpose, some learning objects repositories already have metadata associated to them (Memeti, Imeri, & Xhaferi, 2014).

## *Stakeholders*

Where students are concerned, it is relevant to examine collaboration, active participation, and personal and technical skills. Group work and collaborative activities are an integral part of EL 3.0 (Ahmud-Boodoo, 2015; Banciu & Florea, 2011). The active participation of the student regards the need for their input (Ciravegna, Chapman, Dingli, & Wilks, 2004), namely in the enrichment of learning materials (Shah, 2012). Additionally, the information that the students provide will be the basis for the personalisation of the system and the material (Noskova et al., 2015). Personal and technical skills are central for students to take full advantage of EL 3.0. The learners' lack of digital literacy compromises their capacity of participating in e-Learning settings (Loureiro, Messias, & Barbas, 2012).

The mounting importance of technology in education can overwhelm the teachers (Oakes, 2011). As educators, they are obliged to have a deep knowledge of technology in order to potentiate its advantages (Sue, 2015). When teachers are more comfortable with the use of technology they are more motivated to engage with Web 3.0 (Hussain, 2012). Their digital skills are central to their commitment to online learning scenarios (Loureiro et al., 2012). Within a Web 3.0 scenario, the role that the teachers will assume should be one of meaning creation (Poore, 2014) as they work along with com-

puters to generate knowledge (Ivanova & Ivanova, 2009). Teachers are strengthening their relationships with their peers (Sue, 2015) and by participating in online communities they have the opportunity to advance the material they produce (Noskova et al., 2015).

Finally, the last CSF of this framework accounts for the role that educational institutions have in EL 3.0. Ohler (2008) stated that EL 3.0's nature is contrary to the seclusion of the institutions, nonetheless, they must assume the responsibility of investing in technology that is accessible to students and of guaranteeing that technical support is available (Ahmud-Boodoo, 2015). The provision of training for e-learning is also an institutional responsibility (Paechter, Maier, & Macher, 2010) that is valid both for teachers (Hussain, 2012) and students (Ahmud-Boodoo, 2015; Norman et al., 2011). Moreover, universities and other educational entities should embrace the possibility afforded by Web 3.0 of multiple application integration across institutions (Kaur & Chaudhary, 2015).

## METHODOLOGY

In order to empirically authenticate the EL 3.0 CSF framework, this study designed semi-structured interviews to collect the viewpoints of EL experts. The interviews were structured into four parts and they were expected to last about 40 minutes. The first part was introductory and it referred to the general concept of EL 3.0 and its reach. The other three sections were specific to the CSFs' categories: technology, content, and stakeholders. The interviews were semi-structured, because this type of interviews enables the use of a foundation script to guide the interview, while simultaneously offering the opportunity to introduce some fluidity in the base topics and in the themes that arise from the conversation with the respondents (Dicicco-Bloom & Crabtree, 2006). In the case of this research it was essential to have a script with the CSFs' structure in order to validate the framework, but it was equally relevant to leave room for the participants' spontaneous contribution.

The respondents were selected via a sample of convenience. During the review of the relevant literature the most significant studies were selected and the authors were included in a shortlist as potential participants. From this shortlist of authors, those who had a teaching or research background in e-Learning related fields were invited to participate in the interviews. The invitation included information about the subject of the interviews and the purpose of the study, in order to clarify in advance what was expected of their participation. The final sample was composed of the authors who accepted the invitation to participate in the study. The same script was used in all interviews, which were conducted in person and mainly via Skype. The interviews' transcriptions were used *ipsis verbis* in the analysis. In order to perform the transcriptions of the interviews, in person, an audio recorder was used and, for Skype, the Amolto Call Recorder for Skype software was used.

A qualitative content analysis based on a descriptive approach was performed. Since, qualitative analysis can be significantly facilitated by the use of Computer-Assisted Qualitative Data Analysis Software (CAQDAS), in this research Nvivo was selected to perform the analysis and coding of the interviews. Nvivo is one of the most popular CAQDAS (Hoover & Koerber, 2011; Ozkan, 2004). One of the advantages of using Nvivo is that it allows the coding scheme to be viewed hierarchically. Additionally, codes and subcodes can be connected by using relationship nodes, which facilitates the organisation of data into groups of codes (Franzosi, Doyle, McClelland, Rankin, & Vicari, 2013). Nvivo is particularly advantageous in studies that use small samples and semi-structured interviews (Sotiriadou, Brouwers, & Le, 2014), which is the case of this research. Moreover, Nvivo was a valuable resource for this research because it can be used to validate and refine a priori models (Bandara, 2006).

The interviews were transcribed and imported into Nvivo, where they were coded and analysed. This research's coding plan or framework has an explanatory nature, as it is guided by the initial research and the framework it proposes. The coding process had two distinct phases. The first phase consisted in formatting the responses to allow Nvivo's auto coding. Auto coding was possible also because the questions were the same in each of the interviews. This feature allowed each question to be created as a node. All the interviews were aggregated and then organised by question. The second phase

involved the thematic coding of the responses to identify potential patterns and themes. The thematic coding was composed of top level nodes and subnodes that were obtained from the CSF framework. The coding was concluded only when all the possibilities for new codes were exhausted.

Since the coding process was guided by the CSF framework, tree nodes were used. Tree nodes can be derived from the research´s theoretical models and they are more concrete nodes (Ishak & Bakar, 2012). Also, tree nodes can be hierarchically organised (Saillard, 2011). Given the structure of the CSF framework, this feature is beneficial because it allows the nodes to represent the several categories and their CSFs in top level nodes and subnodes, respectively. Using the literature review as the basis for the development of a foundational tree node maximises the swiftness and depth of the analysis. Nonetheless, it is important to review and refine the tree node constantly (Dean & Sharp, 2006).

## Results and Discussion

The sample of participants was composed of 10 experts (referred to as R1-R10 in this section), 1 Researcher, 2 Associate Researchers, 1 Adjunct Professor, 1 Associate Professor, 2 Senior Lecturers, 1 Assistant Professor, 1 Professor, and 1 Emeritus Professor in the areas of education, e-Learning, lifelong learning, learning technology, information science, and educational computing. The respondents came from seven different countries: Australia, Brazil, Dubai, Germany, Greece, UK, and USA. From the 10 experts 3 of them were female and 7 were male. The Nvivo coding scheme resulted in 3 top level nodes and 14 subnodes, corresponding to the 3 CSFs' categories, the 12 CSFs themselves and 2 CSF requirements; and 1 top node and 4 subnodes for the initial questions on the definition, reach and challenge of EL 3.0, and on the improvements of Web 3.0. Their reference count, in Table 1, concerns the number of times that the sources (interviews) were coded into that specific node. The number of references range from 14 (semantics and annotation homogeneity) to 34 (access) and they illustrate the respondents' focus on certain CSFs.

**Table 1. References for codes and subcodes**

| Node | Subnode | References |
|---|---|---|
| **General** | Definition | 20 |
| | Widespread | 21 |
| | Improvement | 23 |
| | Challenges | 27 |
| **Technology** | Access | 34 |
| | Mobility | 27 |
| | Visualisation | 25 |
| | Web 3.0 | 22 |
| | Interoperability | 24 |
| | Personalisation | 30 |
| **Content** | Semantics | 14 |
| | Big data management techniques | 18 |
| | Annotation homogeneity | 14 |
| | Flexibility and storage | 24 |
| | Cloud computing | 26 |
| **Stakeholders** | Students | 26 |
| | Teachers | 27 |
| | Educational Institutions | 21 |

## *EL 3.0 in Context: Definition and Reach*

Prior to assessing the respondents' opinions about what aspects constitute the critical success factors of EL 3.0, it was important to determine their general opinion about this new version of e-Learning. This scrutiny of EL 3.0 is especially significant since Web 3.0 is emerging at a stage where research still shows that educational institutions remain distant from a complete adoption of several Web 2.0 tools (Oakes, 2011). Two of the participants have also highlighted this slow adoption of the technology afforded by earlier versions of the Web: "I think people have just about caught up with Web 2.0" (R10); "tutors are struggling with Web 2.0 and even 1.0" (R6).

A conclusion that can be drawn from the respondent's answers is the fact that some of them found it difficult to detail the concrete elements that constitute EL 3.0, which is expected of a concept in its early stages of development and implementation. In such cases, the interviewees focused on more general aspects, namely, the fact that it represents an innovative technology, bound to cause resistance and fear, and lead to the increase of social connectivity and interaction, more types of data and a more pervasive use of social media. However, most of the participants were able to define EL 3.0 more concretely. According to those participants, EL 3.0 relates to the Semantic Web and its tools. It promotes a learning system that has no time or location constrictions, adds dexterity to learning, as well as knowledge extraction and creativity, and it allows the presence of an "expert tutor" that is omnipresent. It revolves around learning analytics, big data, Learning Management Systems (LMS) that can be adjusted to the student, machine related meaning for human comprehension, and interactive learning environments (authentic simulations, serious games). Moreover, it derives from "the ongoing digitalisation of all aspects of life" (R4) and "advances in artificial intelligence" (R8).

In terms of the current reach of EL 3.0, the interviewees were unanimous (Figure 2): it is still in an embryonic stage.

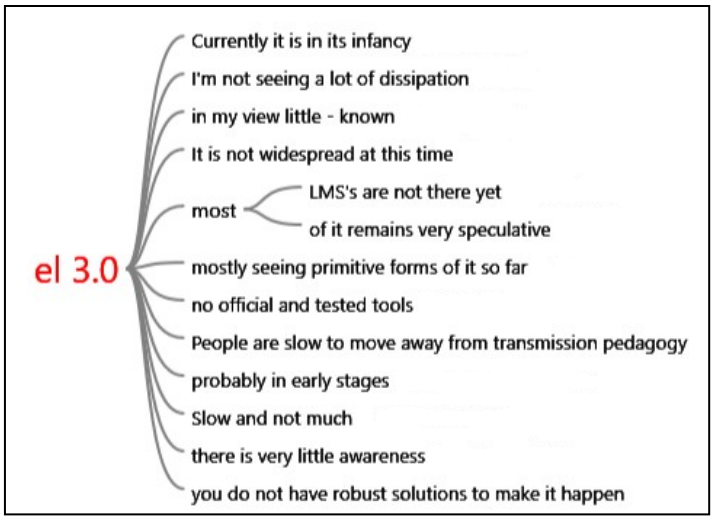


**Figure 2. Nvivo word tree with respondents' citations about the reach of EL 3.0**

According to the respondents, EL 3.0 is not very dispersed, which is in agreement with what Ohler (2008) argues about the experimental nature of Web 3.0. One of the respondents did defend that the ability of EL 3.0 to become mainstream is being potentiated by mobiles devices, the internet, and personal assistants. It is only when Web 3.0 becomes as widespread as Web 1.0, that it can be fully operational (Devedžić, 2006).

## *Improvements Brought by Web 3.0 and the Challenges of EL 3.0's Implementation*

The participants highlighted mainly two types of improvements and challenges: technological and non-technological. The improvements were more related to aspects of a non-technological nature, while the challenges were mainly technological, as it is detailed in Nvivo's coding results in Table 2.

**Table 2. Web 3.0 improvements and challenges for EL 3.0**

| Categories | Improvements | Challenges |
|---|---|---|
| **Technological** | Automated and scalable personalisation | Response-time limitations |
| | Merging and processing data | Experimental |
| | Intelligent systems | Restrictions of learning analytics and big data |
| | Acceleration of learning | Access to data sources |
| | Machines that understand content | Managing privacy |
| | | Misuse of data |
| | | Ability to process data in real time |
| | | Integration with existing tools |
| | | Interoperability |
| | | Infrastructures |
| | | Lack of robust tools to support the reusability of ontologies |
| **Non-technological** | Reduction of the workload of the teacher | Absence of a good pedagogical proposal |
| | Changes the relationship between students and teachers | Teachers adaptation |
| | More control for the students | Training of professionals |
| | Transformation of teaching and learning | Insufficient collaboration |
| | Communication and Social Interaction | |
| | New visions and new ideas | |
| | More wealth of material | |

The majority of the challenges pertains to technology that is yet to accompany the ambition of Web 3.0. Most of the issues that the respondents highlighted have already been mentioned in previous research, namely, the adaptation of teachers, which can be difficult (Oakes, 2011); the difficulty of achieving interoperability (Rego et al., 2010); the management of privacy (Alkhateeb et al., 2010); the fact that it is experimental (Ohler, 2008); and issues deriving from ontologies (Gladun et al., 2009; Karadimce, 2013). With regards to the improvements that Web 3.0 introduces, most of the choices of the participants also have the support of the literature: intelligent agents and personalisation

(Kurilovas et al., 2014); a greater empowerment of learners (Giannakos & Lapatas, 2010); the fact that machines can understand content (David et al., 2010); and the enhancement of social interaction (Halimi et al., 2014).

## *The Role of Technology in Advancing EL 3.0*

All the CSFs in the technology category were validated by the respondents. Also, this category had the three highest scores in terms of references: access with 34 references, personalisation with 30, and mobility with a total of 27 references. Table 3 depicts some of the interviewees' opinions about each of the CSFs.

**Table 3. Participants contribution for the technology category**

| Category | CSF | Interviewees validation |
|---|---|---|
| Technology | Access | "I believe the infrastructure for the internet connection does still pose problems and challenges" (R1) |
| | | "an application…it has to be intuitive enough that a person can, independently of any use of a manual, quickly make use of it" (R9) |
| | Mobility | "it reintegrates learning into the real world, permitting situated, embodied learning" (R3) |
| | | "Anywhere, anytime, just in time, just for me learning demands mobile access. Better and better mobile devices are available" (R8) |
| | Visualisation | "Visualisation will help educators make sense of data that is generated by EL3.0 systems" (R5) |
| | | "That 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) |
| | Web 3.0 | "identify and accelerate individual and group learning pathways" (R7) |
| | | "Personalised, context-sensitive digital support can be provided to learners in real-world context" (R3) |
| | Interoperability | "EU standardisation is crucial for providing platforms and frameworks for shared practice" (R7) |
| | | "will enable the learning experience to continue whenever and wherever the learner desires" (R8) |
| | Personalisation | "e-learning 3.0 will allow personalisation to scale" (R3) |
| | | "EL 3.0 systems will have to keep profiles on learners in order to determine which content to deliver based on their abilities and previous work" (R5) |

### Access

While some respondents argued that the problem of access to technology is no longer valid, others believed that it can still be a challenge in certain situations. In these situations, the use of mobile internet can address this issue, since it seems to be more widely available. According to the participants, in some cases, the problem is not related to access itself, but to the robustness of the technology that is employed, as stated by R2: "it causes me great sadness and dismay when I get a network that does not have a sustainability (…) the ease and fluidity of the access to technology is very important, it creates a more inspiring device." This applies both to hardware and internet connection and it is corroborated by the literature in terms of their availability (Pocatilu et al., 2009) and their trustworthiness (Selim, 2007). Access is constantly being improved and the tendency is to prospec-

tively continue to invest in it. According to R3 "Facebook and Google's plans for blanketing the world with Wi-Fi (via drones or balloons) should open up access enormously."

Besides hardware and internet connection this CSF comprised the user-friendliness of interfaces and applications. This aspect of access is abundantly supported by research in this field (Ahmud-Boodoo, 2015; Devedžić, 2006; Hsu, 2012; Naeve et al., 2006; Wang, 2013), but it was only mentioned by one of the respondents: "In my view if an application needs a user manual, it has some serious trouble" (R9).

## Mobility

The importance of mobility for EL 3.0 was recognised and supported by all respondents. There were 27 references in total for the mobility subnode in Nvivo. During the interviews the participants highlighted several benefits of mobility (Figure 3).

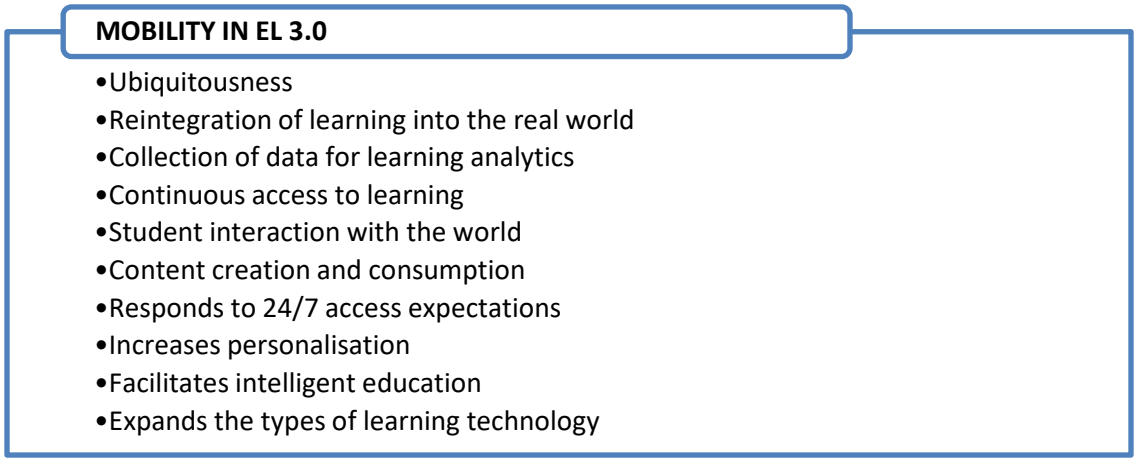


**Figure 3. Nvivo coding results for mobility**

Similarly to what was argued in previous studies (Banciu & Florea, 2011; Hussain, 2012), the participants believe that mobility is a valuable resource in terms of making e-Learning more accessible and ubiquitous and thus less dependent on time or place. In order to fully benefit from these advantages, mobile technology needs to be widespread. On the one hand, there seems be to a notion among the interviewees that students have widespread access to mobile devices and that they will not be excluded from any technological initiative: "It just means that you don't have to think about having a back-up for people who don't have access…If you decide you want to run your course through whatever, a Facebook page or run a discussion on twitter you can just do it, it's not a problem that some people could be left out, because everybody can get access" (R10). On the other hand, one respondent highlighted that in some parts of the world this is far from reality: "ubiquitous access to Wi-Fi and other avenues for connectivity are lagging behind, especially in poor rural areas" (R8).

## Visualisation

This CSF was composed of three core elements: visualisation tools, 3D and immersive web, and 3D visualisation and interaction. While these aspects invoke more technical aspects and the respondents didn't concentrate too much on them in particular, their views on the importance of visualisation for EL 3.0, corroborates the inclusion of visualisation in the CSFs' framework that this study suggests.

Generally speaking, the interviewees mentioned the illustration of the teaching and learning material and they highlighted the fact that visualisation aids a trans-experiential learning and provides more authentic experiences, which was also defended by Norman et al. (2011). Moreover, they underlined the involvement of the senses and the support of learning in real-world contexts, namely, via 3D and augmented reality, which along with virtualisation has been amply supported by the literature as es-

sential elements of EL 3.0 (Amit, 2015; Hussain, 2012; Oakes, 2011; Riera et al., 2015). Also, "visuals are a great aid to communication and learning" (R1).

In terms of visualisation tools examples, the participants mentioned only a few: graphical renderings and infographics, (ex. Gapminder, a provider of animations for statistics (Rosling & Zhang, 2011)), video and general animation.

### Web 3.0

Web 3.0 is an intrinsic part of EL 3.0 and the participants were able to see many advantages in its use. More specifically, they focused on its power to accelerate both individual and collective learning, to simplify the role of the teacher and the student, to enhance interaction and personalisation, and to increase the role of machines in the learning process. In the literature, Rego et al. (2010) advocated that EL 3.0 has the objective of employing the full potential of Web 3.0, and some of the participants agreed with this statement by saying that all the features of Web 3.0 should be used: "Whatever is applicable and technically possible" (R6); "I think we would want to incorporate as many as we could" (R1); "it would be premature to rule out any features of the still emerging Web 3.0 (…) all tools or algorithms that allow enhanced personalisation, understanding, and communication" (R8). Those who were more specific in the numeration of the characteristics of Web 3.0 that would most likely benefit EL 3.0 suggested several aspects, as it can be seen in the summary of Nvivo's coding in Figure 4.

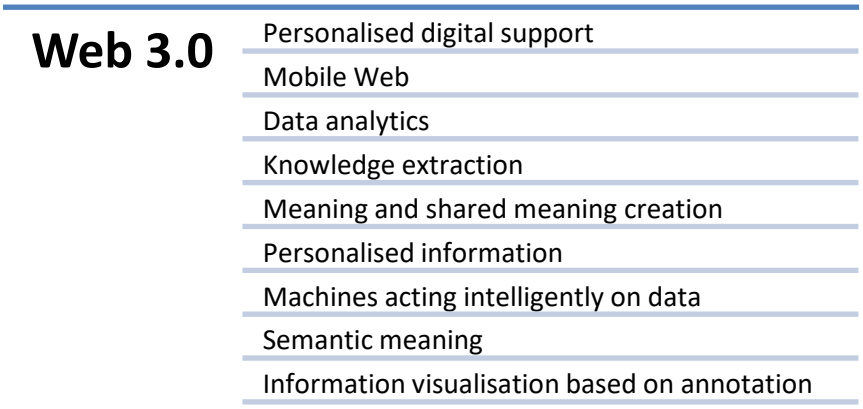


**Figure 4. Web 3.0 features that should be incorporated into EL 3.0**

Overall the participants defended the inclusion of personalised digital support, the Mobile Web, data analytics, knowledge extraction and meaning, and shared meaning creation. Furthermore, they argued for the incorporation of personalised information, similarly to what was argued by Ahmud-Boodoo (2015); machines acting intelligently on data, portrayed in the literature as an important advancement of the understanding between people and machines (Dwivedi & Bawankan, 2013); semantic meaning, which has been researched by previous studies (Ohler, 2008); and information visualisation based on annotation, also corroborated by research in the field (Castellanos-Nieves et al., 2011).

Contrary to an extensive body of research (Devedžić, 2006; Gupta & Dubey, 2013; Holohan et al., 2005; Kaur & Chaudhary, 2015) that highlights ontology and ontology based tools as fundamental features of Web 3.0 to be imported to EL 3.0, none of the respondents mentioned ontology related features.

### Interoperability

Interoperability as a CSF for EL 3.0 had two main aspects emerging from the literature review: semantic interoperability and interoperability of web-based educational systems. Both aspects were validated by the respondents as important facilitating conditions. In terms of semantic interoperabil-

ity, the respondents highlighted Resource Description Framework (RDF), common ontologies, the need to have good vocabularies, and ontologies that can be reused and shared. According to previous studies, these aspects are fundamental for the accessibility and reusability of content (Gladun et al., 2009; Ivanova & Ivanova, 2009). Nonetheless, this scenario is still difficult to attain, as a respondent put it "you can even in an automatic point of view, try to make ontology discoveries, automatic alignment to interoperate. But this is still in the field of research and its precision is not that good yet" (R9).

With regards to the interoperability of web-based educational systems, the interviewees focused mainly on the development of Application Programming Interfaces, the exchange of data among systems, information repositories, and learning management tools. Despite the recognized importance of interoperability, one of the respondents raised some concerns for privacy and security: "Learning environment interoperability is a double-edged sword. Many issues related to privacy and security must be addressed as interoperability is extended" (R8).

Some of the benefits of interoperability that the participants mentioned were also extensively supported by the literature: reusability (Gladun et al., 2009), data exchange (Rajiv, 2011), collaboration among institutions (Aroyo & Dicheva, 2004) and standardisation (Ivanova & Ivanova, 2009). In addition to its advantages, one of the respondents underlined the fundamental role that both technology and collaboration play in accomplishing interoperability: "Interoperability requires both a technical and social/collaboration aspect in EL 3.0. This means not only are the tools needed but also educational participants need to be able to incorporate tools and techniques into their everyday educational practice" (R7).

### Personalisation

Despite an imposing support from the literature (Noskova et al., 2015; Pattnayak & Pattnaik, 2016; Shaltout & Salamah, 2013), only two respondents agreed with the role of artificial intelligence as a resource for personalisation. One of them further added that it still seemed like a prospective phenomenon, rather than a current one, and said it raises issues of trust. With regards to intelligent e-Learning systems, the scenario was very similar. The support of previous research (Bucos et al., 2010) was matched by only one participant, who underlined the capacity of these systems to monitor the progress of students, to tailor content based on their skills and previous work, and to create student profiles to facilitate personalisation. Likewise, the literature that supported user profiling techniques (Kaur & Chaudhary, 2015; Virtič, 2012) was reiterated by only one respondent.

Despite the lack of confirmation of the three core aspects of personalisation as a CSF of EL 3.0, the interviewees validated the general belief of past research (Hussain, 2012; Kaur & Chaudhary, 2015) that cites personalisation as a core concept in learning. The participants mentioned the importance of personalisation in the collection of data about the students' preferences and behaviours, its role in accelerating and enriching the learning process and the existence of multiple adaptive platforms, such as Carnegie Learning (Ritter, Anderson, Koedinger, & Corbett, 2007), MeuTutor (Santana et al., 2016), Grockit (Stack, 2011), and Aleks (Serhan, 2017). They also suggested ways of increasing personalisation, namely, through Latent Semantic Analysis, an alignment among fundamental learning design aspects, and data mining, more specifically the Educational Data Mining community.

One of the participants also raised an issue with regards to personalisation that relates to the use of Moodle and its lack of compatibility with personalisation solutions: "Moodle you will have in almost all universities, but when you try to use Moodle with some personalisation solution that actually does not occur in practice (…) So what you are going to have is other platforms that are developed and that have personalisation but do not necessarily have integration with Moodle" (R9).

In brief, the respondents reiterated the crucial role that the factors related to technology have in the success of EL 3.0, as can be seen in the model generated in Nvivo (Figure 5).

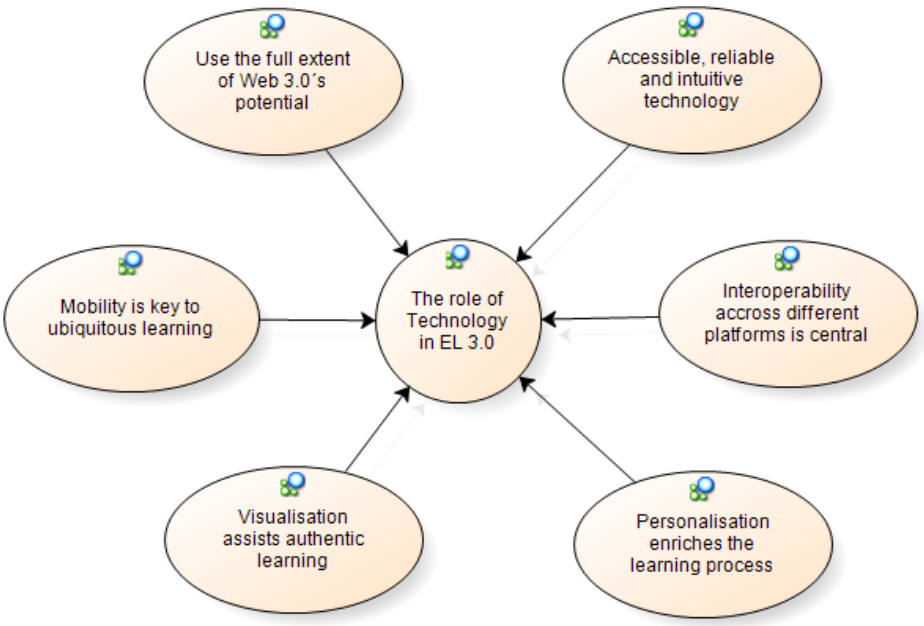


**Figure 5. Nvivo's model portraying a summary of the technological CSFs**

From a technological standpoint, for EL 3.0 to thrive it requires technology to be available, reliable, easy to use, mobile, and interoperable. Also, it requires the incorporation of Web 3.0 features, the support of visualisation tools, and personalisation efforts.

## *Content in the Progress of EL 3.0*

Despite the fact that the content category had all its CSFs confirmed by the respondents, two of its CSFs cause some confusion among the interviewees, which was reflected in their number of references: semantics and annotation homogeneity had only 14 references each. Table 4 shows some of the participants' opinions for this category.

**Table 4. Interviewees' opinions about content**

| Category | CSF | Interviewees validation |
|---|---|---|
| Content | Semantics | "Frameworks will need to be developed to provide semantic annotation based on a learner's activity online" (R5) |
| | | "if you have a good annotation of that, you can reuse that particular resource and that usually does not occur" (R9) |
| | Annotation Homogeneity | "highly important in order to enable reuse of data" (R4) |
| | | "Information that is annotated consistently will be easier for elearning systems to analyse and process" (R7) |
| | Flexibility and storage | "Today, storage and processing that is fast, it's one of the major problems to have an EL3.0" (R9) |
| | | "storage capacity appears to be unlimited in the cloud" (R8) |

### Semantics

This CSF was initially composed of two main aspects: big data management and machine-understandable learning material. Despite the fact that no respondent mentioned any of these items

directly, some of their responses were in line with what they represent. With regards to semantics in general, two respondents were unable to answer this question and one responded outside the scope of what was asked.

The remaining interviewees provided a series of solutions to increase semantically annotated content: interoperability, common standards, light-weight semantic 'standards' (e.g.,. schema.org), automated analysis of content, automated annotation of content, annotation of and between conversations and learning paths, accelerate meaning extraction, development of good repositories with good communication, and reusability. This is compatible with the belief that semantically ready content needs to be developed via content annotation using ontologies and several semantic languages and technologies (Devedžić, 2006; Tiropanis et al., 2009). Also, as R5 stated, "By annotating conversations, learning paths, content reviewed, etc, and relationships between these, e-Learning systems will be able to determine relevant content for presentation."

## Annotation homogeneity

In terms of annotation homogeneity two respondents did not know how to answer and one other stated that it was not an issue in certain fields, only in sectors where there are great amounts of data or when the data is very complicated. Nonetheless, the majority of the respondents was able to highlight several advantages of having homogeneity in annotation as it can be seen in Figure 6.

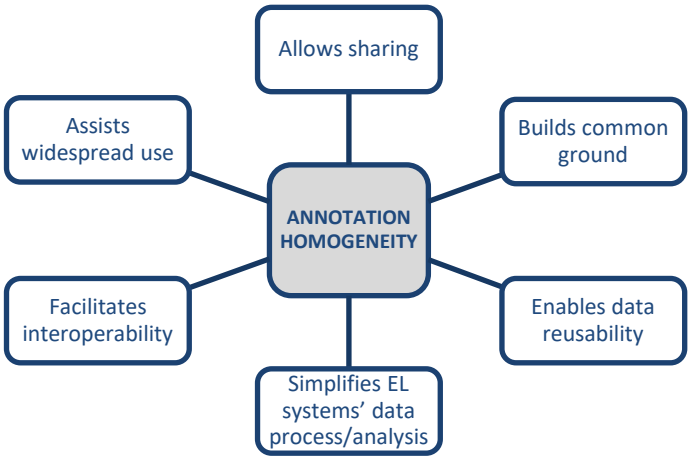


**Figure 6. The affordances of annotation homogeneity according to Nvivo coding**

According to the interviewees there are multiple benefits of having annotation homogeneity. As it was also argued by Vera et al. (2013), it allows data to be more easily processed and analysed; it facilitates interoperability, which also had the support of previous studies (Tiropanis et al., 2009); and it allows sharing and the creation of common ground, and reusability and widespread use.

In order to facilitate this homogeneity, the respondents suggested the creation of a new LMS 3.0, the contextualisation of the annotations with foundational ontologies and training to use ontologies: "we are going to need a new LMS 3.0 to service with more level" (R1); "once you have annotation looking at the context that software can…understand at the semantic level what it is" (R9).

## Flexibility and storage

When faced with the issue of storage in EL 3.0, the participants suggested the use of cloud computing, data management approaches, real-time streaming of media, triple store tools, such as Virtuoso (Papadokostaki et al., 2017), and services like Amazon Web Services (Nawaz, Juve, Da Silva, & Deelman, 2016) (despite being expensive). One of the interviewees added that one of the most significant problems with EL 3.0 is the need to have fast storage and processing: "if we have many students the processing is low and it fails to have scalability" (R9). All the participants recognized the

importance of cloud computing for EL 3.0 and the majority (8) does use it for storing and exchanging learning materials, namely Google Drive and Dropbox. The respondents confirmed the general tendency of the literature that highlights several advantages of using cloud computing, namely, its storage capacity (Banciu & Florea, 2011) its interoperability (Garavaglia & Gaiotto, 2012) and its constant accessibility (Amit, 2015).

In terms of the flexibility of content, it was pointed out that learning cannot be closed, that mobile devices facilitate multimedia content creation and the importance of indexing multimedia. One of the participants gave the example of Flickr: "For images, systems such as Flickr have intelligence to search images based on colour, subject (landscape, human, animal, flower, etc.) so the recognition technology is there to make content flexible across systems or applications." (R5).

In short, the interviewees asserted the importance that content related issues have in the achievement of EL 3.0. The Nvivo model below (Figure 7) depicts the main conclusions for this category.

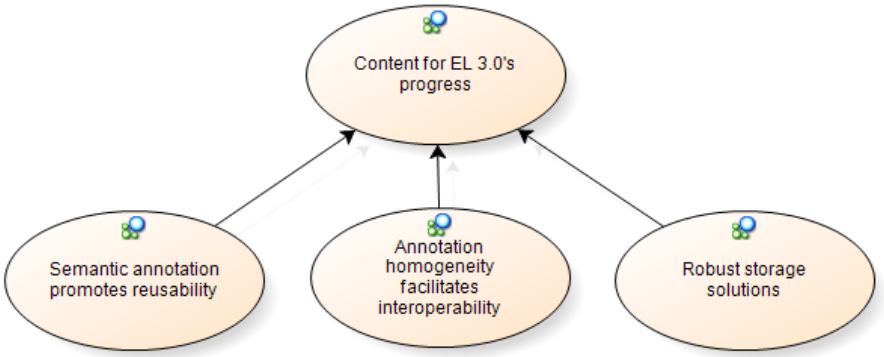


**Figure 7. Main contributions of content related factors**

According to the participants, in terms of content, what EL 3.0 requires to succeed is the promotion of semantic annotation, to invest in the homogeneity of all annotation efforts, and the deployment of solid storage solutions.

## *The Role of Stakeholders in the Development of EL 3.0*

The entirety of the CSFs of this category was substantiated by the participants, although there was an emphasis on students and teachers, which had a higher number of references, 26 and 27 respectively. Table 5 shows excerpts of the participants' stances for this category.

**Table 5. Participants' views on stakeholders**

| Category | CSF | Respondents validation |
|---|---|---|
| Stakeholders | Students | "The only thing that should be expected of the student is interacting (…) you must have those interactions so that EL3.0 can indeed happen" (R9) |
| | | "competencies in using mobile devices and the internet, social media, and creating and digital media" (R5) |
| | Teachers | "embrace and integrate the new technologies" (R7) |
| | | "knowledge facilitator" (R1) |
| | Educational Institutions | "as long as institutions do not support EL wholeheartedly then no progress in using tools for learning will be made" (R4) |
| | | "infrastructure (both technical and administrative) will need to change to support the learning environments necessary for an EL3.0 world" (R5) |

## Students

The three main aspects pertaining to students that resulted from the literature review comprised collaboration, active participation, and personal and technical skills, which were all corroborated by the interviewees. With concern to students' skills, the respondents pointed out innovation, problem solving, engagement in anytime/everywhere learning, willingness to embrace technologies for learning, and creativity. Also, as defended by Loureiro et al. (2012) and as pointed out by the participants, students need to be digitally literate, which includes dealing with mobile devices, internet, and social media. Previous research has underlined the central role of collaboration for EL 3.0 (Ahmud-Boodoo, 2015; Banciu & Florea, 2011) as did four of the respondents.

Student's participation was cited by the majority of the respondents, one in particular said: "Oh I think we have to encourage [collaboration and active participation] as much as possible" R10. The subject of participation is also highly supported by previous studies, which highlight its significance to the enrichment of learning material (Shah, 2012), information input (Ciravegna et al., 2004) and the provision of data for a richer and more personalised learning experience (Noskova et al., 2015).

## Teachers

In line with what the literature already defended (Sue, 2015), an important aspect that became clear in some interviews was the fact that the teachers do require training to deal with the affordances of EL 3.0. Their awareness of and openness to the digital age and technology also seems to be decisive. One of the respondents stated that while there are "some [teachers] that are fascinated, really invested and interact…others create difficulties in everything." (R2). This is coherent with the argument of Hussain (2012) who believed that EL 3.0 would be more prolific as teachers become more familiar with technology and more willing to engage with Web 3.0. There were four central types of roles that according to the respondents the teachers should have: mentoring, expertise, creation and collaboration (Figure 8).

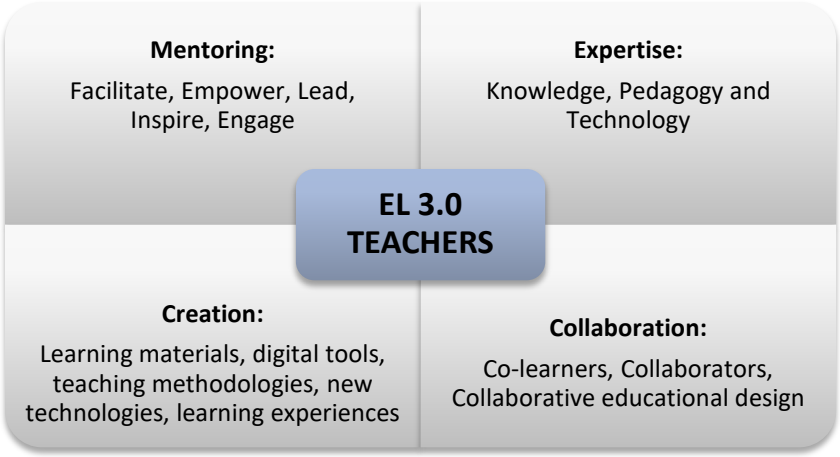


**Figure 8. The role of the teacher in the EL 3.0 context according to the respondents**

With respect to mentoring, the participants believe that teachers should act as a source of empowerment, as leaders working to inspire and engage the learners. In terms of their expertise, they are required to have knowledge, to have pedagogical skills, and be able to employ technology. In their role of creators, which was also made clear in the literature (Ivanova & Ivanova, 2009; Poore, 2014), teachers are expected to design learning materials and learning experiences, to adopt new technologies and teaching methodologies, while making use of digital tools. Finally, in terms of collaboration, in EL 3.0, teachers are the students' co-learners, they act as collaborators in the teaching process and they should be committed to collaborative educational design. Collaboration seems to be a central

part of EL 3.0, with previous studies advising teachers to engage in online communities and collaborative work (Noskova et al., 2015) and to enhance their alliances with other professionals (Sue, 2015).

### Educational institutions

In the interviews, the central role of this stakeholder was widely recognised. One respondent stated that "it is necessary to convince the institution that it has to support EL projects, that it needs to encourage its teachers, that it needs to bring people who are experts in this area to work with teachers and students" R2. Their responsibility for infrastructural development was supported by the literature (Ahmud-Boodoo, 2015) and also by the respondents. They argued that educational institutions are not only responsible for ensuring the availability of the adequate services, but also for guaranteeing that people know how to use them and that they have quality. They need to provide students with access to hardware, software, and connectivity and to make sure that data is available across the different learning systems and platforms. The provision of training for EL was emphasized by only three respondents, although it has been significantly discussed in previous research (Ahmud-Boodoo, 2015; Hussain, 2012; Norman et al., 2011; Paechter et al., 2010).

There are other aspects that emerged in this question that deserve to be considered when discussing the success of EL 3.0. As one of the respondents emphasized, "universities tend to be, you know, rather conservative like that, closed to change" (R10), which had been already mentioned by Ohler (2008) when he stated that the nature of EL 3.0 is incompatible with the isolation of academic institutions. Another participant added that they need to "reinvent themselves to survive" (R8). Other important subjects that were focused on this question include the need for institutions to embrace technology and the digital age, to support and encourage the teachers, and to offer a framework for this new stage of learning.

In summary, the participants confirmed the fundamental contribution that the three main stakeholders have in the progress of EL 3.0, as it is illustrated by this category's Nvivo model (Figure 9).

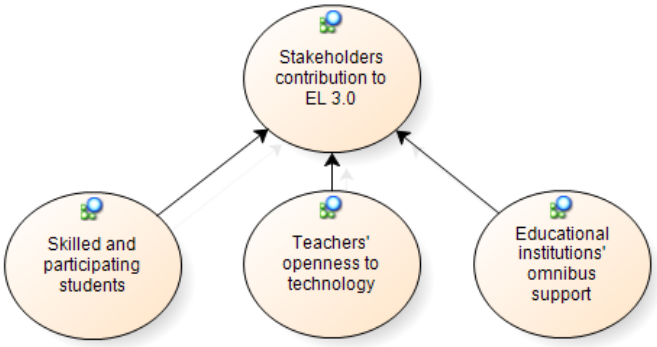


**Figure 9. Stakeholders' role in the promotion of EL 3.0**

With concern to EL 3.0's pervasiveness, the contributions of the respondents highlighted the value of students' skills and their participation in the learning process, the importance of teachers' openness to technology, and the need for an encompassing institutional support.

## REVISION OF EL 3.0 CSFS FRAMEWORK

The analysis of the interviews with EL experts enabled a revision of the initial framework of EL 3.0 CSFs. Since the interviewees suggestions were easily integrated into existing CSFs, no further factors were added to the primary alignment. Overall all the CSFs were validated by the respondents, nonetheless, based on the difficulty that some participants demonstrated when answering some questions of a technical nature, some CSFs were simplified. The CSFs also have a more descriptive representation to facilitate their standalone interpretation. The most significant changes have to do with the

incorporation of annotation homogeneity into semantics and the separation of flexible and storage, which are now two separate CSFs: flexible content and content storage and management. As it can be seen in Figure 10, the interviews' influence on the framework was mainly as a reinforcer.

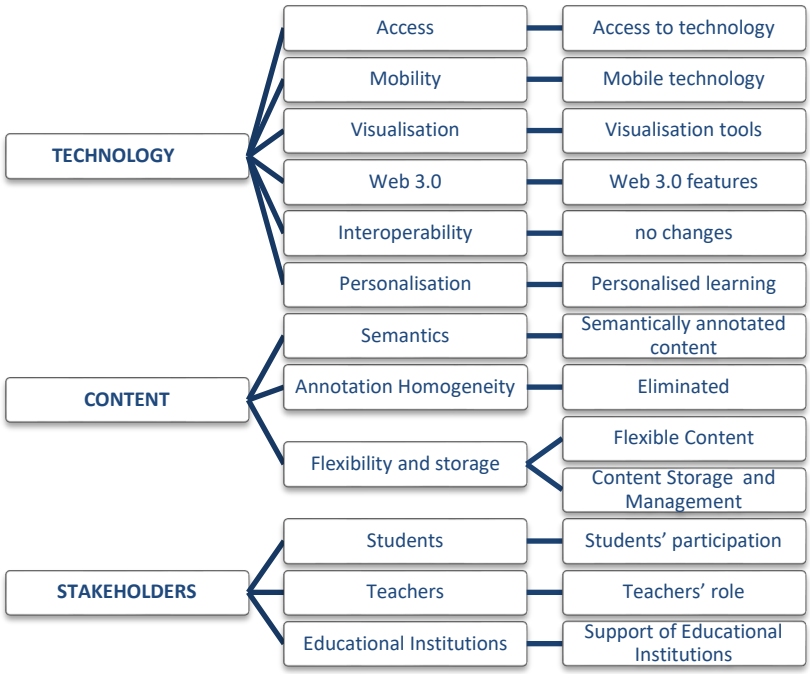


**Figure10. Evolution of the original EL 3.0 CSF framework**

In order to understand the modifications more specifically, it is important to examine each of the categories. In terms of the technology category, the respondents' contribution consolidated the initial CSFs. This was the category that gathered most consensus. Hence, no changes were made in terms of the CSFs and their denominations were merely altered for clarification. With respect to the content category, the question related to semantics raised some confusion and resulted in some respondents not answering or answering outside the scope of the question. Hence this CSF has been replaced by semantically annotated content, which is a clearer concept. Big data management was initially associated to semantics, but it has now been integrated into another CSF (content storage and management), because it has more to do with dealing with content in general and not necessarily with the semantic annotation of content per se. Flexibility and storage was transformed into two CSFs: flexible content and content storage and management. Only cloud computing was mentioned by the respondents in the question related to this CSF, so it was important to separate the two different elements of the original CSF. On the one side there is flexibility, now represented by the CSF flexible content. On the other side there is the issue of storage and management, now identified by the CSF content storage and management. Finally, the stakeholders' category maintains all its CSFs and the only changes pertain to their denominations. This category was substantially corroborated by the answers of the respondents.

## CONCLUSION

E-Learning has become a highly successful and highly competitive sector where technology is used to deliver educational content online. EL 3.0's success is the result of the impact of a variety of factors that combine elements of traditional e-Learning with Web 3.0. The framework that is proposed in this paper provides a threefold structure of EL 3.0's CSFs encompassing technology, content and stakeholders. In order to assess the validity of the CSFs, e-Learning experts were consulted via semi-structured interviews.

According to the participant's answers, despite the challenges associated with the implementation of Web 3.0 in the context of e-Learning, namely, teachers' adaptation, privacy, the lack of robust tools to support the reusability of ontologies, and its integration with exiting tools, it holds great potential. The respondents believe that it will represent a greater empowerment of the students, an enhancement of personalised learning, an improved experience brought by machines that can understand content, and the enrichment of social interactions. As it was made evident in the responses of the interviewees, EL 3.0 is currently in an early stage of development. Regardless of this initial phase, the generality of the CSFs was corroborated by the respondents, which significantly validates the framework. Technologically speaking, EL 3.0 requires technology that is accessible, trustworthy, and user friendly to become more widespread. Its ubiquitousness relies on the existence of mobile solutions that can be broadly available to the students. Also, it is crucial to promote interoperability across different platforms and employ Web 3.0 features as extensively as possible. The participants have equally highlighted the role of visualisation tools in the provision of a more authentic learning and the learning improvement that personalisation strategies constitute. From the perspective of the content category, the participants trust that, in order to succeed, EL 3.0 demands the progress of semantic annotation to safeguard reusability, the assertion of homogeneity for all annotation efforts as a way to facilitate a much needed interoperability, and the employment of robust storage solutions to manage data. Finally, in terms of the stakeholders, the interviewees argue that the pervasiveness of EL 3.0 is dependent on the skills, both personal and technical, and the participation of students. The teachers are required to have openness to technology and to assume a role in mentoring, expertise, creation, and collaboration. With concern to educational institutions, their omnibus support establishes an important foundation for the thriving of EL 3.0.

Nonetheless, not all the CSFs were clear to the interviewees. The responses for technology related CSFs were sometimes vague. The participants did display a broad knowledge of Web 3.0, but some of them were not able to provide a detailed account of its benefits, nor a more specific description of its technologies. These results are in line with previous research that argues that EL 3.0's is embryonic and also with the contribution of the participants, who stated that this version of e-Learning is still in its early stages. These conclusions make the dissemination of EL 3.0 even more pressing. Probing the success of EL 3.0 might seem premature, but the lack of awareness of the new possibilities afforded by Web 3.0 for online education will exclude researchers and practitioners from reaping its benefits.

The modifications that were introduced to the initial structure of the CSF framework for EL 3.0 are vital particularly because future research ventures include the design of a quantitative and self-administered data collection instrument. The interviews allowed a preliminary validation of the framework, but its assessment requires further scrutiny by more objective and quantifiable methods.

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