



## MOOCs to Semantic Web Education

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### Abstract

*The web is a largest information repository which makes multimedia contents available. However, their location is no easy task, mainly since their semantics or meaning can only be captured in their context and in accordance to human perspective. In the past years, the W3C (World Wide Web Consortium) and the international scientific community have been carrying out significant efforts with view to improving the localization, retrieval and reuse of information, which may be inaccessible or stored in servers scattered around the deep web or the invisible web. We are talking about the new web generation: the semantic web. Metadata and ontologies, annotation tools, ontologies tools, agent systems, among other technological developments of Computer Sciences and Artificial Intelligence are the key elements for the development of solutions that are gradually lead to changing the web reality. The main purpose is the integration, interchange and semantic understanding of information not only from the viewpoint of humans, but also from the perspective of machines through the change of the current web into a web of semantic data. But, is there any Massive Open Online Course (MOOC) that contributes to forming people capable of understanding and collaborating in this migration process? In this context, we intend to identify a set of MOOCs oriented to the study of the semantic web and, consequently, to determine the contents transmitted in each of the different courses. As such, through an exploratory research, characterized as documentary, we use as main sources of information as articles and publications on the subject to understand the relevance of the Semantic Web in contemporary education, as well as the importance of MOOC as a vehicle for dissemination and sharing of knowledge in this area.*

**Keywords:** MOOC; online training; semantic technologies; semantic web.

### 1. Introduction

Information and Communication Technology (ICT) models, projects and educational experiments in the educational context have contributed to facilitate the implementation of several formal and informal learning processes by simplifying a set of tasks inherent to these processes. Massive Open Online Courses (MOOCs) can also be included to support online learning processes. The semantic web can simplify this while generate a smarter web. But what is this vision, what changes does it cause and where can we learn and training or develop applications to this new web generation?

To be able to support the answer to this question, we proposed to identify and study a set of MOOCs oriented to the theme of the semantic web. The option for MOOC to support and promote courses on this subject, is related to the fact that this modality is relatively recent and, of course, to foster a new range of challenging possibilities to expand access to quality education [1].

Thus, a research was conducted through an exploratory study, characterized as documentary, using papers and publications in this context as the main sources of information. With this research, based on a set of research criteria, we intend to identify the MOOC oriented for the study of the semantic web and, consequently, to determine the contents addressed. We hope to contribute to the understanding of the Semantic Web in contemporary education, as well as to highlight the importance of MOOC for disseminate contents and sharing knowledge.

### 2. Semantic web

The semantic web is an initiative, led by the W3C, which aims to create a universal medium for sharing information, building a web of linked data and assigning meaning (semantics) to the content of web documents. So, the meaning of the information can be understood not only by humans, but also by machines. The semantic web is a web extension that will allow you to find, share and combine information more easily. The mission of semantic web design can translate into web-driving towards its true potential [2]. Its main objectives are to construct a common structure of data representation in order to facilitate the integration of diverse sources of information to extract new knowledge (only possible through the migration of a web of documents to a web of data); increase the usefulness of

information by connecting it to its concepts and context; and to discover and analyze information more efficiently [2]. Through the semantic web it is possible to take more advantage of hyperlinks, since the links provide the relationships among the information resources, allowing the machines to have access to more layers of information and, consequently, can work and share knowledge with humans. There are several changes from the traditional Web to the Semantic Web that we find interesting to mention. The conventional web was based on hypertext, which allowed to direct the reader to other related screens through links providing a better understanding of the original text. However, this Web had as its main disadvantage: it is easy for the reader to get lost among a large array of information. The Semantic Web contributes to solving this problem, since technology makes it easier to obtain the desired information in a more convenient and effective way.

Updating the work of Raymond Yee [3], the main changes from the conventional Web to the Semantic Web are: the recipients are not only humans, but also computers; the language has evolved from HTML to XML; documents structured; the display of contents in XSL documents and their dynamic edition; editable web; ontologies; aggregation of content from multiple sites; decentralized publication. The evolution of web to semantic web, described by Berners-Lee, Hendler and Lassila in 2001, has been slow to materialize. However, millions of web domains currently contain applications or simply markup on their web pages take a silent step towards the semantic web.

During the first decade of this millennium, the architecture for the semantic web was defined and based on four main layers with their tools: structural, syntactic, semantic and logical layers [4] [5].

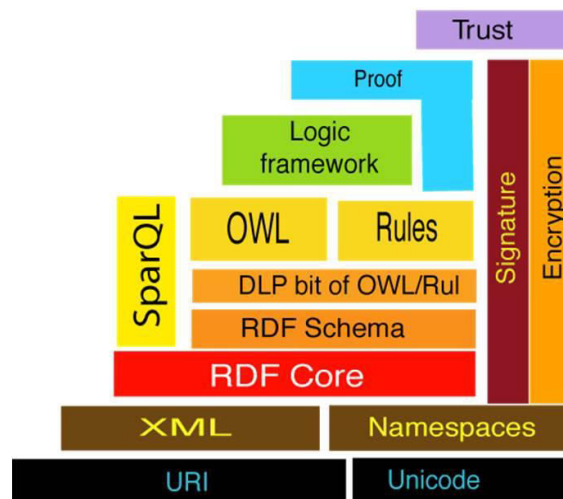


Fig. 1 - Semantic web architecture [4]

### 3. Massive Open Online Courses

MOOCs are a continuation of the trend in innovation, experimentation and the use of technology initiated by distance learning and online, to offer learning opportunities in a massive way [6]. MOOC provide open access, based on a model of distance education, promoting large-scale interactive participation [7] and integrating social networks, accessible online resources and facilitated by leading professionals in the field of study [8]. They represent innovation, as well as the incorporation and use of technology to diffuse what was previously restricted to the walls of institutions [9].

Although the MOOC emerged in 2012, this technology is still in the process of being adopted by educational institutions: some are developing MOOCs, others are using MOOCs developed by others, others are waiting to see the results and others are rejecting the official adoption of this technology [10]. It seems clear that MOOCs are currently being adopted by their institutions, as "the emergence of extreme innovations such as MOOC has the potential to transform higher education and create new competition and centers of excellence among universities around the world [11]. These innovations (MOOCs) are an opportunity for teachers to change their practices, since "from the point of view of institutions, MOOC serve to promote universities, favoring the recruitment of new students and also as a field for pedagogical experiments" [14], as well as a useful tool for training teachers. However, these innovations may imply a profound change in the educational culture and organization of the teaching profession. Thus, it is essential that teachers be trained in the effective use of technologies for the planning, development and evaluation of the teaching-learning process, particularly in learning environments such as MOOCs.



#### 4. The study

This work was accomplished through an exploratory research, characterized as documentary using as main sources of information papers and publications in the context of the identification of MOOC oriented to the study and comprehension of the theme of the semantic web. Thus, through the present study, it was intended to concretize four main objectives:

- i. Identify a set of MOOCs oriented to the study of the semantic web;
- ii. Determine the contents transmitted in each of the different courses;
- iii. Understand the relevance of the Semantic Web in contemporary education;
- iv. Understand the importance and contribution of MOOC to learning process.

In order to better organize and categorize data from exploratory analysis of semantic web courses, the following set of search parameters were established: MOOC platform, course designation, promoter, duration of course, requirements, language, features and tools used, summary and contents, evaluation, certification, and crediting.

The data collection was carried out, from March 1<sup>st</sup> to 31<sup>st</sup>, 2019, through an exploratory research, based on the parameters previously mentioned. It is interesting to mention that courses that were only based on the study of a certain semantic technology were ignored. In addition, it was decided to perform a search only on the most well-known and used MOOC platforms worldwide. It should be noted that only the MOOCs were searched on these platforms using the keywords "Semantic web" in Portuguese, English, Spanish and French languages. After the data were collected, a content analysis was carried out to identify the content on the topic of the semantic web and, consequently, to determine the level of presence of the study of this subject in the MOOC. The content analysis was developed based on previously defined research parameters.

All the data obtained were properly categorized and treated in Microsoft Excel based on the search parameters. Each of the 12 courses identified were analyzed, especially the part of the content available (videos, quizzes, tests, readings, exercises, aids, presentation slides as PDF, articles, programming tasks and references) and the part of asynchronous communication tools (in this case, the discussion forums). Finally, with support in the framework of qualitative results, a final analysis was carried out to standardize the data.

The table 1 summarizes the identification of MOOCs in the context of the Semantic Web:

Id	MOOC platform	Course designation
1	FUN	Semantic Web and Data Web
2	Coursera	The Semantic Web: Tools for the publication and effective extraction of information on the Web
3	Miriada X	Semantic Web and Linked Data (4. <sup>a</sup> edition)
4	Future Learn	Introduction to Linked Data and the Semantic Web
5	Future Learn	Web Science: How the Web Is Changing the World
6	OpenHPI	Knowledge Engineering with Semantic Web Technologies
7	OpenHPI	Linked Data Engineering
8	OpenHPI	Semantic Web Technologies
9	Udemy	Content Writing in the Semantic Web
10	Udemy	Semantic Web in 1 hour
11	Udemy	Learn Semantic Web - Next Phase of WWW in 1 Hour
12	UPV	Semantic Web and linked data

Table 1 - MOOCs in the context of the Semantic Web

Of all the contents available in the MOOCs, videos are the ones that are most present, mainly because are less time consuming to the participants. The presentation slides the PDFs and articles are just one example of the content that is present in all MOOCs, perhaps because of the ease of access by the participants and the work habits (digital or paper readings) of their educational or professional lives. According to the documentary analysis, the quizzes, tests, exercises and programming tasks were used mainly to the assessment of activities. At the end of each module/section there was a mandatory assessment with the purpose of issuing the certificate of participation or the certificate of achievement or certificate of completion of the course. The certification is possible if you make corresponding payment (this in most of the courses studied). Of the 12 courses studied, only one gives credits (ECTS), so it is verified that this dimension is not yet on the agenda for this type of courses. Regarding the actual contents of the Semantic Web, they are



relatively superficial, that is, they do not address the most important aspects of the topic. All courses introduce the necessary concepts to understand the semantic web key technologies, but don't have practical exercises or challenges to practice. Thus, it is suggested that the next editions of MOOC be more oriented towards the deepening of this theme so that the participants obtain more knowledge and skills in the area.

This kind of courses serve as platforms of knowledge for any individual who wishes to learn, which makes them a powerful and emerging learning strategy with repercussions in the educational area.

## 5. Conclusions

Through the development of the present research, we have identified the MOOCs related to the theme of the semantic web. The offer of this type of courses is frankly scarce considering the importance that the semantic web assumes in the current society. They all addressed the key concepts and technologies of the semantic web. However, they correspond to courses to obtain essential knowledge about the semantic web and its technologies, and not courses that allow learning to make applications or content with such technologies for this new generation of the web.

The identification of the courses and their contents contributed to obtain information relevant to the deepening of the problem of the lack of courses in this subject. Will the web need to evolve so that the technologies become more accessible and easier to use to generalize the creation of contents for the semantic web? Certainly, but this does not justify the fact that there are no more courses in the face of the new semantic reality that needs to be achieved. It is expected, therefore, that the promoters of the MOOC, especially higher education institutions, invest in courses on this subject that are fundamental to understand how semantic web themes are useful to education particularly regarding teaching-learning in an era entirely based on technologies.

## References

- [1] A. Teixeira, J. Mota, L. Morgado, and M. Spilker, "iMOOC: Um Modelo Pedagógico Institucional para Cursos Abertos Massivos Online (MOOCs)," *Educ. Formação Tecnol.* 1646-933X, vol. 8, no. 1, pp. 4–12, 2015.
- [2] E. Miller, "Weaving meaning: An overview of the Semantic Web," Univ. Michigan, Ann Arbor, Michigan USA, 2004.
- [3] R. Yee, "The sea change of the Web: What is the second-generation, Semantic Web?," *Berkeley Comput. Commun.* 11, vol. 4, 2001.
- [4] Berners-Lee, "The Semantic Web," 2002.
- [5] W3C. "W3C DATA ACTIVITY, Building the Web of Data". Available in <https://www.w3.org/2013/data/>
- [6] T. de Monterrey, "Edu Trends Report." 2014.
- [7] G. Siemens, "Connectivism: a theory of learning for the digital age," *Int. J. Instr. Technol. Distance Learn.*, vol. 2, no. 1, 2005.
- [8] G. Siemens, "Massive open online courses: Innovation in education," *Open Educ. Resour. Innov. Res. Pract.*, vol. 5, 2013.
- [9] J. Ma DLee, Kelly, CKuo, Grace., "A massive open online course on pharmacogenomics: not just disruptive innovation but a possible solution," *Pharmacogenomics*, vol. 14, no. 10, pp. 1125–1127, 2013.
- [10] A. McAuley, B. Stewart, G. Siemens, and D. Cormier, "The MOOC model for digital practice, SSHRC Knowledge Synthesis Grant on the Digital Economy," *Recuper.* <http://www.edukwest.com> 2010.
- [11] F. M. Hollands and D. Tirthali, "MOOCs: Expectations and Reality. Full report.," *Online Submiss.*, 2014.
- [12] C. R. F. Riedo, E. M. de Aguiar Pereira, J. Wassem, and M. F. Garcia, "O desenvolvimento de um MOOC (Massive Open Online Course) de Educação Geral voltado para a formação continuada de professores: Uma breve análise de aspectos tecnológicos, econômicos, sociais e pedagógicos," *SIED EnPED-Simpósio Int. Educ. a Distância e Encontro Pesqui. em Educ. a Distância*, 2014.