Semantic Web, Reusable Learning Objects, Personal Learning Networks in Health: key pieces for digital health literacy

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Abstract. The knowledge existing in the World Wide Web is exponentially expanding, while continuous advancements in health sciences contribute to the creation of new knowledge. There are a lot of efforts trying to identify how the social connectivity can endorse patients' empowerment, while other studies look at the identification and the quality of online materials. However, emphasis has not been put on the big picture of connecting the existing resources with the patients "new habits" of learning through their own Personal Learning Networks. In this paper we propose a framework for empowering patients' digital health literacy adjusted to patients' currents needs by utilizing the contemporary way of learning through Personal Learning Networks, existing high quality learning resources and semantics technologies for interconnecting knowledge pieces. The framework based on the concept of knowledge maps for health as defined in this paper. Health Digital Literacy needs definitely further enhancement and the use of the proposed concept might lead to useful tools which enable use of understandable health trusted resources tailored to each person needs.

eHealth literacy**,** Personal learning environments in Health, PLE, service user

Introduction

The knowledge existing in the World Wide Web is exponentially expanding, as new knowledge is created by continuous advancements in health sciences. On the other hand the use of technology and the Internet increased throughout the world and among patients as well. It has been identified in 8 member states of the European population that almost half of the population has a poor or problematic level of health literacy [1] while over a third of U.S. and Canadian adults have basic or below basic health literacy [2], [3]. To this extent, around 60% of people in the EU have used the Internet to search for health-related information [4], over 30% of the responders were dissatisfied.

A Personal Learning Network (PLN) can be described as an informal learning network that consists of "a set of connections to people and resources both offline and online", in which "we can learn anytime, anywhere, with potentially anyone around the world who shares our passion or interest" according to Richardson and Mancabelli [5]. The patients' driven online support networks are continuously increasing and play a more

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central role into patients' health care [6]. There are a lot of efforts trying to identify how the social connectivity can endorse patients' empowerment [7], while other studies look at the identification and the quality of online materials [8]. However, emphasis has not been put on the big picture of connecting the existing resources with the patients "new habits" of learning through their own PLN.

Algorithms and models for health-trusted information have been proposed [9], [10], but the acquisition in practice are lacking in terms of how users are searching information. When they are in a dedicated portal they are more likely to work effectively, but when they do it randomly through search engines the information is random.

At the same time, the use of the Reusable Learning Object (RLO) has been proved to be an essential tool for health knowledge acquisition [11] and they can defined as 'interactive, multimedia web-based resources based on a single learning objective which can be used in multiple contexts' [12].

A "knowledge map" may have multiple definitions, but within this paper concept it will rely on the idea of learning dependency or prerequisite knowledge similarly to Gordon [13], that draws on the ideas of what knowledge is and on spatial representation structures. Knowledge representation in the semantic web can be done through ontologies, as the one proposed in mEducator [14] to describe the medical education resources and connection with the Linked Open Data Cloud can be achieved through multiple instances [15].

In this paper we propose a concept framework for empowering patients' digital health literacy adjusted to patients' current needs by utilizing the contemporary way of learning through Personal Learning Networks, existing high quality learning resources and semantic technologies for interconnecting the knowledge pieces.

1. The Fruits in The Basket

A PLN can be considered the most contemporary means of learning for patients since it can provide active collaboration anytime. It encompasses all the possible knowledge that exists on the web following learners' individual way of learning. In order to be achievable and applicable into practice the learner must be a mature learner, be able to perform critique to the offered knowledge and among others (in respect of each individual case) to be able to identify and understand health related knowledge; to create and maintain a supportive network; and to be digital literate. In order to identify the medical knowledge needed the user should know what she is looking for. Is the user able to critique the validity of the information on the resource? Is the resource health trusted? Can the user understand the resource; in what depth? Is there a necessity for prior knowledge in order to understand the resource? How the learner found the prior knowledge? All these questions can lead the user, looking for health trusted information, into an endless loop of information seeking and understanding through their PLN.

Analysing the knowledge for a specific health theme that the user desires to acquire, based on Gordons proposal [13], prior knowledge or supporting knowledge is needed in order to be understandable the desired knowledge. At the same time, knowledge desired can be linked with different resources (educational resources, videos, conversations, forums, tweets etc.) for each one of the learning objectives (Figure 1 A and B). Using the mEducator scheme/ontology we can describe the resources in machine readable way, at least all those created purely for health education.
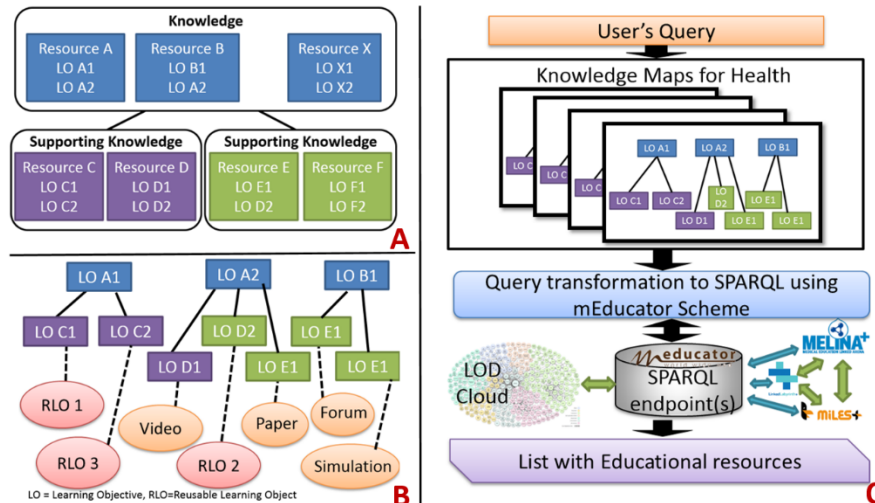
Figure 1. A and B: Knowledge Maps for Health Concept. C: Abstract Framework for Knowledge Maps for Digital Health Literacy (Used LOD cloud diagram 2014, by Schmachtenberg M. et al, http://lod-cloud.net/).

As depicted in Figure 1A, each of the resources may have one or more learning objectives, while some of them might be duplicated and covered from more than one resource. Thus, we can easily result in a knowledge map of learning objectives (Figure 1B). In this knowledge map, the dependences between learning objectives are identified. Each learning objective can be connected with a learning resource through the appropriate mechanisms similar to the proposals in [10], [14]. The big advantage of RLOs is that they have a single learning objective which can be used in multiple contexts and thus they can be reused in many different health themes.

A Personal Learning Network can be enhanced by the use of the "Knowledge Maps for Health". Since PLN is not a specific environment, but an aggregator of tools that the user uses to acquire knowledge, the "Knowledge Maps for Health" could be offered as an additional tool with which the user will be able to signpost to different resources in order to understand the theme/ resource/ dialogue that she selects to read.

Thus, the framework can be utilised in the following steps: Initially, the user performs a query. The appropriate knowledge map is selected and based on its learning objectives a SPARQL Query is formed. This query reaches both the mEducator endpoints, but also the Linked Open Data cloud. A list of resources is returned and the links with a short description is provided to the user. An abstract representation signposting key concepts is depicted in Figure 1C.

1.1. Scenario of Use

Katerina wants to find out what HIV is. The information that she finds out in a web site is saying that "HIV is a virus that attacks the immune system, and weakens your ability to fight infections and disease…". But then she is not sure what an immune system actually means and she looks at Wikipedia. Then it starts to become more complicated because she is not aware of what the differences between the innate immune system and the adaptive immune system are. Thus, she chooses to use the Knowledge Maps for Health app in order to point her out to different resources. She looks for: "what is HIV" and a list of different resources in hierarchical list appears. In this list of resources Katerina selects the links for the one that she does not have the knowledge of.

2. Discussion and Conclusion

In this paper, our aim was not to provide the technical details of such concept, thus we consider a number of other limitations. As with all the tools within a PLN, users must select to use it. Marketing and linking with resources (including networks) that they already use may increase the visibility of the provisional tool. That contradicts with the concept of creating qualitative and health trusted resources (e.g. RLOs). Recent advancement though revealed great acceptability of such resources [11].

Health Digital Literacy is an open research field and despite the fact that a lot of studies already exist there is a continuous need to fill in the uprising gaps. We are aiming to develop the aforementioned concept and test it in order to provide another tool in the PLN of the users. Health Digital Literacy needs definite further enhancement and the use of the proposed concept might lead to useful tools which enable use of understandable health trusted resources tailored to each person's needs.

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