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Sharing notes: An academic social network based on a personalized fuzzy linguistic recommender system

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ABSTRACT

Social networks are Web systems that enable and encourage a collaborative work, making it possible to exchange information between users, which makes them especially useful in many areas. Specifically, they could be used in an academic environment with the aim of improving the educational processes, not replacing, but complementing the most traditional face-to-face models. But nowadays the increasingly widespread use of new technologies and social networks is causing the information we have available to grow disproportionately, making it more difficult and expensive to access information of interest. To alleviate this problem, automatic tools such as recommender systems, could be used to facilitate the accesses to relevant information, that in an academic environment would help to customize the educational processes. So, in this paper we present *SharingNotes*, an academic social network that can generate personalized recommendations to improve teaching and learning processes. To achieve this goal, it incorporates a hybrid recommender system that uses an ontology to characterize the degrees of trust among network users, and adopts the fuzzy linguistic modeling to improve the representation of information. Then, the use of this platform allows adapting the educational process to the circumstances of each student. The evaluation developed demonstrates the usefulness of this educational social network, as well as the users' satisfaction while interacting and working with it.

1. Introduction

The main reasons that govern the new education scenarios involve a reform of the educational system focused on the learning and active role of the students, as well as in building knowledge as the complete integration of information and communication technologies in education systems (Bhattacharya and Nath, 2016; Cobos et al., 2013; Moscoso, 2003; Secades and Arranz, 2016). New technologies enrich the learning process with the capabilities of spreading the information in an easy and efficient manner, besides giving the participants (professors, students, experts, and so on) tools for both personal and group communication that reinforce the tutorship action and the collaborative learning.

In this manner, social networks are one of the Web technologies that facilitate and promote this collaborative work (Capuano et al., 2018). These are defined as Web services that enable the users to set up a public or semi-public profile within a bounded environment, establish a list of users to maintain a connection with, and see and traverse its own list as well as the ones established by other users inside the system (Boyd and Ellison, 2007). To achieve this, and depending on the case, social networks give to the users some tools for building groups, private messaging, public messaging, internal e-mail or chat, among others (Herrera-Viedma et al., 2017). But more significant are the networks that provide information exchange between users, because this made them really suitable for some professional environments (Alonso et al., 2013). For example, these are successfully applied in the corporate world where they are set up as platforms that changes the corporate work strategy following the same open and dynamic way of other sites such as Facebook[1] or Twitter,[2] but specially oriented to encourage interaction, collaborative work, innovation and productivity in business

[1] https://www.facebook.com/.
[2] https://twitter.com/.

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world (Vignola and Encina, 2012). One of the most popular professional social network is LinkedIn,[3] with more than 225 million users.

As aforementioned, collaborative work and social interaction among the educational system users is an important part of the learning process. These characteristics have enabled the teaching field to be another successful field of social networks application (DeHaro, 0000; Limongelli et al., 2015; Mor Mora et al., 2015), taking always into account that the collaborative social learning does not substitute the traditional model, it complements this model. In Mor Mora et al. (2015) it is demonstrated that social networks are more capable of broadcasting information than the classic educational web platforms, enhancing the performance of learning processes. In spite of many people use the general purpose social networks such as Facebook or Twitter, there are specific teaching networks as Edmodo,[4] Ning,[5] or redAlumnos,[6] which maintain in touch all the participants of the education process, and provide the material to develop their full capabilities. Edmodo is a technological, social, educational and free platform that allows communication between students and teachers in a closed and private environment as a microblogging, created for a specific use in education. It is an educational social network that allows to organize contents, make assignments and maintain an active and constant communication and interaction between teachers and students, including parents, thus favoring collaborative learning. Ning is an online platform that allows its users to create social websites and social networks. The most significant feature of Ning is that anyone can create their own personalized social network for a particular issue or need, targeting specific audiences. Many teachers are using Ning to develop educational resources. The features were customized so that participants could upload images and videos of students developing projects as well as links to blogs and Flickr. RedAlumnos is a training platform that connects teachers and students, so that the teacher can teach online courses and support their face-to-face classes. It can also be installed in a teaching center and have virtual classrooms, online exams, edublogs, chats, etc. It has free and paid services.

However, the increment of the Internet usage, specially the social networks, makes that generated content and information in this media increases everyday, in a way that the number of resources we can access is growing daily in an excessive amount. This implies that in order to develop these type of Web tool, we have to face the problem known as *Information Overload*, which can be defined as the inability to extract relevant knowledge from a large amount of information. This problem may also mean having more relevant information than one can assimilate (Meghabghab and Kandel, 2008). This large amount of available information introduces noise into our information access processes, causing us to be unable to access relevant information (Porcel and Herrera-Viedma, 2010; Porcel et al., 2010). For example, every day we receive a large number of emails that are not useful to us, but we also receive emails with information of our interest. The problem is that with so much information we do not pay the appropriate attention to an important mail and we lose information believing that it is something without value. This problem takes on special importance in Web environments such as social networks, where information grows much faster than users are able to process. Specifically, we see it in the field of educational social networks, with an exponential growth in both the number of users and the content they manage, whether messages, forums, groups or the shared teaching materials (Mor Mora et al., 2015).

In this situation appears the need to have automatic tools to help users to access the information, in the correct personalization of their educational processes and to identify collaboration possibilities with other users in similar circumstances, in order to dynamize and improve educational processes. To face this problem recommender systems emerged and have evolved more and more (Burke, 2007; Hanani et al., 2001).

These are tools that facilitate the users the personalized access to information of interest, distinguishing between what can be relevant or not for them. To achieve this goal, recommender systems exploit previous behaviors and similarities between users to predict new needs. They have been applied successfully in many fields, but mostly in e-commerce (Schafer et al., 2007), film tastes, or even to the selective broadcast of researching resources (Tejeda-Lorente et al., 2014) or in educational environments as it is our case (Cobos et al., 2013; Ratneswary and Rasiah, 2014). These systems base their operation on different schemes, according to the specific scope in which they will be applied, emphasizing content-based, collaborative, knowledge-based, demographic or utility-based (Burke, 2007; Lops et al., 2011; Schafer et al., 2007). More recently, trust-based schemes have emerged, extracting knowledge from the social environment of the users (Golbeck, 2005; Lee and Ma, 2016; Park et al., 2016; Wu and Chiclana, 2014; Wu et al., 2015). Also, it has been explored how a social environment can improve the quality of the generated recommendations by the system, but only in certain cases and according to which techniques are analyzed (Bellogín et al., 2013; Deng et al., 2014; Sankar et al., 2015; Sun et al., 2015). Indeed, the collaborative approaches present a good behavior in other cases, so it seems that the ideal thought would be a hybridization between the social and collaborative approaches. And it is precisely the approach we draw in our proposal and we integrate it into our system.

In this paper, we present *SharingNotes*, an educational social network capable of generate personalized recommendations to improve teaching and learning processes. The Web platform has been developed in the University of Jaén (Spain) and it is accessible by the link: http://sharingnotes.ujaen.es/. To customize access to educational resources, it makes use of a recommender system that makes a hybridization between the content-based, collaborative and trust-based approaches. Precisely to characterize the degrees of trust among social network users, an ontology is used, and the method presented in Martínez-Cruz et al. (2015) is adopted to estimate the trust between two users when they have not explicitly valued trust between them. Therefore, the main advantage of using SharingNotes instead of other social networks is that it incorporates a recommender system to personalize the teaching and learning processes and that it has been designed specifically for a university environment. On the other hand, the drawback of this proposal is that until its use is more widespread, we will not obtain a performance of the most appropriate recommendations and really adjusted to the profile of each user.

Finally, we also face the problem of the wide variety of representations and evaluations of information, which is more pronounced when users are part of the process, as is the case at hand. Therefore, we adopt the fuzzy linguistic modeling that will help us to represent and efficiently manage the qualitative information present in the communication processes. Specifically, we integrate in the system the multi-granular approach that gives us greater flexibility in the system-user interaction, because it allows us to manage the information by representing the different concepts of the system with different linguistic label sets (Mata et al., 2009; Morente-Molinera et al., 2017, 2015). In this case, the use of simple granularity would make it difficult for users to interact with the system, by not adapting the number of labels to the degree of user experience or different concepts that must to be assessed.

The rest of the article is organized as follows. In Section 2 we include the necessary preliminaries for the understanding of the rest of the sections. In Section 3 the developed system is presented. In Section 4 we describe the experiments developed to evaluate the system. Finally, in Section 5 the conclusions are presented, and the future work is pointed out.

[3] https://www.linkedin.com/.
[4] https://www.edmodo.com/.
[5] http://www.ning.com/.
[6] http://www.redalumnos.com/.