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Preface Special Issue on Educational Applications on the Web of Data: New trends and perspectives

Education has become a key component of any society since it is the means by which humanity functions and governs itself. It allows individuals to appropriately integrate into a given community. For this reason, new ways of interaction between students and educational contents are emerging in order to improve the quality of education. From this perspective, information technologies are playing an increasingly crucial role in the delivery of digital education, which in turn is driving research into finding ever better technological solutions. The emergence of the Web of Data and its gradual adoption in learning or education related settings has led to the creation of an embryonic “Web of Educational Data” [1] including institutional data from universities, as well as Linked Data about publicly available educational resources. However, while the very nature of the Linked Data approach offers promising solutions that can potentially transform education and learning, adoption and take up is still hindered by issues which are both technical as well interdisciplinary. Under this context, semantic based technologies have emerged to afford a common and standard data model that eases the interoperability, integration and monitoring of knowledge based systems. Furthermore, the Linked Data initiative as practical view of the Semantic Web has posed the baseline technology to easily integrate, enrich and consume data in a distributed/federated system.

In the education domain, knowledge management is becoming critical. From official education resources such as the ones available in Massive Open Online Courses (MOOC) platforms to those available on the web (blog posts, wiki, social network posts, web pages, digital newspaper, etc.), there is an increasing need of organizing, linking, evaluating, searching and suggest educational contents. Moreover and due to this huge amount of information resources, it seems clear the need of establishing levels of confidence, trust and quality on such contents. That is why, some efforts have been done in order to apply and integrate semantic Web technologies to consume heterogenous data sources [2 12]. In this light of elevating the meaning of educational resources, semantic technologies are considered a cornerstone to provide a new user centric and smart environment for Linked Data Education. Ontology models and standards for educational data, visual tools, career plans, curriculum preparation, searching and recommending systems, expertise ranking or e Learning analytics techniques are examples of services that aim to improve and enhance existing e Learning platforms through semantics and Linked Data.

Taking into account the emerging necessity of an intelligent and self aware environment to manage educational resources and the need of providing user centric educational services, this special issue looks for collecting the main approaches for semantic based knowledge management in the context of e Learning as well as the principal methods, techniques and standards for leveraging Linked Data as a key driver of the new Digital and Linked Education ecosystem.

The aim of this special issue was to explore the recent advances regarding the implementation of conceptual frameworks, strategies, techniques, methodologies, informatics platforms and models applying new perspectives for developing educational applications on the Web of Data.

This special issue in the *Telematics & Informatics* (TELE) journal just contains one type of contribution: regular research papers. These works have been edited according to the norms and guidelines of TELE. Several call for papers were distributed among the main mailing lists of the field for researchers to submit their works to this issue. We received a total of 23 submissions which were subject to a rigorous review process to ensure their clarity, authenticity, and relevance to this special issue. At least three reviewers were assigned to every work to proceed with the peer review process. Seven papers were finally accepted for their publication after corrections requested by reviewers and editors were addressed. The seven regular research papers introduce new and interesting results in the form of theoretical and experimental research and case studies under new perspectives for developing educational applications on the Web of Data.

The special issue opens with a research paper entitled *An Evolutionary Approach for Personalization of Content Delivery in eLearning Systems based on Learner Behavior Forcing Compatibility of Learning Materials* where Christudas et al. presents an evolutionary approach for personalizing learning content for individual learners from a very large database in an e learning system. The proposed work improves the quality of the self learning process in an adaptive e learning system by providing the most suitable content for individual learners. The paper depicts the results of personalizing the learning process by tuning the compatibility level of the learning objects with respect to the learning style of the learner, the complexity level of the learning objects with respect to the knowledge level of the learner and the interactivity level of the learner based on the satisfaction level of the learner during the learning process using a modified form of genetic algorithm named as Compatible Genetic Algorithm (CGA). The proposed work improves the efficiency of the genetic algorithms by forcing compatibility in the learning objects which has not been implemented so far in existing systems. Forcing compatibility into the search space not only helps to reduce the search space but also fills the search space with better chromosomes. The results show improvement in scores of the learners and also in their satisfaction levels.

In the second contribution, entitled *Hybrid Occupation Recommendation for Adolescents on the Interest, Profile, and Behavior*, Ochirbat et al. implemented a hybrid recommendation system called Occupation Recommendation (OCCREC) that integrates content based and collaborative filtering methods. They involved three sets of information including student's profiles, vocational interests from the questionnaire using Holland code, and their behaviors. The student profile contains two types of data, namely, background and interest/hobby retrieved from Facebook. In the experiment, the students from four countries consisted of Mongolia, Sri Lanka, Taiwan, and Thailand used the OCCREC. Five occupations were shown to the students by using five similarity measures which were Euclidean, Intersection, Cosine, Jaccard, and Pearson. Finally, OCCREC allows students to rate the results accordingly based on user's satisfied scores and to share their experiences on Facebook.

In the third paper, entitled *Teamwork assessment in the educational web of data: A learning analytics approach towards ISO 10018*, Conde et al. discuss how Web of Data is an emerging research field that contributes to make better decisions because it gathers, combines and analyses different data sources available worldwide. This idea has been used to improve a learning analytics tool. By means of this tool, teachers can perform teamwork competence assessment of a group of students taking into account how the individuals acquire the essential components of such competence. In this sense, authors use the Comprehensive Training Model of the Teamwork Competence in Engineering Domain (CTMTC) method to gather competence evidences and improve the system with a learning analytics tool to support the process. This tool is able to transform competence evidences and stores them in a competence ontology built upon ISO 10018 concepts. The final result is the production of educational results for the web of data.

In the fourth contribution, entitled *Gamification for Enhancing Web 2.0 Based Educational Activities: The Case of Pre Service Grade School Teachers using Educational Wiki Page*, Nesrin Özdener presents a study that seeks to uncover the effects of using gamification elements in courses that make use of a Wiki environment on the participation rates of undergraduate students in Wiki based course activities as well as on student academic success in the course. Owing to the fact that the group of students chosen for the study consisted of pre service grade school teachers, their opinions on the use of the Wiki environment along with its embedded gamification elements in their future careers have been sought.

The fifth paper, entitled *System for Recognizing Lecture Quality Based on Analysis of Physical Parameters*, Uzelac et al. describe a smart classroom system that is able to classify students' satisfaction with the lecture quality by examining parameters of the physical environment obtained using different smart devices. The system is based on the Random forest classifier, which showed the best accuracy among all machine learning algorithms available in Weka tool, with dataset collected during 28 lectures and evaluated using 10 fold cross validation. The system is implemented using different set of tools (such as Matlab and Weka) and can extract features from the ambient sound and analyze values obtained from different smart devices deployed in the classroom. Based on the extracted and captured data the system provides in real time information about the students' satisfaction with the lecture quality.

The sixth contribution, entitled *Prerequisites between Learning Objects: Automatic Extraction based on a Machine Learning Approach*, Gasparetti et al. introduce a general purpose content based approach for identifying prerequisite relationships among learning materials. The proposal is based on a feature based representation of the learning materials based on the extracted text content and weak taxonomies publicly available on the web. A machine learning based approach performs the binary classification of each pair of learning objects given as input. The accuracy of the approach was validated by means of an experimental evaluation on real online courses covering different subjects, where the average precision stood at 28% above the performance obtained by similar approaches in the literature.

The last paper, entitled *An Affective and Web 3.0 Based Learning Environment for a Programming Language* is by Zatarain Cabada et al. They present a Web based Environment for learning Java Programming that aims to provide adapted and individualized programming instruction to students by using modern learning technologies as a recommender and mining system, an affect recognizer, a sentiment analyzer, and an authoring tool. All these components interact in real time to provide an educational setting where the student learn to develop Java programs. The recommender system is an e learning 3.0 software component that recommends new exercises to a student based on the actions (ratings) of previous learners. The affect recognizer analyzes pictures of the student to recognize learning centered emotions (frustration, boredom, engagement, and excitement) that are used to provide personalized instruction. Sentiment Text Analysis determines the quality of the programming exercises based on the opinions of the students. The authoring tool is used to create new exercises with no programming work.

Last but not least, we would also like to express our gratitude to the reviewers who kindly accepted to contribute in the evaluation of papers at all stages of the editing process. We equally and especially wish to thank the Editor in Chief, Jan Servaes for granting us the opportunity to edit this special issue and providing valuable comments to improve the selection of research works.

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