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Contributions of Ontology's and Utilities of Interoperability in E_Learning Systems

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ABSTRACT

E-Learning is an important pedagogical advance, it uses the Web as a support for dissemination of knowledge and interaction between the different actors of E-Learning. Several learning platforms have been developed and several are available on the open access web. Indeed, a learning system using an LMS (Learning Management System), a VLE (Virtual Learning Environment) or equivalent (with a front office and a back office present) is used and must allow to follow the "electronic course" of the learner. These systems are compatible with technical and pedagogical standards of interoperability. Thus, because of the development of computer systems a great disparity of types of hardware and software has appeared. These systems can only interact if they have a common perception of information. This aspect makes it necessary to take into account the interoperability that is also present in the databases. This aspect makes it necessary to take into account the interoperability that is also present in the databases. It consists of acquiring and integrating information, data and services from heterogeneous databases. This heterogeneity occurs for example when databases are implemented by different models, be they relational, hierarchical, etc. Indeed, since these platforms also offer communication tools, assessment tools, and the possibility of depositing educational resources. In this context, ontology's have a primary role to play as an intelligence enhancer for knowledge sharing and reuse. This thanks to the computer mediation for the dissemination of knowledge between the different actors. In this work, we will focus on the contributions of ontologies for the description of learning preferences by considering the different aspects of interoperability in E-Learning.

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Introduction

E-learning systems are an important educational advance. It uses the Web (hypertext structure, multimedia capabilities, etc.) as a support for knowledge dissemination and interaction between the different actors (teachers, learners, tutors, administrators, ...). Several e-learning platforms have been developed and several are available on the open access web. These platforms are environments that allow a teacher to easily create and manage learning situations on the Web, leaving him free choice of models, strategies and methods that are on the educational side that that of learning. They also offer synchronous or asynchronous communication tools (videoconferencing, discussion forums, chat, e-mail, document transfer, etc.), evaluation tools (tests, exercises, surveys, works, ...), and the possibility of depositing educational resources (PDF files, video sequences, ...).

This requires us to take into account the heterogeneity of the different information systems used. Indeed, systems generally need to communicate, exchange information and resources in the form of programs, data or services. The field of e-learning is one of the largest research areas currently undertaken mainly in Artificial Intelligence (AI) and Information Systems (IS). The field in general, is supported by SI which are structured especially around the formations, in order to support the storage, the access, the diffusion and the sharing of information relative to the various actors of the educational act. The information comes from many heterogeneous and distributed sources, produced and managed autonomously by different institutions. In this sense, two points to consider ontology's and interoperability.

Indeed, ontology's play an important role in knowledge-based systems. In addition to reuse and sharing of knowledge, they facilitate communication that can take place between people and / or systems in different organizations. In particular, they enable the achievement of interoperability between different systems (Mellal, 2007). Thus, ontology's then allow the sharing of understanding

and communication in particular contexts and according to needs. So, we can use the ontology to create a network of relationships that defines the connections between system components. This communication characteristic is offered thanks to the unambiguous terms used. Ontologies help to facilitate the understanding and interpretation of information exchanged, presenting themselves as an exchange format. So, Interoperability occurs when different organizations need to communicate and exchange information in order to achieve a given goal.

The work presented in this article focuses on the contributions of ontologies in e-learning systems and at the same time identifies the important role played by interoperability to make different systems work together. To address our research, our work will be divided into three blocks, provide an overview on e-learning systems, show the usefulness of interoperability in e-learning systems and justify the contributions of ontologies in e-learning systems.

E-Learning Systems

E-learning is "the use of new multimedia technologies on the Internet to improve the quality of learning by facilitating access to resources and services on the one hand, on the other hand exchanges and remote collaboration "(European Commission, 2001). E-learning is part of Information and Communication Technologies for Education (ICT) and allows non-face-to-face activities. This is most often the use of computers or mobile devices (smartphones, tablets, PDAs, etc.) connected to the Internet. E-learning is especially suited for developing cognitive skills, and with specific methods, interpersonal skills. The e-learning training can be done in self-learning (digital learning tutorial) or be conducted by a facilitator (chronological syllabus). The facilitator (s) have a major role in planning activities and facilitating training activities for participants. They use two groups of communication tools. Asynchronous (time-independent) tools that correspond to the use of e-mail, discussion forums, wikis, and shared publishing, blogging, and webcasting tools. Synchronous (real-time) tools that correspond to live contact times through instant messaging, polls, interactive whiteboards or screen sharing, application sharing tools, audio conferencing, and more. video, live webcasting. E-learning can be structured according to a sequence of different sessions or customized according to the profile of the participant. Similarly, they use evaluation tools (tests, exercises, surveys, work, ...), and the possibility of depositing educational resources (PDF files, video sequences, ...).

Three essential concepts to define for e-learning systems: an educational object, a user profile and a training platform.

An educational object, or Learning Object (LO), is defined as "any entity, on a digital medium or not, that can be used for teaching, learning, and training". For Bourda and Helier, they gave examples of the object of pedagogical such as: "pedagogical objects can be, for example, transparencies, course notes, web pages, simulation software, training programs. teaching, educational objectives, etc. " (Bourda and Helier, 2000). An educational object can be reused for different purposes. For example, an exercise can be used in a series of tutorials only as part of a review.

A user profile is a collection of persistent data that characterizes a particular user or group of users. Such a model may contain characteristics about a user's knowledge, preferences, interests (Tamine et al, 2007).

A training platform is software that assists the conduct of distance learning. It is based on collaborative work techniques and includes the necessary tools for the three main actors of training: learner, teacher and administrator. A platform uses means of work and communication: videoconferencing, e-mail, forums, chats, etc.

The use of these systems is relatively standard, the teacher creates training paths, incorporates teaching resources and monitors the activities of learners. The learner can consult online or download the educational content, perform exercises, self-evaluate and carry out work to be transmitted to the teacher to evaluate them. Learners and teachers communicate individually or in groups, and can create discussion topics. The administrator, for his part, manages and maintains the system. Today there are several choices regarding free training platforms such as Moodle, Ilias, Dekios, Claroline Connect, ... (Brunel et al, 2016).

E-Learning Systems and Interoperability

Our work context is more specifically based on the transfer, sharing and exchange of data in the form of knowledge and skills. It is to support learners (students, civil servant, ...) in initial training or continuing education in completely heterogeneous environments. What motivates us in our work is that the majority of the research work and projects concerning the development of training courses are aimed at developing standards and reference architectures for specific learning activities, according to each field, discipline and each specialty in order to achieve interoperability. It is difficult, if not impossible, to use the architecture adopted by a project or a given job in a new project or job, if they are targeting a different activity. Training systems are constantly evolving, they take many different forms. For example, we take initial training systems and distance learning systems. These two training systems are different by their stake holders, their roles and their activities. It is also about the diversity of information exchanged. Another motivation is the essential need for interoperability of information systems in training by safely exchanging and increasing the coherence and quality of the data and the various services offered, and by considerably reducing the different forms heterogeneity.

For example, computer interoperability or inter working is the ability of a computer system to operate with

other existing or future computer products or systems without access or enforcement restrictions. Both terms are standardized by CSA and the International Electrotechnical Commission. Indeed, according to the marketing dictionary of journaldunet.fr, interoperability is a computer term designating systems capable of adapting and collaborating with other independent systems already existing or still to be created. This compatibility capability makes it easy to create a network and transfer data from different programs. Interoperability is used in both telephone networks and computer networks. Its purpose is to enable different systems, software, protocols and hardware to work together despite their differences, and share information easily without any compatibility concerns. A capacity more and more sought after by users and companies. Four types of interoperability to be considered (ISO / IEC 2382-18, 1999):

• ***Organizational interoperability*** (knowing how to share) is about business process modeling to take into account collaboration between departments that do not have the same structures and do not manage similar processes;

• T***echnical interoperability*** (ability to communicate) concerns aspects related to the connection of systems, the definition of interfaces, the integration and consolidation of data, the middleware layer, etc .;

• ***Semantic interoperability*** (knowing how to understand each other) to ensure that the exact meaning of the information exchanged can be understood by any application that was not necessarily initially designed for that purpose. (Emergence of the XML standard);

• ***Syntactic interoperability*** (knowing how to communicate) concerns the way in which the data are coded and formatted by defining in particular the nature, the type and the format of the messages exchanged, It leads to the notion of an open system allowing to assume the heterogeneity of the components.

Indeed, in the context of e-Learning technology, standards are usually developed for use in the design and implementation of systems to ensure interoperability, portability and reuse. These attributes apply to the systems themselves and the content and metadata they manage. E-Learning standards are generally multi-part and typically consist of a "data model" data model that specifies normative content in abstractions, one or more "bindings" that specify how the data model is expressed formally, often in XML and an application programming interface (API) or service definition (service definition) that defines the points of contact between the systems that cooperate.

In conclusion, e-Learning and interoperability of user activity data allows for many important use cases, for Universities, businesses and organizations requiring the combination, integration and analysis of data. through several systems, allowing offline learning with possible synchronization, or the use of third-party authoring tools.

E-Learning Systems and Ontology's

The smooth running and functioning of an e-learning system requires us to take into consideration needs such as the need for archiving and research, the need for sharing, the need for customization and adaptation and the need for re-use of educational objects. In this paragraph we will try to define all of these needs and at the same time mention the contribution of ontologies in the proper functioning of these needs.

Regarding the ***need for archiving and research***, given the diversity and exponential growth of educational resources used in the context of e-learning training, it is increasingly difficult to find the relevant educational documents. An e-Learning application therefore shares the same problem of relevance with the Web when learners want to access the knowledge at their disposal (Benayache, 2005). Indeed, the approach based on the search for information in the resource itself is limited, on the one hand, by the absence of certain information that is not generally contained in the resource and, on the other hand, by the multimedia nature resources because most image or sound resources do not contain textual information. This prompted the e-learning community to agree to use metadata. Metadata provides a common set of tags that can be applied to any resource, allowing organizations to describe, index, and search their resources. This can be justified by taking into account the semantic web perspective, which is becoming a foundation for distance learning environments, ontology's specifically offer rich semantics, better than any other method of representing knowledge. already known. Thus, in a problematic of finding educational content on a teaching platform, relying on the conceptual vocabulary defined in an ontology can help to improve the precision of this research by avoiding ambiguities at the terminological level and by authorizing decreasing inferences. noise and increasing relevance. In conclusion of the need for archiving and research, we note the need for metadata based on ontology's (FORTIER, 2001).

Concerning ***sharing needs***, the problem of common understanding in e-learning arises on several orthogonal levels that describe the different aspects of use of documents. Two cases to consider when creating content and accessing and searching for content by a user. For the creation of the content, the probability that two content authors express the same concept differently is very high. In other words, everyone can provide the content but using different keywords. For the access and search of the content by a user, there is a problem concerning the keywords to be used to search the learning material (Boutemedjet, 2004). Indeed, the construction of an ontology is done by way of consent, and thus represents the understanding shared a priori of a group or community, instead, as is the case in most systems, to rely on a meaning given by some individuals or by an authority, to which all must adjust (Psyché et al, 2003). As a result, providers of learning

content and learners will be on the same wavelength (a common vocabulary) and can better share the material. In conclusion of the sharing need, the emergence of a need for a common vocabulary based on ontology's.

Concerning ***the need for re-use of pedagogical objects***, in view of the increasing volume of pedagogical documents available on the Web, few pedagogical objects are reusable. The search and selection of relevant text fragments, figures, exercises, from a document whose purpose for reuse in a new document has become almost impossible, therefore it is necessary that the designers of the documents pedagogies have at their disposal a means of rapid and flexible access to relevant pedagogical objects. Indeed, an educational document must be indexed according to a domain ontology and an educational ontology. Concerning the first ontology, the pedagogical document domain indexing aims at indexing by the concepts of the domain the fragments that refer to it. Domain ontology can reuse models already made, build coherent courses from the same set of concepts. Concerning the second ontology, indexing according to the pedagogical point of view makes it possible to associate to the pedagogical object an objective, a type of learning task, a teaching operation, etc. An educational ontology makes it possible to mark and reuse pedagogical objects presenting educational properties already listed. In conclusion of the need for reuse of pedagogical objects, we note the need for the indexing of ontology-based pedagogical documents.

Regarding ***the need for customization and adaptation***, an e-learning system is intended for a community of users who do not have the same expectations, knowledge, skills, interests, etc. They are able to understand or accept only documents whose organization, content and presentation are adapted to their needs. Indeed, the indexing of educational documents must take into account the characteristics of the users, in order to be able to provide for each one the content that corresponds to their profile (Ghebghoub et al, 2006). Similarly, in conclusion for the need for customization and adaptation, we note the need for an ontology that took into account the characteristics of users.

Before concluding, we quote in this section three examples of the use of ontology's in e-learning training systems:

• ***The Self-Learning Networks*** (SeLeNe) project is studying the feasibility and design of a tool to meet the needs of communities (Teachers and Learners) in web-based learning. The SeLeNe project takes documents (DocBook) as input and transforms them into learning objects (OA), then it offers services for the discovery, sharing and collaborative creation of these objects, which facilitates a unionized and personalized access to these resources Learning Object Metadata Descriptions (OA) and associated schemas form the information directory where users can make queries to locate resources appropriate to their learning or teaching needs. Users also need to define custom views on this wide range of heterogeneous data (Keenoy et al., 2004, Zouaq et al, 2007).

• ***The Trial-Solution*** project consists in its general approach to cutting out e-books into elementary teaching resources and then refining this division and annotating the resources with metadata on their semantic contents, their pedagogical characteristics and their interrelations in the objective to allow a search saying smart. All annotated resources are available on a Web server dedicated to teachers and learners. Resource search and document publishing tools have been developed to allow these end users to search the server. The Trial Solution platform integrates three main services. The automatic retrieval and annotation of educational resources from e-books, the re-engineering of retrieved educational resources, and the search of the repository of resources thus constituted, based on semantic annotations of resources (Buffa et al, 2005).

• ***The ontology-based ALCOM*** (Abstract Learning Object COntent Model) project has been developed to facilitate interoperability between some existing models (Leamativity, dLCMS, PaKMaS, and SLM). Some models have been analyzed and mapped to the ALOCOM generic model. This method has three main steps. The first concerns the implementation of a global ontology that covers existing models, the second concerns the implementation of a local ontology for each model, and the third step concerns the definition of correspondences between ontology's. The correspondences established between the ontology's (global and local) can allow the sharing and reuse of the learning objects through the warehouses of learning objects (Verbert, 2008).

As a conclusion to this part, which deals with the different needs of e-learning systems, we can confirm the contribution of ontology's in the different needs of e-learning systems, whether in archiving, research, sharing or reuse. customization and adaptation of different educational objects. Indeed, ontology's play an important role in knowledge-based systems. In addition to reuse and sharing of knowledge, they facilitate communication that can take place between people and / or systems in different organizations. In particular, they enable the achievement of interoperability between different systems (Mellal, 2007). Thus, ontology's then allow the sharing of understanding and communication in particular contexts and according to needs. Thus, the ontology can be used to create a network of relationships that defines the connections between system components. This communication characteristic is offered thanks to the unambiguous terms used. So, ontology's help to facilitate the understanding and interpretation of information exchanged, presenting itself as an exchange format. So, Interoperability occurs when different organizations need to communicate and exchange information in order to achieve a given goal.

Conclusion

As a conclusion of this work, we presented an overview of the e-learning systems, we defined the concepts, pedagogical object, user profile and platform. Then we showed after proposing a definition of interoperability and defining the role of each type of interoperability, the different roles played by interoperability for business process modeling, the aspects related to the connection of systems , the exact meaning of the information exchanged and the way in which the data are coded and formatted between the different systems and in particular the e-learning systems. We presented the various contributions of ontology's concerning the different needs of e-learning systems in archiving, research, sharing, reuse, customization and adaptation of different pedagogical objects. Similarly, three e-learning projects have been mentioned, based on ontology's. In perspective of our work taking into consideration the characteristics and the advantages that the ontology's present on the one hand and the interoperability on the other hand, we will try to extend our research the exploitation of ontology's for the construction of a shareable vocabulary for annotating and searching educational documents.

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