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The Agent Based Modeling to represent the OER

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ABSTRACT

Within this paper we focus on the representation of open educational resources based on the agent-based modeling. The open educational resources (OER) concept is introduced as well as the agent-based modeling approach (ABM). We then propose to represent an OER by an agent and to take into account some properties such as its dynamic aspect and its behaviors. An agent structure in then introduced based on the modeling of learning objects.

Indexing terms/Keywords

Open educational resources, agent, agent-based modeling, behavior, learning object.

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INTRODUCTION

The concept of 'Openness' is based on the idea that knowledge should be disseminated and shared freely through the Internet for the benefit of society as a whole (Yuan, 2008). The Open Educational Resource (OER) movement is part of a global effort that began in 2001 when the Hewlett and the Andrew W. Mellon foundations jointly funded MIT OpenCourseWare (OCW), the first institution committed to making all of its course materials freely available (Hylén, 2006), (Ossiannilsson, 2012). Since then, more and more additional institutions have launched OpenCourseWare Web. The OER are generally deposited into repositories, corresponding to digital databases that house these learning content. Through these repositories, OER are rendered accessible to learners and instructors on the World Wide Web (McGreal, 2010). Much of the scholarly discourse around OER has focused on non technological issues like legal aspects around licensing, the moral imperative of sharing educational materials for the benefit of individuals in developing nations, etc (Duval, 2011). These OER are represented in different ways (Okada, 2012), (GLOBE, 2011), however, their assumption that content and tools can be freely revised, remixed, and redistributed creates new opportunities and challenges not present in many works (Duval, 2011). To associate these properties and others to an OER profile, we propose to use an Agent-Based Modeling concepts (ABM) approach by matching the OER specificities to an agent (Macal, 2010). At the beginning of this paper the OER concept is presented, then the principles of the agent-based modeling are introduced. The proposition of using the concept of ABM to match the OER is then introduced.

THE OPEN EDUCATIONAL RESOURCE (OER)

Definitions of the Open Educational Resources (OER)

There is no authoritatively accredited definition for the term Open Educational Resources (OER) (Hylén, 2006), (Jisc, 2012); the most often used definition of OER is, "digitized materials offered freely and openly for educators, students and self-learners to use and reuse for teaching, learning and research (Hylén, 2006), (OECD, 2007). OER are also defined as reusable digital materials offered for free and intended to facilitate teaching and learning for educators, students and self-learners (Issack, 2011). The term OER may also be used to refer to learning materials such as learning objects (quizzes, crossword puzzles, flashcards, animations, etc.), or audio lectures, or images, or entire course content and open courseware, etc. One of the hallmarks of OER is their flexibility, many are modular in nature, allowing them to be used in novel combinations to suit particular learning activities. They can be adapted to keep pace not only with new technologies but also with changes to academic disciplines and teaching methods. Depending on the resource, these updates might be made by the creator or by the users of the resource. These learning contents are generally offered under a copyright license granting permissions for users to engage in the "4R" activities: reuse, revise, remix, and redistribute. Most of the definitions agree that OER include content, software tools, licences and best practices (Unesco, 2009).

Describing the OER

According to Duval (Duval, 2011), much of the scholarly discourse around OER has focused on non technological issues like legal aspects around licensing, the moral imperative of sharing educational materials for the benefit of individuals in developing nations, etc. Unlike its conceptual predecessor, the learning object (LO), relatively little attention has been paid to the technical aspects of the OER and few projects deal with the technical aspects that do or should underpin the open educational resources movement (Duval, 2011). This is partly because those working in the OER area have inherited a rich body of technical work from learning objects researchers. However, the OER assumption that content and tools can be freely revised, remixed, and redistributed creates new opportunities and challenges not present in prior learning objects work (Duval, 2011). Currently, the most relevant standards for describing learning objects are "Learning Object Metadata" (LOM), "Dublin Core", and "MPEG-7" (Duval, 2008). The IEEE Learning Object Metadata (LOM), published by the IEEE in 2002, is a hierarchical metadata standard usually encoded in XML (Duval, 2008). Its purpose is to enable the description of (LO) through attributes that include the type of object, author, owner, terms of distribution, and format, as well as pedagogical attributes, such as typical learning time or interaction style (Duval, 2008). LOM is based on early metadata schemes that were developed by the ARIADNE Foundation and the IMS Global Learning Consortium (IMS, 2001), (Duval, 2010). The other LO's standard is the Dublin Core (DC) (DC, 2005), it is a standard for generic resource descriptions. The simple DC metadata element set consists of 15 elements, including title, creator, subject, description, publisher, contributor, date, type, format, identifier, source, language, relation, coverage, and rights (Duval, 2010). The MPEG-7 is an ISO standard for describing multimedia content. MPEG-7 Multimedia Description Schemes are metadata structures in XML that facilitate searching, indexing, filtering, and access (Martínez, 2002). Thereby the spread of OER creates substantial educational opportunities, but also reveals challenges that require further work in order to reach their full potential (Dillenbourg, 2008), and the technical aspect of the OER is one of these challenges. Learning resources need to be searchable across repositories, and it must be possible to download, integrate and adapt them across platforms (Hylén, 2006), (Yuan, 2008). Core to technical innovations in OER is the need to simplify the user experience across the entire range of OER activities, from access to use reuse and creation (Yuan, 2008). Therefore, it is important to provide flexible, extendable platforms and easily adaptable open tools to access, use, reuse, create and post content to the Web.

For that reason, much of the OER motive is about evolving infrastructure for enhanced content creation and use of infrastructure for accessing digital content. In addition, higher education syllabi continually evolve to accommodate new courses and OER may contribute to reduce the impact of these frequent updates. It would be advantageous to locate these OER and to integrate them into courses. Thereby, the OER assumption that content and tools can be freely revised, remixed, and redistributed creates new opportunities and challenges not present in prior learning objects work (Duval, 2011). According to Campbell (Campbell, 2010) a crucial factor is the production of material that can easily be reused in other contexts and cultural settings and that re-usability should be a critical factor in the planning of all OER (Ossiannilsson, 2012). Campbell (Campbell, 2010) also indicates that one major barrier to the mainstream adoption of OER is the lack of a consistent structure for tagging and classifying resources. There is a vast wealth of resources available but they often lack information on vital factors such as educational level, prerequisites, context, related material, learning outcomes, etc (Ossiannilsson, 2012). Campbell indicates that there are still no satisfactory tools for searching video and audio material apart from searches by title and some basic attributes (Campbell, 2010). On the other hand one recurring concern amongst teachers is the difficulty in finding relevant material and the lack of precision in most search engines for OER (Campbell, 2010). Recently, in 2012, UNESCO has launched the biggest international event for Open Education, the OER World Congress, aimed at creating awareness on policy, governmental, institutional and user level. The main outcome was a global recommendation to governments and institutions: "The Paris OER Declaration and its Implications" (Unesco, 2012). This Declaration recommends facilitating finding, retrieving and sharing of OER (Pawlowski, 2012). Among the recommendations of this Declaration, Pawlowski (Pawlowski, 2012) mentions "Encourage the development of user-friendly tools to locate and retrieve OER that are specific and relevant to particular needs. Adopt appropriate open standards to ensure interoperability and to facilitate the use of OER in diverse media.". Other organizations are also working in the same direction like the "Joint Information Systems Committee" (JISC), a British board whose role is to advocate the use of digital technology to ensure that UK remains world-class in research, teaching and learning (Jisc, 2012). JISC's committee conducted a project on the OER Impact Study to explore the use of open educational resources in UK universities (Masterman, 2011), and this project's recommendations are similar to those mentioned above. This research report encourages continuing to support the development of technologies to improve the discoverability of OER produced by universities (Masterman, 2011). Bates (Bates, 2011) shares also these recommendations and indicates that a crucial factor for the OER is the production of material that can easily be reused in other contexts and cultural settings and that re-usability should be a critical factor in the planning (Ossiannilsson, 2012). He argues that "All too often we see resources that are simple fly-on-the-wall recordings from a specific situation and no thought has been devoted to secondary use" (Bates, 2011). Bates also mentioned that open resources should be easily adaptable to different contexts, for example by producing shorter clearly tagged lecture modules rather than a one-hour continuous lecture (Bates, 2011). Therefore, the concept of OER will be ideal if it is endowed with some properties when it is stored in a repository (Bates, 2011). An open educational resource should be uniquely identifiable and have attributes that allow it to be distinguished from and recognized by the others (Macal, 2010). An OER should also be able to function independently in its environment and in its interactions with other OER, at least over a limited range of situations. An OER should also have behaviors that relate information sensed by another OER to its decisions and actions. An OER can have a state that varies, the OER's behaviors may be conditioned on it. Thus an OER should have protocols for interaction with the others, such as for communication, its content's updating, the capability to respond to the environment, etc. An OER should also have the ability to recognize and distinguish the traits of other OER. OER may be heterogeneous and may also be endowed with different amounts of resources or accumulate different levels of resources as a result of OER interactions, differentiating OER further. To associate these properties and others to an OER profile, we propose to use an agent-based approach by matching the OER specificities to an agent.

THE AGENT BASED MODELING

The concept of Agent

According to Macal (Macal, 2010), the different definitions of the term "agent" have many points in common. Some of them consider that an "agent" is any type of independent component (software, model, individual, etc.). The behavior of this independent component can range from primitive reactive decision rules to complex adaptive artificial intelligence. Others consider that a component's behavior must be adaptive because the agent label is reserved for components that can in some sense learn from their environments and change their behavior in response. According to Jennings the fundamental feature of an agent is the capability of the component to make independent decisions (Macal, 2010). This requires from agents to be active rather than purely passive (Macal, 2010). Abdou et al. (Abdou, 2012) indicate that agents are conventionally described as having four important characteristics:

- Perception: agents can perceive their environment, including other agents in their vicinity.

- Performance: they have a set of behaviors that they are capable of performing such as moving, communicating with other agents, and interacting with the environment.

- Memory: agents have a memory in which they record their previous states and actions.

- Policy: they have a set of rules, heuristics or strategies that determine, given their present situation and their history, what they should do next.

Abdou et al. (Abdou, 2012) claim that agents with these features can be implemented in many different ways. Nevertheless, every agent design has to include mechanisms for receiving input from the environment, for storing a history of previously input and actions, for devising what to do next, for carrying out actions and for distributing outputs (Abdou, 2012).

The concept of agent-based modeling ABM

According to Abdou et al. (Abdou, 2012), an Agent-Based Modeling (ABM) is a computational method that enables a researcher to create, analyze, and experiment with models composed of agents that interact within an environment. A model is a simplified representation of a "target" system that expresses as clearly as possible the way in which that system operates (Abdou, 2012). This representation can take several forms such as equation, a graphical network, etc. The computational methods, such as agent-based modeling, involves building models that are computer programs. The program represents the process that are thought to exist. For example, in the social world we might build a model to study how friends ("agents") influence each other's purchasing choices. For Borrill, in the ABM approach, systems are modeled as collections of autonomous interacting entities ("agents") with encapsulated functionality that operates within a computational world (Borrill, 2010). Macal (Macal, 2010) presents the Agent Based Modeling and Simulation (ABMS) as a new approach of modeling complex systems composed of interacting, autonomous 'agents'. Macal (Macal, 2010) considers that agents have behaviors, often described by simple rules, and interactions with other agents, which in turn influence their behavior (Macal, 2010). By modeling agents individually, the full effects of the diversity that exists among agents in their attributes and behaviors can be observed as it gives rise to the behavior of the system as a whole. Macal also argues that by modeling systems from the 'ground up'—agent-by-agent and interaction-by-interaction—self-organization can often be observed in such models. Patterns, structures, and behaviors emerge that were not explicitly programmed into the models, but arise through the agent interactions (Macal, 2010). The emphasis on modeling the heterogeneity of agents across a population and the emergence of self-organization are two of the distinguishing features of agent-based simulation as compared to other simulation techniques such as discrete-event simulation and system dynamics (Macal, 2010). According to Macal (Macal, 2010) a typical agent-based model has three elements: a set of autonomous agents, a set of agent relationships and methods of interaction, and the agents' environment. A model developer must identify, model, and program these elements to create an agent-based model. There is a variety of approaches to designing and implementing agent-based models, but according to Macal (Macal, 2010), bottom-up, highly iterative design methodologies seem to be the most effective for practical model development. Modern software (and model) development practices dictate that model design be independent of model implementation. That is, a good software (model) design should be able to be implemented in whatever computer language or coding scheme is selected. Macal (Macal, 2010) proposes a series of questions that should be asked when developing an agent-based model, their answers will lead to an initial model design. These questions are introduced in the next section to examine the adaptability of the OER to an ABM.

ABM TO REPRESENT THE OER

To respond to the characteristics of the ideal OER proposed above in the paragraph (Describing the OER), we propose to use the concept of the ABM to represent the OER. The idea is to match the OER with agents having interactions that may be used to compose an entire course, or to select a resource, or even to be informed by its different updates, etc. As Macal (Macal, 2010) proposes we will answer his questions, in Table 1, to have an initial model design of our approach.

Table 1. Macal's questions for the initial model design

Macal questions	Our Answers
1. What specific problem should be solved by the model?	In our problem, an OER should be able to act autonomously and also to interact with others. Every OER should be able to introduce itself when it is invoked by users or by another OER (a single OER, a courseware, etc). An OER is a dynamic entity as it can be updated by different users. Each OER should be able to undergo updates. How to illustrate this dynamicity as well as the behavior's autonomy?
What specific questions should the model answer?	The model should answer: how to simulate an OER behavior ?
What value-added would agent-based modeling bring to the problem that other modeling approaches cannot bring?	Essentially the dynamic aspect and the behavior's autonomy. In the current modeling approach there is no communication between the OER. In the ABM approach, if an OER, corresponding to a course, needs to integrate some OER, it can interact with them. It can ask its neighbors about their goals for example. This is possible because an agent has a memory and a specific behavior.
2. What should the agents be in the model?	An agent corresponds to an OER
Who are the decision makers in the system?	The manager of the repository if we suppose that these OER are stored in a repository as well as students, teachers, researchers

What are the entities that have behaviors?	Every agent or OER has a behavior which depends on its type, its interlocutor (neighbor), the required action, etc. For example an entity corresponding to a course may have a behavior corresponding to "include". This may allow an OER to include one or more OER in its content. For example a mathematical course concerning "Matrix calculation" may include an OER concerning calculation of matrix determinant. This inclusion is based on the OER interactions. Then an OER may have a behavior allowing it to ask the other OER and to explore the answer. This is different from an object oriented modeling approach because the agent's relationship are not permanent. In fact a relationship between two OER is not hierarchical and it is not related to a type.
What data on agents are simply descriptive (static attributes)?	We propose to describe an OER by using a set of attributes based on those proposed by Globe and by JISC as detailed after this table.
What agent attributes would be calculated endogenously by the model and updated in the agents (dynamic attributes)?	Dynamic attribute in that they have a behavior, or specifying multiple URL corresponding to the OER's versions. An OER corresponding to a course may also add other OER to itself.
3. What is the agents' environment?	The agents environment can be a LMS, a (.ppt) presentation, a simple text, a repository, a web engine, or even another OER.
How do the agents interact with the environment?	The principle agent's interactions may be: * to describe itself, when a user selects it, * to transmit information to another OER concerning its objectives or the results it may produce * to launch another OER if it is incorporated in a course
Is an agent's mobility through space an important consideration?	NO
4. What agent behaviors are of interest?	an OER has to introduce itself, it has to interact with others, it has to remember its last version or to communicate that it has many versions, etc.
What decisions do the agents make? What behaviors are being acted upon? What actions are being taken by the agents?	When an OER is composed of a set of OER, such us a course, it may take a decision to include another OER or to delete one for example depending on its results or its version.
5. How do the agents interact with each other? With the environment? How expansive or focused are agent interactions?	According to Macall (Macal, 2010) how agents are connected to each other is generally termed an agent-based model's topology or connectedness. A topology describes who transfers information to whom. The literature proposes some topologies among which we propose the "soup" for our OER. In the "soup", or "aspatial" model, agents have no location because it is not important; pairs of agents are randomly selected for interaction and then returned to the soup as candidates for future selection. This is globally true for our case because an OER may be used by many OER as it can be a component in many courses or included in another OER (e.g. a jpeg inserted in a file (doc)). In our case relationship varies frequently.
6. Where might the data come from, especially on agent behaviors, for such a model?	Data may come from another agent as well as the environment
7. How might you validate the model, especially the agent behaviors?	We proposed a project to the virtual university of Tunis (UVT) to transform its course repository. The UVT offers for free, to the Tunisian students and teachers, some courses developed by Tunisian teachers. These course are currently stored into a database and may be consulted via http://www.uvt.rnu.tn/uvt/index.php/fr/cours. Our project aims to use an open source and free software to simulate our ABM approach using this set of courses. The structure of these agent-courses will be based on the attributes proposed in Table2. We also planned to use the software NetLo which has become an established and widely used free software platform and language. It has a flat learning curve, includes powerful software concepts, and is on the way to becoming a standard tool in ABM development and prototyping (Grimm, 2010). According to Railsback (Grimm, 2010) et. al. we have to iterate modeling several times, because our first models can always be improved in some way.

In addition to the Macal's criteria, the protocol ODD (Overview, Design concepts, and Design Details) describing agent-based models, is used to test the adaptability of the OER to an ABM approach (Grimm, 2010). OER seems to be adapted to an ABM because the different ODD's rubrics have answers concerning the OER. Details are not represented here but the Macal's criteria may be considered as a summary of them (Table 1).

As proposed in our answer of the second criteria (Table 1) of Macal we propose to describe an OER by using a set of attributes based on those proposed by Globe (GLOBE, 2011) and by JISC (Jisc, 2012). JISC, which represents UK's expert on information and digital technologies for education and research, proposes some attributes for the OER. The aim is to ensure that content released through an OER can be found, used, analyzed, aggregated and tagged. So content can take the form of information added to resources in applications such as flicker and YouTube, time and date information automatically added by services such as slideshare, and author name, affiliation and other details added from user profiles when resources are uploaded (OECD, 2007), (Jisc, 2012). These attributes are included into those presented in Globe (GLOBE, 2011) , (Campbell, 2010). On the other hand the "Global Learning Objects Brokered Exchange (GLOBE)" consortium's main objective is to enable the sharing of learning objects between repository networks worldwide (GLOBE, 2011). In order to reach this goal, each member adheres to a set of technical standards that facilitate the interoperability between repositories. The first step to achieve interoperability is to be able to communicate and to obtain the metadata from partner repositories. GLOBE members had agreed to use the Learning Object Metadata (LOM) standard that prescribes the type of fields or elements that the metadata could contain. LOM proposes around 50 different metadata elements grouped into nine categories: General, Lifecycle, Meta-Metadata, Technical, Educational, Rights, Relation, Annotation and Classification (Ochoa, 2011). In its report, Globe (GLOBE, 2011) tries to find the best application profile for GLOBE. The definition of "best", in this case, is the application profile that all the current member repositories already fulfill or are close to fulfill and that has as mandatory the largest number of key LOM fields (GLOBE, 2011). For that purpose the frequencies for each field in computed and simple descriptive statistics were used to establish the fields that are always or almost always present in the metadata of each repository. The harvesting collected a total of 635.851 metadata instances from the studied repositories. The previous frequency analysis could be used to determine the fields that are almost always present in the different repositories (Ochoa, 2011) . On the other hand, there is no quantitative way to establish which are key elements of LOM. For this, the representatives of the GLOBE members proposed a tentative Application Profile containing mandatory and recommended fields (or attributes) with what they consider as the most important fields of GLOBE. An attribute can be optional, or recommended or mandatory. The attributes proposed by GLOBE are in the Table 2.

Table 2. The Globe attributes (GLOBE, 2011)

1	General	This category groups general information that describes the learning content as a whole.
1.1	Identifier	Defines an entry within a listing identification system applied to this learning content.
1.1.1	Catalog	The name of the listing identification system.
1.1.2	Entry	Actual string value of the entry.
1.2	Title	Name given to the learning content.
1.3	Language	The primary human language or languages used within the learning content.
1.4	Description	Textual description of the content of the learning content.
1.5	Keyword	Keywords or phrases describing this learning content.
1.6	Coverage	The span or extent of the coverage of the learning content.
1.7	Structure	Underlying organizational structure of learning content
1.8	Aggregation level	The functional granularity of this learning content
2	Life cycle	This category describes the history and current state of this learning content and those which have affected it during its evolution.
2.1	Version	This edition of the learning content
2.2	Status	The completion status or condition of this learning content
2.3	Contribute	This element describes those people or organisations that have affected the state of this learning content during its evolution.
2.3.1	Role	Kind of contribution

2.3.2	Entity	The identification of and information about people or Organisations contributing to this learning content.
2.3.3	Date	Date of the contribution
3	Meta-metadata	This category describes the metadata record itself rather than the learning content.
3.1	Identifier	A globally unique label that identifies this metadata record.
3.1.1	Catalog	The name of the listing identification system
3.1.2	Entry	Actual string value of the entry.
3.2	Contribute	Those entities that have affected the state of this metadata instance during its life cycle.
3.3	Metadata scheme	Version of LOM / GLOBE Metadata Appliction Profile used
3.4	Language	Language of this metadata instance. This is the default language for all language strings.
4	Technical	This category describes the technical requirements and characteristics of the learning content.
4.1	Format	Technical data types of all the components of the learning content. This data element is used to identify the software needed to access the learning content.
4.2	Size	The size of the learning content in bytes. This data element refers to the actual size of this learning content. If the learning content is compressed then this data element refers to the uncompressed size
4.3	Location	A string that resolves to an item location for accessing the item.
4.4	Requirement	This sub category describes the technical capabilities required to use this learning content.
4.4.1	OrComposite	Grouping of multiple requirements.
4.4.1.1	Type	Type of requirement
4.4.1.2	Name	Name of the required technology to use this learning content.
4.4.1.3	Minimum version	Lowest possible version of the required technology to use this learning content.
4.4.1.4	Maximum version	Highest possible version of the required technology to use this learning content.
4.5	Installation remarks	Description of how to install this learning content.
4.6	Other platform requirements	Information about other software and hardware requirements.
4.7	Duration	Time a continuous piece of learning content takes when played at intended speed.
5	Educational	This category describes key educational or pedagogic characteristics of the learning content.
5.1	Interactivity type	Predominant mode of learning supported
5.2	Learning Resource Type	This data element is used to identify the kind of the learning content. It is an ordered element; most dominant kind first.
5.3	Interactivity level	The degree of interactivity characterizing this learning object.
5.4	Semantic density	The degree of conciseness of a learning object
5.5	Intended end user role	An audience group targeted for the learning content
5.6	Context	The education or training sector at which the learning content is aimed.
5.7	Typical age range	Age of the typical intended user.
5.8	Difficulty	How hard it is to work with or through this learning object for the typical intended target audience
5.9	Typical learning time	Approximate or typical time it takes to work with or through this learning object for the typical intended audience
5.10	Description	Comments on how this learning object is to be used.

5.11	Language	The human language used by the typical intended user of this learning object.
6	Rights	This category describes key intellectual property rights and conditions of use for the learning content.
6.1	Cost	Whether use of this learning object requires payment.
6.2	Copyright and other descriptions	Whether copyright or other restrictions apply to the use of this learning object.
6.3	Description	Text description of rights associated with the learning content. Alternately, a URL that refers to the full description of the rights associated with this resource.
7	Relation	This category describes the relation of the resource to other resources.
7.1	Kind	Kind of relation
7.2	Resource	The target learning resource that this relationship references
7.2.1	Identifier	A globally unique label that identifies the target learning resource
7.2.1.1	Catalog	The name or designator of the identification or cataloging scheme for this entry. A namespace scheme.
7.2.1.2	Entry	The value of the identifier within the identification or cataloging scheme that designates or identifies the target learning resource. A namespace specific string.
7.2.2	Description	Textual description of the content of the related resource or nature of the relationship.
8	Annotation	This category provides comments on the educational use of the learning content and information on when and by whom the comments were created.
8.1	Entity	The person or organisation that created the annotation.
8.2	Date	Date the annotation was created.
8.3	Description	The content of the annotation.
9	Classification	Helps to categorize the learning content.
9.1	Purpose	The purpose of Mandatory classifying this item.
9.2	Taxon path	A taxonomic path in a specific classification system. Each succeeding level is a refinement in definition of the preceding level.
9.2.1	Source	The name of the classification system.
9.2.2	Taxon	A particular term within a taxonomy.
9.2.2.1	ID	The identifier of the taxon, such as a number or letter combination provided by the source of the taxonomy.
9.2.2.2	Entry	The textual label of the taxon
9.3	Description	Description of the item relative to the stated classification purpose.
9.4	Keywords	Keywords and phrases descriptive of the item relative to the stated classification purpose.

This study lists also elements used by the GLOBE providers that are not in the LOM standard but are added by extending the standard in one or more application profiles. Ochoa et al. (Ochoa, 2011) present three elements that are found to be the most significant additions in the GLOBE metadata set:

– general.learningobjectkind is added to distinguish between a real world object (i.e. a building) or a media object (digital resource) that e.g. describes that real world object.

– technical.geolocation is also added to be able to add geo-coordinates in the case of a real world object such as a building. This field enabled the creation of typical mobile applications where users walk through a city and get extra information about the buildings in their neighborhood.

– general.subtitle is added, it has a value in 73% of their metadata instances. In LOM, only 1 title is allowed with one or more translations of that title which is obviously not enough.

The attributes proposed by Globe may be proposed to describe an agent representing an OER as they include those proposed by JISC too. The above attributes (Table 2) are certainly well adapted to the learning objects (LO) but some should be redesigned for the OER like the static attribute (Contribute 2.3) and the associated ones. In the (LO) approach objects are proposed to be used but not to be updated by users and to be re-used. In the OER approach one resource can have many versions and each version may be associated to a user. This dynamic aspect may be solved by the property of memory that is present in an ABM approach. The static attribute (Relation 7) should also be revisited for the OER structure. In fact an OER may have many relationship with different OER and this dynamic aspect is also well adapted to the ABM. These properties are also invoked in the JISC project (Jisc, 2012), and for these dynamic attributes corresponding to OER behavior, or the multiple URL corresponding to the OER's versions the project proposes to record them in an associated file, so embedding relevant descriptive information within the OER is practicable (Jisc, 2012). In addition to these attributes we propose to consider the behavior introduced in Table 1.

CONCLUSION

Open Educational Resources (OER) are considered to have huge potential to increase participation and educational opportunities at large and to promote widening participation and lifelong learning. OER can be small or large, purpose-made or adapted from pre-existing materials, according to the user's particular requirements. Unfortunately, it has shown that openness in itself is not enough to unfold these potentials, and a number of elements need to be taken into account in order to improve the OER use. This paper has attempted to highlight the OER' specificities and that describing them like the learning objects is not totally adequate. Since the OER have their particular properties we propose the Agent Based Modeling (ABM) approach to represent them. An OER is represented by an agent to take into account some properties such as its dynamic aspect and its behaviors. This paper begins by introducing the OER concept and its current specificities. The concept of agent is then introduced as well as the ABM approach (Macal, 2010). The last paragraph presents our proposition to adapt the ABM to the OER field based on the Globe description of the learning objects (GLOBE, 2011). In addition the protocol ODD is used to confirm the adaptability of this approach (Grimm, 2010). The next step is the practical realization of our proposition to test its weakness and its strengths.

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