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# Inspiring the Instructional Design Process through Online Experience Sharing

Grégory Bourguin<sup>1</sup>, Bénédicte Talon<sup>1\*</sup>, Insaf Kerkeni<sup>1</sup>, and Arnaud Lewandowski<sup>1</sup>

<sup>1</sup>University of Lille Nord de France, ULCO, LISIC  
bourguin@lisic.univ-littoral.fr, Benedicte.Talon@univ-  
littoral.fr, Insaf.Kerkeni@univ-littoral.fr,  
lewandowski@lisic.univ-littoral.fr

**Abstract.** A lot of pedagogical resources are available thorough the Web. Paradoxically, this plethora of resources makes it hard for instructional designers to discover and decide which ones will best fulfill their needs while building particular teaching setups. In different application domains and web 2.0 solutions, end-users' experience has been identified as a major source of information that can help others in such resource selection process. However, if these solutions are interesting, none of them totally fulfill the needs and end-users' experience can hardly be browsed while being dispersed over the web. In this paper we present our research prototype called EVOXEL and show how it can help instructional designers by completing widely used web solutions. Strongly inspired by results coming from social and human sciences, and built upon ontological mechanisms, EVOXEL is designed to let teachers share the experience they have developed during their own instructional activities, experience that has crystallized in the educational resources assemblages they have built while performing their tasks. This experience can then be browsed, inviting others to be inspired from it while discovering resources described in concrete contexts of use and from their own user's point of view.

**Keywords.** Instructional Design, Experience Sharing, Open Educational Resources, Ontology, Activity Theory

## 1 Introduction

Open resources platforms [14] like MERLOT [23], Jorum [17] or Open Stax CNX [10], and the web in general, offer an increasing set of online or downloadable pedagogical resources. These repositories provide access to a plethora<sup>1</sup> of resources that may range from courseware, learning objects, content modules, assessment tools or design support tools, to educational methodologies and best practices [8, 16]. Re-using and combining these resources helps pedagogical designers while facilitating the design process of new educational activities. Schuwer and Wild [28] reported that « Lecturers should have an overview of the various learning materials available for

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<sup>1</sup> 40 000 *materials* in MERLOT, 16 000 *resources* in Jorum, ...

their specific field of knowledge, and act as curators to ensure access to the best possible resources. They should apply both open and traditional materials, and know how to create a learning arrangement that is suited to the learning process and based on optimally aligned learning materials and teaching methods ». Studies have shown for long that infrastructures should provide better means to find adequate educational resources [5][14]. Paradoxically, the plethora of available resources still results in the important issue that is how to help pedagogical designers finding and selecting the most appropriate one(s) for their particular needs.

Platforms like Jorum [17] offer web resources that are organized into fixed categories like *educational level* or *subject area*. However, researchers have shown that resources can have different meanings depending on the context and the users who view them [10]. Fixed categorization does thus not necessarily help users in discovering a resource and understanding what it can serve for since the resource could have been categorized differently from another point of view. Repositories also categorize the resources around sets of generic tasks. There is usually a shift between a generic task and the user's one. Users then have to determine if the generic task will match their own. Another important criteria is how the resource will complete and articulate with the other resources involved in the activity. The answers are usually hard to find without testing and this may result in time and money loss.

Trying to overcome these issues, research and industry have identified end-users' experience as a major source of information that is expected to help future users in discovering and selecting their own resources. Different solutions like social tagging [4][6] and experience sharing systems have been set up [18, 19][27][29]. In the first part of this paper we show how, even if interesting, these widely used solutions are partitioned and lack of semantics. As a result, end-users' experience remains disseminated over the web and can hardly be browsed. In a second part, we present the new approach we defined to overcome this issue. This approach is designed not to replace existing solutions, but to complete them. We then introduce the EVOXEL architecture and the web application prototype built around an OWL (Web Ontology Language) activity-based meta-model, and an OWL-DL (Description Logic) reasoner. Finally, we report how a pedagogical designer used EVOXEL to build and share her own experience about pedagogical resources assemblages, and show how this experience can be browsed while using EVOXEL's features.

## **2 End-Users' Experience**

Our research aims at helping pedagogical designers in selecting web educational resource(s) for realizing a particular teaching task in a particular context. According to Activity Theory [1], task performance (or activity) usually involves a set of different and complementary tools (or resources). This resources assemblage is an important part of activity: it helps in performing it, but also influences its outcome. Thus, best selecting a new resource for creating or completing a resources assemblage implies that a user can clearly understand what can be done with it in his particular context. As we underlined it, the classical categorization of resources that structures web re-

positories presents some limits regarding this issue. During the last years, several solutions taking benefits from the Web 2.0 features have emerged. All of them involve end-users who are invited to share their own experience regarding the resources they have used.

### **Rating, Commenting and Tagging Systems**

One of the most widely spread Web 2.0 features is the rating system letting end-users find and provide information about the quality of a shared resource. Studies have shown the importance of these systems [14]. Some solutions like TeacherTube [13] allow free ranking, and others like MERLOT [23] have organized the evaluation process to provide better rating quality. A rank indicates how a resource has been accepted by a more or less large number of users. Higher rank means that the resource fitted well in these users' tasks. A rank thus cannot be well understood if it is disconnected from the user's concrete activity in which the resource has been evaluated.

This information may be found in another interesting Web 2.0 feature: the comments sections like those provided in CloudWorks [4]: "a place to share, find and discuss learning and teaching ideas and experiences". A comment can contain information about the commenter and inform about the context in which the resource has been used. It can help the reader to evaluate if the commenter ranked the resource in a context that matches its own. Unfortunately, the free form of comments makes such information mostly implicit, unstructured and hard to extract.

One of today's most popular solutions for end-users to provide their point of view about a resource is offered by tagging systems which can result in folksonomies like del.icio.us, Flickr and CiteULike [19][12]. This solution is usually already integrated in educational resources repositories and researchers have shown that tagging can serve for indexing shared resources [4][6], and can also be used as a key concept for collaborative learning [21]. In this study, Lavoué underlines that "social tagging systems are a means for social exchange of knowledge structures". Kim [18] indeed noticed that tags actually reflect personal views of the world by individual users: tagging a resource is offering a point of view on it. More precisely, Saab [27] reports that tags actually "form the entry points into our complex intrapersonal schemas and rich ontological understanding of experience". However, the author also explains that folksonomies, even if created by end-users, cannot be considered as directly matching a particular user's culture. Classical folksonomies can only be considered as reflections of cultural schemas only for dominant cultural groups. Thus, to help sense making, a tagging system would gain in less considering taggers in the masses. Even if their purposes are different from ours, we agree with Kim [18], Deparis [7], Saab [27] and Knerr [19] proposing to augment tagging systems with ontological features in order to keep track of the links between a tag and its creator. This approach would help in discovering information coming from someone's experience, and the context in which it has been built. Moreover, Singer [29] has shown that investigating one's universe (what he has created, its favorite resources, etc.) helps users to assess him, and then to be inspired from him. As underlined by Draxler [9], accessing to one's context helps in assessing that person, and facilitates resource appropriation.

### **Sharing Resources and Context of Use**

Popular web tools like blogs, forums, wikis or video channels are particularly involved by end-users to let others enter and discover their universe. All these means are widely used to share experience about different resource assemblages and can offer extensive information for discovering and understanding one's context. As noticed in [26]: "Observations show that many designers do not work in the linear process proposed by common ID models. Approaches marrying prototyping, zigzagging, top-down and bottom-up design are commonly practiced". During this process, designers look for inspiration by browsing teachers or institutions' spaces where people share their own experience about resources assemblages involved in different activities. The power of these means is partly due to the freedom offered to users for expressing themselves while sharing their experience. The matter comes from the fact that the resulting informal content lacks of computable semantic, and can thus hardly be browsed. As pointed before, most of these systems nowadays provide tagging mechanisms that partially palliate this issue: a post (text/image/video/...) can be tagged and readers can select a set of tags to discover similar posts. This solution is useful but does not totally help since these tagging mechanisms are usually designed to describe each post in the whole. For example, considering a post describing a course, each tag is associated with the whole activity. There is usually no mean to create a tag that semantically only applies to some sub-elements like a particular resource referenced in the course.

Teachers are usually involved in multiple pedagogical activities. Discovering that a teacher involves a particular resource in a particular activity could lead to discover that this teacher is also implied in other activities of the same type. These similar (but different) activities probably involve different resources assemblages that may inspire and lead to the adoption of better and unexpected resources. Reciprocally, users often involve a same resource in several activities. Discovering that a resource, or a type of resources is involved in different activities may help in understanding what can be done with it, and may inspire by discovering it in unexpected assemblages built for unexpected purposes. In common media spaces, it is nowadays still hard to deeply browse such relations that indeed exist between educational resources and the different contexts in which they are used.

Recent systems propose interesting structures in which resources can be assembled for a more or less precise purpose. For example, TeacherTube [13] allows its users to create *classrooms* that can group different medias. There is unfortunately no mean to discover all the *classrooms* (and associated resources assemblages) in which a particular resource is used. MERLOT [23] goes further by letting users create and share *ePortfolios*. Each *ePortfolio* contains resources assembled to perform a pedagogical task, and is accompanied with textual information like prerequisites, pedagogical approach, learning outcomes, assessments, etc. Considering our purpose in this paper, one of the most interesting MERLOT's feature consist in the possibility to discover all the *ePortfolios* in which a selected resource has been involved, thus allowing the discovery of all the assemblages in which a resource has been involved by MERLOT's users. If these aggregation structures are indisputably useful, one drawback is their "flat" modeling of activity. A resource's context of use is an activity, and

an activity's context is often another activity. For example, teachers usually think in modules that are part of a department's activity. Each module contains courses themselves involving tutorial classes and synthesis projects. All these activities can involve different resources assemblages and are contextualized by each other. Existing systems do not provide the structure and semantics needed to deeply search or browse through such relations. These lacks slow down discovery, understanding, assessment and inspiration.

### 3 The EVOXEL Approach

EVOXEL is the generic approach we propose to overcome these limits. This approach is generic in the sense that, being inspired by the generic representation of human activity proposed by the Activity Theory [1][20], its ontological meta-model has been successfully used other application domains [3]. The main concept of this approach is the introduction of activity-based online personal ontologies.

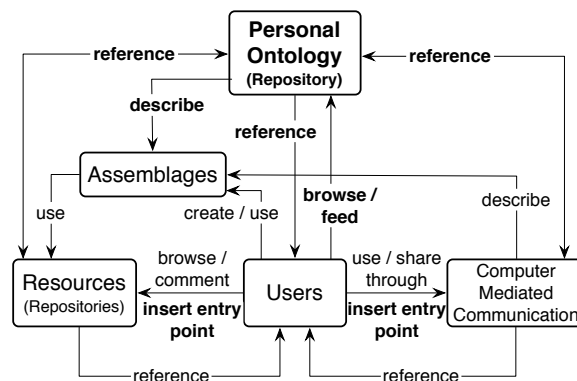
#### 3.1 Activity and Experience

From a theoretical point of view, our work has for many years strongly been influenced by results coming from the Activity Theory (AT) [1]. AT describes an activity as a subject (the user/actor in this paper) realizing an object. The tool concept mediates the relation between the subject and the object. The tool (or resource in our work) helps and also influences the subject in the realization of the object of activity. AT also describe the community, the rules and division of labor mediating concepts to represent the social dimension of human activity. We are here particularly inspired by the mechanisms of experience crystallization that is described in AT. AT underlines how, in response to contradictions, every element of an activity can be transformed during its realization. Even the subject evolves while gaining experience. This experience is involved when a subject transforms his working context. As a result, the transformed elements crystallize the subject's experience, and this experience is implicitly available when reusing them. From our point of view, a resource assemblage developed by a user during an activity crystallizes his experience. Sharing a resources assemblage is sharing experience about a concrete particular context of use. This is exactly what EVOXEL has been designed for, and we use the activity concept to let end-users describe and share their crystallized experience. Such description corresponds to a personal ontology.

#### 3.2 Online Personal Ontologies

Figure 1 describes a global picture of the existing web means completed (in bold) with elements from our approach. In their day-to-day activities, *teachers* realize their tasks thanks to *assemblages* of several *resources*. When looking for a new resource, a teacher's quest usually ends in browsing web *repositories*. Selecting a resource is often oriented by the discovery of other users' rating and comments that may be

available in these repositories. Information may also come from *computer mediated communication platforms* (such as weblogs, forums, etc.) where one may find other educational actors describing the resources they use to carry out their own activities. The bold parts of the figure represent EVOXEL's contribution to this ecosystem. The purpose of *personal ontologies* is to keep track of the experience crystallized in resources assemblages developed by users in the context of their activities, and to provide a way to infer and browse the links that exist between them. Users feed their personal ontology by describing and tagging their resources and activities. Each of these descriptions can refer to web medias that may be associated with them. These descriptions are shared in EVOXEL's personal ontology *repository* and users can insert links towards these ontological elements into existing web solutions (web repositories, weblogs, forums, etc.). These links serve as *entry points* for others that will thus be able to follow them and browse one's universe and experience, directly starting from the medias they are familiar with. In other words, EVOXEL's personal ontologies serve as inferred maps connecting existing web solutions. Each map reflects a particular point of view that results from one's own experience built while using particular resources assemblages in concrete activities.



**Fig. 1.** EVOXEL approach for experience sharing.

Personal ontologies are meant to be easily manipulated, shared and browsed on the web. We have chosen to use the Ontology Web Language (OWL) for creating the ontological meta-model that resides in the core of EVOXEL. As explained in the previous parts of this paper, our purpose is to use tagging as a mean for social exchange of knowledge structures [21], using tags as reflections of personal views of the world [18] while forming the entry points into our complex intrapersonal schemas and rich ontological understanding of experience [27]. As a result, our tagging system should allow creating tags with as much semantics as possible. Thanks to OWL, the elements described by users in their personal ontologies can be tagged while taking benefits from all the expressiveness and power of ontological tools. Tags are not just keywords, but can be commented, structured in hierarchies and use inheritance. Ontological reasoners can be used to infer and reveal relations between the elements described by users, and advanced search mechanisms can be set up.

Other researchers have already used OWL to define activities meta-models. This is for example the case for the BPMN ontology [11] that is a formalization of the structural components of the OMG's BPMN (Business Process Modeling Notation). Such meta-model can be used to describe relations between resources and activities at a very low grain. However the meta-model consists of 95 classes, 439 class axioms, 108 object properties and so on... This meta-model is clearly only usable by BPMN specialists. At the opposite, our goal is to let end-users describe basic and non-exhaustive links between their resources and activities. Such meta-model should consist of as less as possible entities, facilitating its understanding by EVOXEL users. We thus have used Protégé [26] for building our own simple activity meta-model. This meta-model, inspired from the AT and the work of Kuutti [20], is presented in Fig. 2. One can notice that this model only references one actor by activity. This could seem surprising while considering AT in which social dimension is a constituting part of activity. This is due to our particular purpose in this system: sharing personal ontologies, i.e. models (or abstractions) focusing on one's particular point of view regarding its resources and activities.

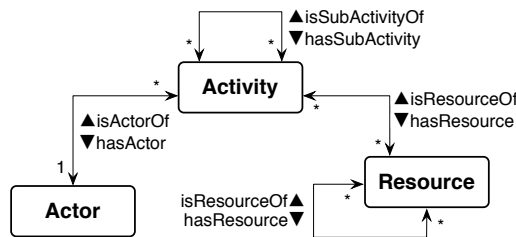


Fig. 2. EVOXEL ontological meta-model for representing personal ontologies

## 4 The EVOXEL prototype

In order to test the feasibility of our approach, we have developed a prototype. In this part, we will present its architecture, explain how pedagogical designers can use it to share their experience crystallized in pedagogical resources assemblages, and show how this experience can be browsed.

### 4.1 EVOXEL's Architecture

The EVOXEL prototype is a web application whose architecture is summarized in Fig. 3. The server side is realized in JEE and applies the OWL API [25] for creating, managing and querying personal ontologies. The EVOXEL modeler lets actors share their experience by describing elements constituting their universes, i.e. resources, activities and tags. Each element's description may contain URL(s) to point to a representation of this element anywhere else over the web (e.g. an activity containing an URL towards a blog post, a resource pointing to a Jorum OER, etc.). We use Angular



JS [1] to provide a client side single page application. This technology has revealed particularly useful in the modeler to maintain a coherent view of all the highly connected and editable elements constituting personal ontologies. Each described universe corresponds to a personal ontology that can directly be browsed. The environment dynamically provides a fixed URL for each element in a universe (activities, resources and tags). These URLs can thus be inserted anywhere on the web and serve as entry points for discovering one's EVOXEL universe. Opening such URL displays a synthesis of all the information concerning the pointed element, and the JFact [15] ontological reasoner plugged in our JEE server is used to infer all the links that can be deduced between this element and the rest of the actor's universe. This mechanism allows web surfers to jump easily from one element to a connected one. The browsing system is completed by an ontological search tool that will be described in the next part of the paper.

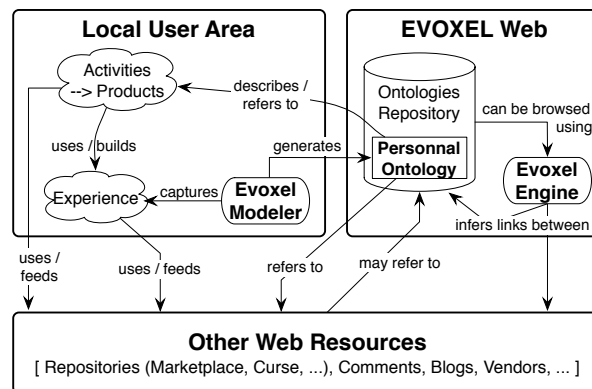


Fig. 3. EVOXEL's architecture

## 4.2 Sharing Pedagogical Experience in EVOXEL

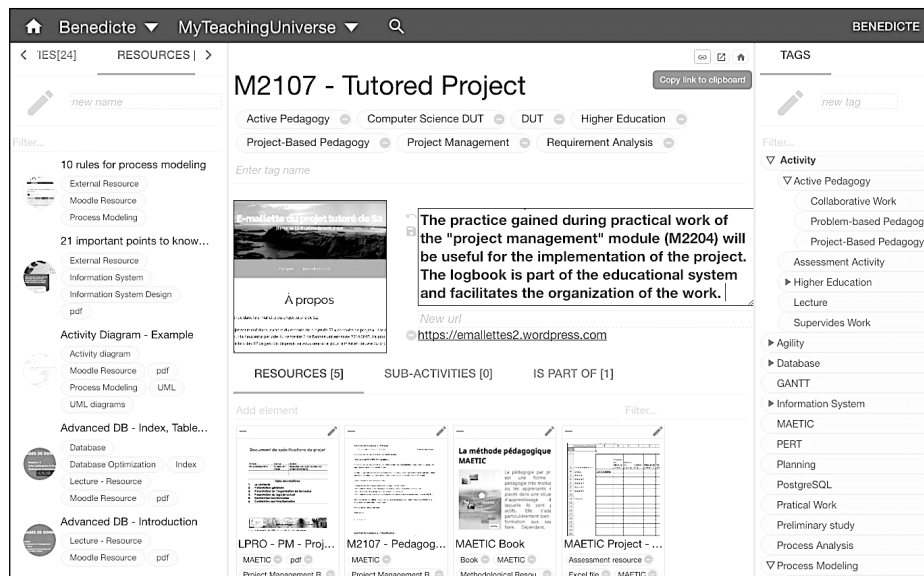
The following part has been built from the real activities of a pedagogical designer who has been involved for many years in learning research [30]. We however would like to underline that this part is not a full evaluation of EVOXEL. Such evaluation is planned and will involve a larger number of users over a longer time period.

### Activity Modeling – Sharing Experience

The designer we solicited for this demonstration regularly produces learning and teaching resources using various on-line educational environments. While testing EVOXEL, she created a personal ontology she called *MyTeachingUniverse*.

As it can be seen in the left part of Fig. 4, she described several resources and activities corresponding to her real life pedagogical work. The right part of the figure shows the set of tags she created to describe the elements of her universe. These tags constitute the vocabulary she created to describe her universe according to her own experience. Each tag can be edited and commented to provide more semantic. The set

of tags can be organized in hierarchies to refine the meaning of a tag. A tag can be in multiple hierarchies and the reasoner prevents from ontology inconsistencies. Applying a tag to an element automatically applies the upper tags in the hierarchies. For example, in Fig. 4, the *Project-Based Pedagogy* tag has been applied to the *M2107 – Tutored Project* activity, and EVOXEL infers that the *Active Pedagogy* tag also applies to this activity. The center pane is used to focus on and deeply describe an element. In Fig. 4, the description of the *M2107 – Tutored Project* activity contains a link towards a WordPress site where the corresponding real task can actually be performed. It includes an assemblage of five resources and show that this activity is part of one other (super-)activity. Each element presented in the modeler (including tags) has its own EVOXEL description that can be modified by focusing on it. Each element also provides its own EVOXEL URL that can be pasted anywhere on the web, and serve as an entry point in the designer’s universe.



**Fig. 4.** The EVOXEL Modeler: left pane is used to create/manage resources and activities, the center pane allows editing a focused element, and the right pane is used to create/manage tags

### Browsing Shared Experience

Once an elements’ URL(s) has been inserted in a web medias (LMS, Blog, MERLOT Material, Jorum resource, CloudWorks comment, TeacherTube channel, etc.), other users can discover our designer’s whole universe. For example, she inserted the EVOXEL URLs corresponding to the *MAETIC Book* [22] in her day-to-day blog. This book is one of the resources used in the *Tutored Project* shown in Fig. 4. Following this link, a blog reader discovers this resource and its surrounding elements in the designer’s universe. The corresponding page is shown in Fig. 5.

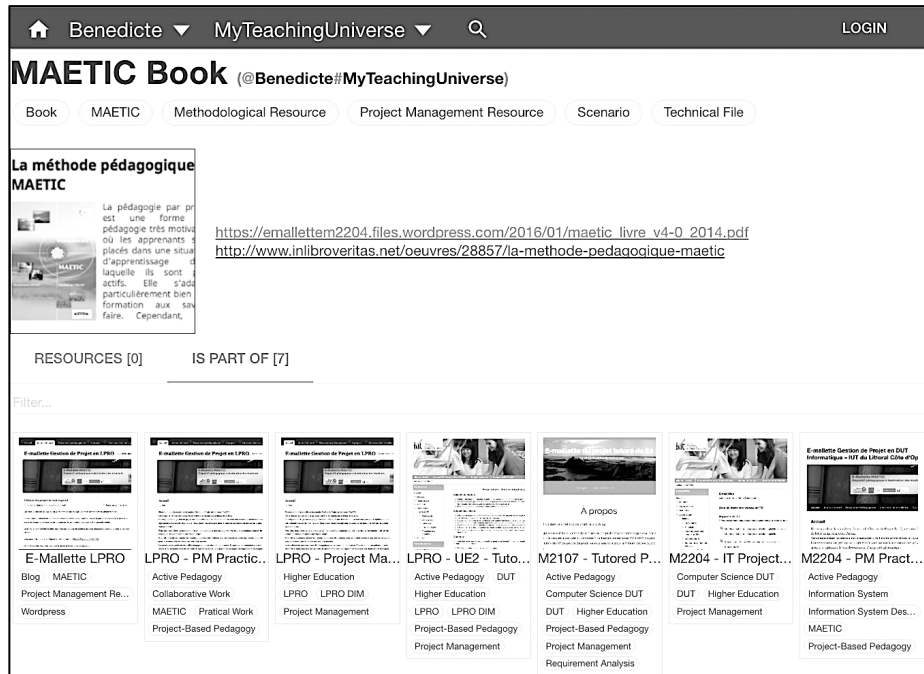


Fig. 5. The MAETIC Book resource in EVOXEL

The description provides two links inserted by the designer for obtaining the book, and displays all the information inferred by EVOXEL about this resource. In this example, EVOXEL shows all the tags inferred for this book in the designer's universe, and all the elements (activities and other resources) including it. It is important to notice that everything in this page is a link that will lead to the full description of another connected entity. Clicking on a tag (including those tagging the elements in the *is part of* section) will show its hierarchies, an eventual comment left by the designer for better understanding it, and all the inferred elements associated to this tag in her universe. Clicking on an activity in the *is part of* section leads to discover the resources (including the MAETIC Book) assembled for it, the associated tags, the other connected activities and so on. Starting from a simple URL inserted in a widely used web media, this mechanism literally allows a user to browse the designer's universe. It leads to discover resources described and tagged from her point of view, and invites to understand and be inspired from resources assemblages that crystallize her experience about pedagogical activities.

This browsing mechanism is completed by a search panel (Fig. 6) that takes benefits from the semantics carved into personal ontologies. Most educational resources repositories provide a search tool trying to match given strings with the available elements. The matching uses the name, the textual information and the tags associated with the materials. The same mechanism can be used in EVOXEL by filling the

*Search strings* field in the search panel. It is also possible to look for all the elements *Tagged with* a selection of tags issued from this universe.

The screenshot shows a search interface for 'MyTeachingUniverse'. The search panel is titled 'Looking for elements' and contains the following sections:

- Search strings:** A search bar with a magnifying glass icon.
- Tagged with [1]:** A dropdown menu showing 'Lecture' with an 'Enter tag name' field, a 'Tags list' dropdown, and an 'ADD TAG' button.
- Including [1]:** A dropdown menu showing 'SCRUM' with an 'Enter tag name' field, a 'Tags list' dropdown, an 'ADD TAG' button, and a 'Look up in hierarchy' toggle switch.
- Part of [1]:** A dropdown menu showing 'Active Pedagogy' with an 'Enter tag name' field, a 'Tags list' dropdown, and an 'ADD TAG' button.
- Part of [1]:** A dropdown menu showing 'Active Pedagogy' with an 'Enter tag name' field, a 'Tags list' dropdown, and an 'ADD TAG' button.
- Matching Elements [1]:** A section showing a single result: 'Software production process'. Below this, a list of resources is displayed: 'Higher Education', 'Lecture', 'Software lifecycle', and 'Supervises Work'.

**Fig. 6.** – A complex search using EVOXEL’s meta-model and ontological features

A more complex search can be performed by adding criteria like all the elements *including* a set of: (sub-)activities, types of (sub-)activities, resources, and types of resources. Another criteria can also be all the elements that are *part of* some: activities, types of activities, resources and types of resources. The example shown in Fig. 6 shows a user looking for elements *tagged* with *Lecture*, *including* elements *tagged* with *SCRUM*, and that are *part of* elements *tagged* with *Active Pedagogy*. In other words: all the *Lectures* using *SCRUM* in an *Active Pedagogy* process. In this case, Fig. 6 shows that the structure and semantics introduced by EVOXEL has been used to discover a matching activity named *Software production process*. Clicking on it allows discovering its resources assemblage, and browsing all its connected elements in the designer’s universe.

## 5 Discussion

While testing this prototype, the designer felt that the cost of the bootstrapping (creating the first elements and tags) of the modeling process was a little effort. However, as her universe grew, the effort significantly decreased since she was able to reuse diverse elements. To reduce the bootstrapping issue, we are currently testing new EVOXEL features in which users can directly import elements from someone else's universe. Users can then edit the imported elements in the context of their own personal ontologies for providing their own point of view. The system however keeps track of the links towards the original entities in a linked data approach. We hope this feature will help users to be inspired from different but connected point of views over the same elements.

The pedagogical designer also found her personal ontology very useful for herself: starting from "simple" descriptions of her elements, EVOXEL inferred links between them and offered a structured view of her teaching activities. She then (re)discovered and used the relations between these elements which served as reminders while working with her Learning Management Systems. The search system also revealed an interesting feature for herself by helping her to easily retrieve information about resources and activities previously involved in specific contexts.

While working with different pedagogical designers, we noticed that they modeled their universe in somehow radical different ways. Some designers think about their universe in a highly hierarchical fashion, and others do not. For example, one designer described activities directly containing no resource but split in many different sub-activities, themselves split in smaller ones and so on, and the leafs of these activities trees only contained one or two resources. This way of thinking is totally understandable since, even in AT, this recursive structure can be used to describe human activities at low grain. Such hierarchical way of thinking also reflected in the organization of the tags tree. At the opposite, some actors mainly created "global" activities containing several resources, and created tags which were poorly related to each other in their definition, but were "manually" put together on diverse elements. It is too early for us to say which way of structuring is better (or if there is a best one), particularly from an experience "consumer" point of view. In order to harmonize the browsing of such different ways of thinking, we have added functionalities for presenting synthesized views of hierarchies, and for performing search request that traverse them. For example, looking at an activity containing sub-activities, a user can display the resources assemblage made of all the resources used in the recursive sub-activities, thus providing readings of detailed universes at different abstraction levels.

In this paper, we have shown the meanings we have developed to help users in discovering, browsing and being inspired from one's experience. We now need to deeper evaluate them by involving a larger set of users over a longer period. This evaluation is on its way and we have started to plug Google Analytics features in the system. The main idea is to track users (designers or learners) coming from one web site that contains an EVOXEL entry point. This should help to study how they traverse the personal ontologies (favoring which type of links, performing more or less complex searches) and help us to further develop our approach.

## 6 Conclusion

Regarding the still growing set of available online educational resources, pedagogical designers face the critical challenge of selecting the one(s) that will best fulfill their needs. In this paper, we have shown how existing systems try to overcome this issue by letting users share their own experience about these pedagogical resources, thus expecting to let other users take benefits from it. We have also shown that these solutions provide information that is partitioned and mostly lacks of semantics. We thus have proposed EVOXEL: a new approach designed to overcome this issue by completing the existing and widely used solutions. This approach uses online personal ontologies to share the links that exist between a pedagogical designer's resources and activities. This solution focuses on the actor's experience that has crystallized inside the resources assemblages he has developed while performing pedagogical activities.

The prototype created to test the feasibility of the approach is a web application that takes benefits from OWL-based technologies. We have shown how a pedagogical designer can create an online personal ontology structured around a few core concepts. The resulting elements provided entry points that can be inserted over the web to let others discover, understand and be inspired from her experience. EVOXEL's personal ontologies offer inferred maps connecting existing web solutions while reflecting one's particular point of view.

We have discussed advantages and limits of the approach and prototype. EVOXEL still need to be developed. The deep evaluation of the current features that we are preparing with pedagogical designers and their students will certainly help to enhance experience sharing and reusing over the web. The first investigations presented in this paper, and our first users' positive feelings let us expect interesting results in further developing this research.

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