An Exploratory Study of User Perception in Visual Search Interfaces Based on SKOS

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Gaona-García, Paulo Alonso, Giannis Stoitsis, Salvador Sánchez-Alonso and Katerina Biniari. 2016. "An Exploratory Study of User Perception in Visual Search Interfaces based on SKOS." *Knowledge Organization* 43: 217-238. 88 references.

Abstract: Repositories are web portals that provide access to learning objects. Resources can be easily located through the use of metadata, an important factor to increase the ease of searching for digital resources in repositories. However, there are as yet no similarly effective methods in order to increase access to learning objects. The main goal of this paper is to offer an alternative search system to improve access to academic learning objects and publications for several repositories through the use of information visualisation and Simple Knowledge Organization Schemes (SKOS). To this end, we have developed a visual framework and have used the Organic.Edunet and AGRIS as case studies in order to access academic and scientific publication resources respectively. In this paper, we present the results of our work through a test aimed at evaluating the whole visual framework, and offer recommendations on how to integrate this type of visual search into academic repositories based on SKOS.

Received: 6 October 2015; Revised: 20 February 2016; Accepted: 1 March 2016

Keywords: visual search interfaces repositories, use, learning, knowledge representation, knowledge organization systems

1.0 Introduction

The development of repositories is one of the most widespread initiatives for centralising search processes in the field of learning objects. The purpose of repositories is to aggregate learning resources from different content providers while enabling them to update their own resources (Tatnall 2009) and to store educational materials with the objective of optimising the management and search processes. The evolution of digital repositories has enabled management centralisation and provided access to thousands of digital resources. However, the rapid development of educational materials has posed a challenge to the creators of digital repositories that aim to organise, classify and manage content. Over the last few years, one of the most widely accepted strategies to address these needs has been the use of classification tools based on knowledge representation schemes.

The large number of digital resources has generated limitations that, in some cases, affect the use of repositories for accessing educational materials. These limitations have led to the development and use of alternative solutions based on the implementation of markup languages (semantic languages) and knowledge representation schemes, which are used to facilitate classification, categorisation, linking and content management. The use of these strategies based on Simple Knowledge Organization Systems (SKOS) has led to a solid technological structure that links to a series of semantic enrichment strategies (Rajabi, Sicilia and Sanchez-Alonso 2015), which give access to certain management and administration activities for creators and developers of repositories.

Currently, most digital repositories include SKOS-like ontologies, thesauri, etc., in order to offer creators and experts alternatives to manage, sort and organize learning objects within a repository. These alternatives, on the other hand, facilitate and make possible the use of the repository to help users display additional information and identify relationships, categories, areas of expertise, etc. However, these classification schemes are sometimes not used and exploited to the extent that would be desirable, because for regular users like students, teachers and researchers, the use of such educational repositories is: 1) not always easy because their interfaces do not always offer adequate search strategies; 2) regular users are not familiar with the complex systems of knowledge representation, which experts and creators of repositories have used to classify resources; and 3) the current user interfaces and search mechanisms do not always properly provide the essential functionalities demanded by the users for the location of digital resources. The difficulty of operating these repositories can hamper learning processes and consequently lead to the eventual abandonment of these tools.

Previous related studies have found that navigation problems in repositories may occur when users try to return to a previously accessed record (Jeng 2005). Other limitations are related to the optimal combination of navigation and search methods (Hartson, Shivakumar, and Pérez-Quiñones 2004) that do not allow displaying (in an at-a-glance way) the materials available in the repository, as far as the thematic coverage is concerned (Hitchcock et al. 2003; Tsakonas and Papatheodorou 2008; and Rho 2014). Therefore, it is difficult to judge whether it is worth searching for materials in the repository, or whether it is more convenient and effective to use some other external search strategy, e.g., using general purpose search engines like Google. However, there are still no effective methods to design visual search interfaces through the use of knowledge representation schemes, and more specifically, the few studies of visualisation tools focus on search engines to access resources through only one repository. Moreover, the majority of these efforts do not include knowledge organization systems as simple methods for integrating navigational search interfaces in order to access resources in several repositories.

The use of graphical syntax is a method employed in several studies (Smart et al. 2008; Russell et al. 2009; and Silvis and Alexander 2014), and our purpose is: 1) to exploit these graphical-capabilities based on knowledge areas through the use of knowledge organization systems in order to search relevant resources hosted in several repositories; and, 2) to analyse the results according to user perception and performance of visual search interfaces. As a result, this paper investigates whether, through information visualisation techniques, we can help creators of digital repositories to provide better services for their users in order to: 1) integrate several repositories through a single point of service in order to search resources according to a navigational knowledge area structure; 2) locate materials in a more effective and precise manner in very large collections of several repositories; 3) help users to improve locating materials according to a thematic structure; and, 4) identify effective visual search interfaces according to the context and criteria searching for performing browsing and searching processes over several repositories. We offer an alternative method of access to the creators of repositories in order to improve search outcomes for learning objects in several repositories. This alternative relies on the use of visual search interfaces classified according to SKOS. We use Organic.Edunet (Manouselis et al. 2009) and VOA3R/AGRIS (Šimek et al. 2012) as case study repositories. For the purposes of this paper, we focus on the current capacity of repositories to integrate effective data visualisation. We propose a formal framework for the effective visual searching of learning objects that will satisfy the basic needs of repositories.

The second section of this paper will provide background information on repositories that provide access to learning objects with respect to: 1) Organic.Edunet and VOA3R/AGRIS as metadata repositories and knowledge representation schemes; 2) the limitations of metadata and visual search interfaces in repositories; and 3) related work in the field. In the third section, we describe the methodology for developing the proposed visual framework, including the details of evaluation of this visual framework used for our case study. Section 4 presents the results of this evaluation, giving special attention to user satisfaction with regard to the visual framework and suitable visual interfaces and section 5 discusses these results. The sixth and final section presents conclusions and outlines the authors' intentions to integrate this type of visual search into learning repositories in future work.

2.0 Background

In general, the user interface of digital repository search systems provides at least two search alternatives: simple (also known as basic) and advanced. The basic search does not require the user to have a deep knowledge of the system or the search process. It allows the user to perform a quick search but restricts them to the use of keywords and precise queries. The basic search mode is considered easy to understand and use without prior experience. On the other hand, advanced searches are normally related with additional mechanisms and options that users select in order to obtain a refined search based on user needs. e.g., Boolean search, a strategy defined from logical search filters (AND/OR) by associating keywords and some selection criteria in order to search resources based on title, author, year, etc., or faceted search (Tunkelang 2009), a visual method for search based on classification strategies of digital resources like: keywords, location, language, country, type of resource, etc. More knowledge and skills are required to use the advanced method. Understandably then, basic searches are the most popular. However, a search for learning objects in repositories could return a huge list of results if definitions of essential elements that help the refinement of the search are not provided.

Previous studies (Tenopir 2003) have found that some search interfaces do not completely meet the needs of the final users. Often, the results displayed (Nash 2005) are not relevant to the user-defined criteria. Moreover, navigation problems may occur (Jeng 2005) when users try to return to previously consulted records. Regarding this, Kim and Kim (2008) found a number of problems associated with the design of the interface of an institutional repository in Korea. The study showed that the topics of interest queried by users were not sufficiently visible, because the navigation menu was too small and too dark. Thus, the design of an interface is of a paramount importance as it can greatly facilitate the search process and significantly improve user satisfaction (Shneiderman and Plaisant 2004). Below, we provide brief background information on repositories, using the Organic.Edunet and AGRIS repositories as examples. We also outline the importance of knowledge representation schemes, some of the obstacles to accessing learning objects, and, finally, related work.

2.1 Educational repositories

Organic.Edunet (Manouselis et al. 2009) is a pan-European service (www.organic-edunet.eu) that facilitates the access, use and exploration of learning objects related to organic agriculture and agro-ecology. It pretends to display a federation of multilingual repositories for quality learning objects in order to facilitate the search and access of digital resources hosted in different repositories. Actually, this repository contains more than 12,000 learning objects in the form of images, text and videos.

VOA3R (Šimek et al. 2012) is a pan-European online service developed in a project funded by the European Commission. It is a service provider for the integration of existing open access repositories and libraries, sharing scientific and open access research associated with agriculture, food and the aquaculture environment. VOA3R systematically creates relationships between metadata and learning objects through the use of the AGROVOC thesaurus keywords (Agrovoc 2016), thus relating research topics in the VOA3R/AGRIS repositories. The main purpose of the VOA3R platform is to reuse mature metadata based on the assessment of metadata quality of digital resources which include "inconsistency" (Palavitsinis, Manouselis and Karagiannidis 2013; Sanz-Rodriguez, Dodero and Sanchez-Alonso 2011; Kumar, Nesbit and Han 2005; and Shreeves et al. 2005), "re-dundancy" (Palavitsinis, Manouselis and Karagiannidis 2013; Ochoa and Duval 2009; Barton, Currier and Hey 2003) and ambiguity (Cechinel, Sánchez-Alonso and Sicilia 2009; Gaona-García, Sánchez-Alonso and Montenegro Marín 2014; Lytras and Sicilia 2007; Park 2009). These conditions would improve the establishment of a robust community focused on its services, e.g., sharing and increasing the quality of learning objects, and retrieval of relevant, open content from scientific publications. In general, the use of mature metadata improves the development of repositories for: 1) classifying and indexing of educational materials (Xavier Ochoa and Duval 2006; Stuckenschmidt and Van Harmelen 2004); 2) reusability of educational materials in open repositories (Cervera et al. 2009; Sanz-Rodriguez, Dodero and Sanchez-Alonso 2011); and 3) the location of relevant materials (Russell et al. 2009; Cechinel et al. 2012; Ochoa and Duval 2009).

Both Organic.Edunet and VOA3R/AGRIS use a knowledge organisation system (KOS) based on a controlled vocabulary to classify their resources. Organic. Edunet's learning materials are organised based on an organic agriculture and agro-ecology (OA-AE) ontology. This OA-AE ontology is stored and published by a web tool (Mooki-Tool 2016). AGRIS, on the other hand, uses AGROVOC terms linked to many datasets of the linked open data (LOD) variety (Bizer, Heath, and Berners-Lee 2009), e.g., DBpedia, which allows users to take advantage of a web of linked data.

The OA-EA ontology also uses mappings of OA-AE concepts onto terms defined in AGROVOC (Sánchez-Alonso and Sicilia 2009). AGROVOC is a mature thesaurus that provides a rich vocabulary of terminology associated with agriculture, forestry, food and related domains. For this reason, we use the same KOS based on the recommendation by Martín-Moncunill et al. (2015), which is linked to both repositories in order to access learning objects (Organic-Lingua 2016) and scientific publications (VOA3R/AGRIS) (VOA3R-Agris 2016) related to organic agriculture and agroecology.

2.2 Knowledge representation schemes

Some repositories integrate a knowledge representation scheme, such as a thesaurus or ontology, to better represent and classify learning objects. The representation scheme includes data structures that are defined by the use of tables, trees, links, graphs, etc. Each data structure has advantages and disadvantages when it comes to the representation of different types of knowledge. Advantages include: 1) Uddin's and Janecek's (2007) conclusion that through the use of multidimensional taxonomies, users could improve the location of resources; and 2) Stafford et al.'s (2008) evaluation of a bilingual version of a thesaurus-based graphical user interface (GUI), which found that the integration of search and navigation capabilities were useful for access to digital resources. Meanwhile, one of the most representative disadvantages (Gašević, Djurić and Devedžić 2009) is associated with the rigidity of the scheme and levels of reasoning. Other studies (Gómez-Perez 1999; Noshairwan, Qadir, and Fahad 2007) have identified errors associated with the definition of an ontology taxonomy. According to Gašević and Devedžić (2009), there is no generic method for knowledge representation that could serve as the standard for structuring data in all cases. In order to obtain an overview of these knowledge representation structures, each user needs to navigate through the interface, an essential attribute in the field of information visualisation (Graham, Kennedy and Benyon 2000), to carry out an evaluation process of user-interface.

In some cases, knowledge is represented as raw data, often stored as complex structures according to logical sequences, rules, trees, semantic graphs and other forms of representation (Flouris, Plexousakis and Antoniou 2003). These structures correspond to a formal classification and, in the best case, to semantic relationships of the data at the level of dependence, association, affinity, etc. Each knowledge representation technique requires a form of notation that include aspects of metadata records related to the subject area, level of affinity, links and forms of association, etc. To be effective in the context of learning environments, a knowledge representation scheme must be consistent. It must be as detailed as possible (Chrysafiadi and Virvou 2013) in order to represent a subject area and its connections to other subject areas. This form of representation allows, among other things, the expansion or limitation of the knowledge offered to users of the scheme. The tools most often used to design knowledge representation schemes for repositories include taxonomies, ontologies, thesauri, graphs and mind maps.

2.3 Limitations of repositories

The use of knowledge representation schemes in repositories is to facilitate organization and search processes related to specific topics or knowledge areas. However, a search for learning objects could return an unmanageably long list of results if the essential elements for refining the search are not provided. If indicators for assessing the quality of recorded information are not provided (Kumar, Nesbit, and Han 2005), searching for learning objects may be seen as entailing a considerable waste of time and effort.

Recent studies of usability in repositories have also revealed limitations in the use of interfaces. These studies have identified a series of limitations affecting some libraries and digital repositories. Tsakonas and Papatheodorou (2007) for example, conducted a usability analysis of the digital library E-LIS in which they found it difficult to perform certain search processes. Certain search tasks such as knowledge domains or topics by collections proved to be excessively time-consuming to carry out, and great effort was required to understand the user interface. Given that these strategies of searching were not sufficiently robust and flexible on their own, the authors emphasised the importance of complementing these strategies with others in order to better facilitate the location and accessing of digital resources in the collection. Studies by Buchanan and Salako (2009) and Petrelli (2008) similarly concluded that search processes based on a limited list of filtered criteria were highly time-consuming for users. Awareness of the limitations discussed here influenced the design and implementation of our visual framework tool based on the use of knowledge representation schemes such as the OA-AE ontology (API-Organic.Edunet 2016) to access learning objects and scientific publications in both Organic.Edunet and VOA3R/AGRIS. The next section will discuss the methodology and the details of the design and implementation of our visual framework tool.

2.4 Related work

The use of visual search methods has emerged only recently in the field of digital repositories. Some methods focus on the adequate level of access to digital resources. The *MACE* project (Stefaner et al. 2007) proposes several alternatives of visual search (semantic, social and contextual) for accessing digital resources in the field of "design and architecture" through classification strategies involving keywords, location, competence, social area and facets (Wolpers, Memmel and Stefaner 2010). These studies focus on perspectives that use various navigation paths combined with social labelling. Studies on the use of *MACE* showed that the principles of multifaceted navigation facilitate immersion processes through activities of collaborative tagging (Stefaner et al. 2007), and that the definition of metadata is crucial for the improvement of search processes based on contextual-search strategies.

Other visual methods used in search interfaces (Tunkelang 2009) are called "facet browsing" or "facet search." Related studies reveal that this method is highly recommended: 1) to organize and browse document collections (Ferré 2008; Stefaner, Urban and Seefelder 2008); 2) for relevance similarity of documents like books, blogs and photos via position on a base map (Dörk, Carpendale and Williamson 2012); and, 3) for heterogeneous data with explicit semantics (Polowinski 2009). An example of this method is "Fluid views" (Dörk, Carpendale and Williamson 2012), a tool that integrates dynamic queries, semantic zooming, and dual layers in order to explore collections like books or photos in digital libraries. *PivotPaths* (Dörk et al. 2012) is another example of a tool to explore information for maneuvering through faceted information spaces. The topics are depicted in a row and are connected to facets via links. Weighted faceted browsing (Voigt et al. 2012) is another tool that provides a sophisticated relevance ranking of the result set based on the distinction between mandatory and weighted optional search criteria. Video Lens (Matejka, Grossman and Fitzmaurice 2014) is a framework which allows users to visualize and interactively explore large collections of videos and associated metadata.

3.0 Methodology, design and evaluation

We define three phases in order to make our study. These aspects are related to the analysis of: 1) connecting learning objects of both Organic.Edunet and VOA3R repositories to a visual framework (section 3.1); 2) the design of a visual framework (section 3.2); and, 3) the evaluation of visual search tools based on usability aspects in order to analyze the use of interfaces through the development of a case study based on a human computer interaction (HCI) perspective (section 3.3).

3.1 Connecting learning objects to a visual framework tool

The OA-EA ontology provides instances to connect academic resources through the use of an API search (API-Organic.Edunet 2016). Additionally, to access scientific publications, we use mapped vocabularies defined by a SKOS format. For learning resources, the OA-EA ontology provides concepts and useful classifications associated with agriculture and agro-ecology. For scientific publications, the OA-EA ontology includes instances in order to connect bibliographical references associated with SKOS format through the use of LOD. This interface provides data in SKOS format, built in agreement with the syntax provided by the AGROVOC in order to maintain compliance with the other main organic agriculture repositories. Figure 1 illustrates the model of connections with resources used in both repositories (Organic.Edunet and VOA3R/AGRIS).

Figure 1 presents the model of the process to connect resources to a visual framework tool for the two repositories. The first step was implemented in order to connect educational and scientific resources based on OA-AE ontology that are stored and published by a central tool called MoKi (Mooki-Tool 2016). In the second step, we transformed the KOS of the OA-AE ontology to the JavaScript

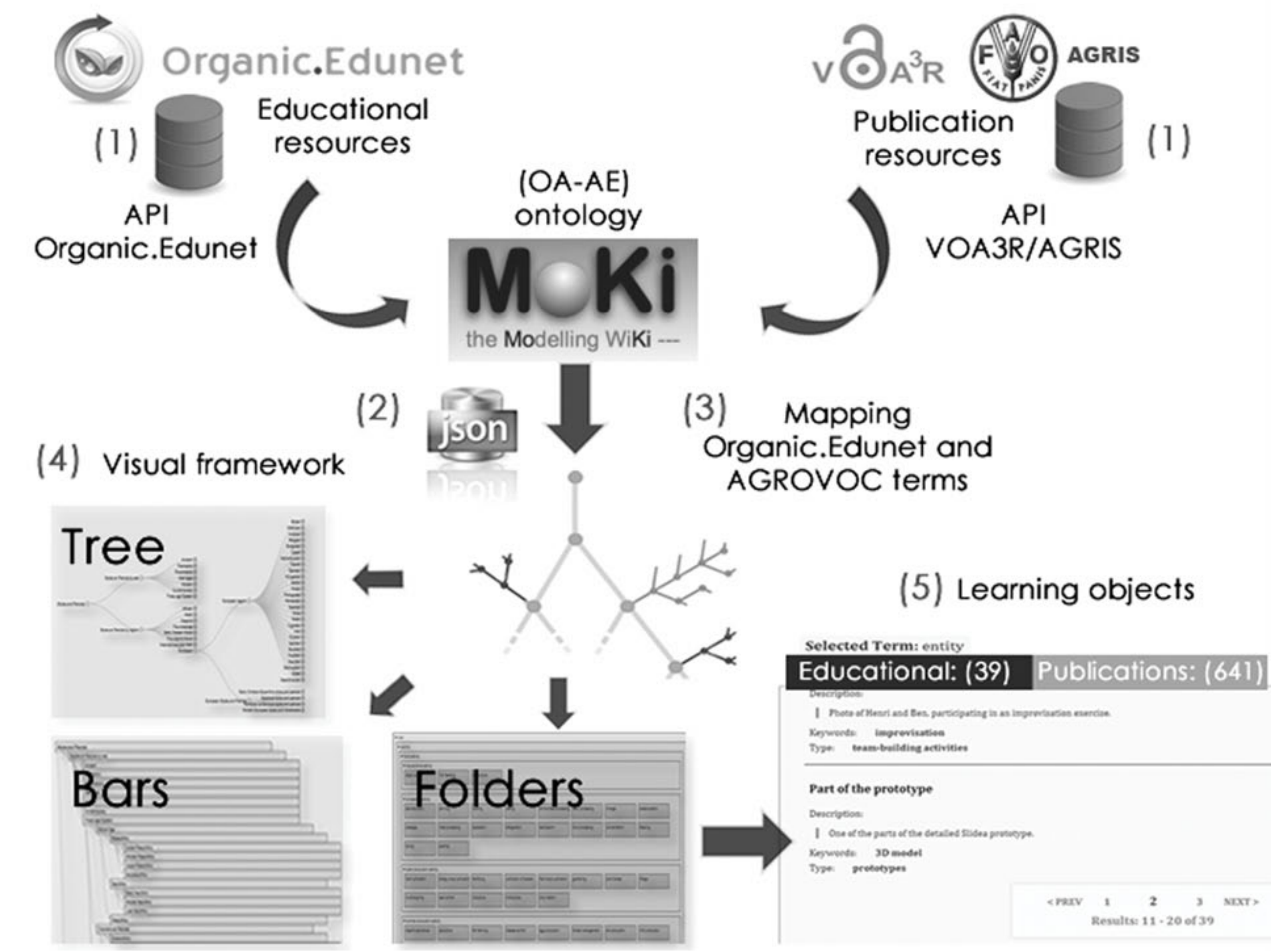


Figure 1. Model of process to connect learning objects in repositories.

Object Notation (JSON) format in order to define the navigational structure of the search. In the third step we established a connection to the learning objects of both educational and scientific publications through the use of Organic.Edunet and AGROVOC vocabularies. We then integrated three visual search interfaces (tree layout, indented tree and flow tree layout) based on the D3js (2016) library. Finally, we developed a visual strategy to display the found learning objects according to the topics selected by the search interface's selection of a visual framework tool. In the next section, we describe the development and integration of the visual search interfaces.

3.2 Design of visual framework

There are a large variety of visual techniques discussed by Draper, Livnat and Riesenfeld (2009), Gleicher et al. (2011) and also by Ren et al. (2010) in order to help end-users build interactive information visualisation. For the design of the visual search interfaces, we used a library called D3js made by Bostock and Heer (2009), a project for manipulating documents based on data through the use of JavaScript, Scalable Vector Graphics (SVG) and Cascading Style Sheets (CSS), and selected three navigational search interfaces: tree layout, indented tree and "flow tree layout," an adaptation of indented tree by White (2016).

These navigational interfaces were selected based on: 1) characteristics that relate to the visualisation techniques defined by Draper, Livnat and Riesenfeld (2009), Gleicher et al. (2011) and Graham, Kennedy and Benyon (2000), which include classification and hierarchical depth; 2) related studies based on taxonomy classification interfaces (Wang, Chaudhry and Khoo 2008; Dinkla et al. 2011; Gaona-García et al. 2014; Gaona-García, Sánchez-Alonso and Montenegro Marín 2014); and, 3) the use of navigation prototypes for hierarchical structures (Merčun and Žumer 2010; Merčun, Žumer and Aalberg 2012).

To carry out the model of process, we used a three-layer model to define a visual framework tool. Figure 2 illustrates our framework proposal for defining a strategy of connecting and linking learning objects.

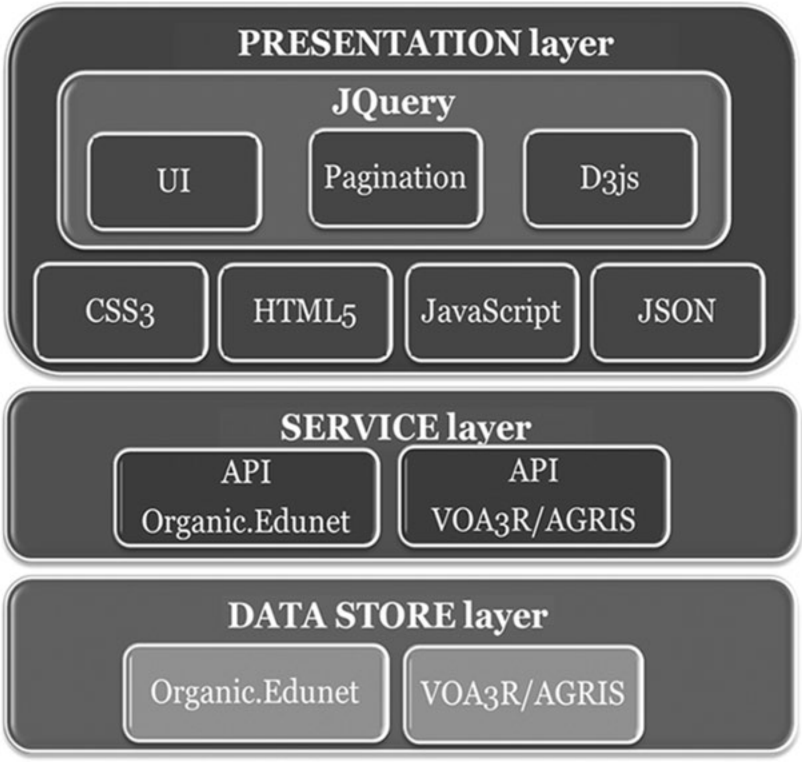


Figure 2. Visual framework proposal.

The three layers of the model are as follows:

- Presentation layer: The presentation layer is implemented for the management and display of data to the user. This layer treats the whole visual representation of the data, including both the user side and the drivers and graphics libraries (D3js, JavaScript, CSS3 and HTML5). The latter are responsible for processing the data to provide a unique representative data format. In this case, converted from SKOS format to JSON format.
- Service layer: This layer is used for the consumption of services through web services where the information (metadata) is obtained to be processed and presented in the presentation layer. In this case, we consumed these services through the use of API Organic.Edunet (API-Organic.Edunet 2016) and used mappings to AGROVOC concepts for access to VOA3R/AGRIS.
- Data storage layer: This layer translates all requests and processes performed by the user in the presentation layer (topics of navigational search) into language understandable to repositories (OA-EA ontology), e.g., all metadata of learning objects (title, description, keywords, language, etc.) and mapping to topics or knowledge areas to the Organic.Edunet and VOA3R/AGRIS repositories.

Figure 3 present a mockup of the design of the visual search tool that we defined, in order to integrate visualisation interfaces and repositories.

Based on principles of human computer interaction (HCI), aspects defined by the design of interfaces proposed by White and Roth (2009), Russell et al. (2015), Hearst (2011), and according to the purpose of the research to integrate several visual search interfaces in both academic and scientific repositories, we focus on four basic aspects for the design of a visual search tool: 1) selection of visual search interfaces; 2) use of searching topics in a navigational interface in order to apply principles of exploratory search; 3) searching topics in a traditional search box method; and, 4) unfolding taxonomies of themes selected by the visual search interface. Figure 3 depicts a representation of the navigational structure of the visual search interface: 1) users can select a navigational view: "trees," "bars" and "folders;" 2) it presents the navigational search for the tree interface; and, 3) the user selected the concept in a traditional search box method or the visual search interface, and then the taxonomy classification of the topic selected is displayed.

3.3 Evaluation

We used the Technology Acceptance Model (TAM) to conduct a questionnaire survey in order to evaluate the

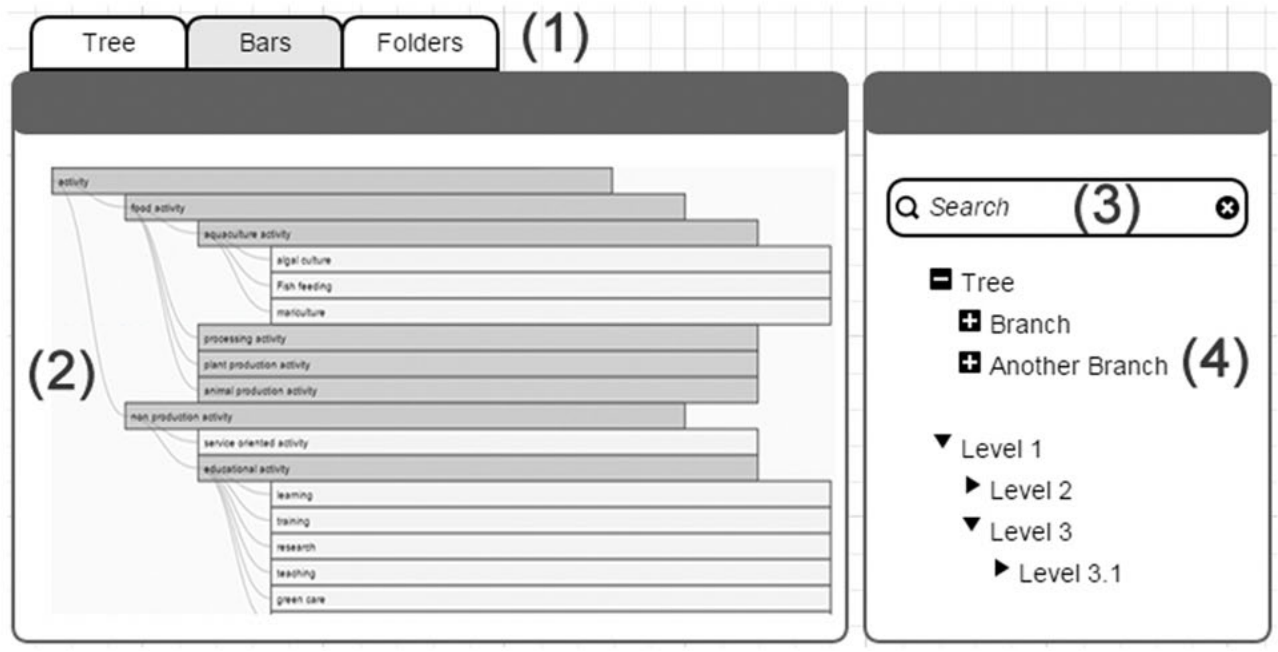


Figure 3. Design of visual search tool.

visual framework tool. TAM has been used in many digital libraries (Fuhr et al. 2007; Jeong 2011; Park et al. 2009; Thong, Hong and Tam 2002) and repositories (Kim and Kim 2008; Tsakonas and Papatheodorou 2008; Zhang, Maron and Charles 2013). The survey obtained subjective impressions of the visual framework and demonstrated the potential value of the approach for improving access to learning and scientific resources in the two repositories, i.e., to academic learning objects associated with the Organic.Edunet repository and scientific publications associated with the VOA3R/AGRIS repository. The purpose of this evaluation was to obtain values with which to analyse the usability, usefulness and performance of the visual framework. These three traits are predominant aspects of these types of studies (Griffiths, Johnson and Hartley 2007) to evaluate the performance of applications in information systems. In addition to these traits, other significant attributes that have been used for evaluation in related research (Buchanan and Salako 2009; Jeng 2005; Tsakonas and Papatheodorou 2006; Tsakonas and Papatheodorou 2008) in the field of digital libraries are "ease of use," "navigation," "relevance," "learnability," "terminology," "reliability," "response time" and "aesthetic." Also notable are the attributes "coverage," "precision" and "hierarchical taxonomy" defined by Gaona et al. (2014), which have been used to evaluate subjective impressions of digital repositories.

According to the objectives of the study and the recommendations commonly used for this type of study (Nielsen 1994), 74 participants were selected for the test. Participants included 26 students from the Agriculture University of Athens, 32 researchers and 16 librarians. All participants are involved in the use of academic and scientific publications in the field of agriculture and agroecology, respectively.

The questionnaire was developed in two different cities (Athens, Greece and Madrid, Spain) and is comprised of two parts. The first part (preparation phase, section 3.3.1) is a training phase to introduce participants to the visual framework and learning objects associated with repositories. The second phase (evaluation phase, section 3.3.2) had two objectives: 1) analyse the whole visual search tool in order to assess the integration of the visual navigational search with learning resources found in both repositories; and, 2) analyse the user satisfaction of interfaces to identify the most suitable visual search interface.

3.3.1 Preparation phase

This phase served to introduce the Organic.Edunet ontology and explain the concepts of, and differences between, academic and scientific learning resources. The preparation phase purposely did not involve any real interaction with the visual search tool so that the data collected would illustrate the existing wants and preconceptions of the participants. The preparation phase consisted of a training session with participants in a face-to-face setting. The organiser of the training session gave a short talk on similar related tools, e.g., navigational search of Organic.Edunet (Organic-Lingua 2016) and VOA3R (VOA3R-Agris 2016) repositories and explained the historical context. Following the talk, a questionnaire was distributed to the participants

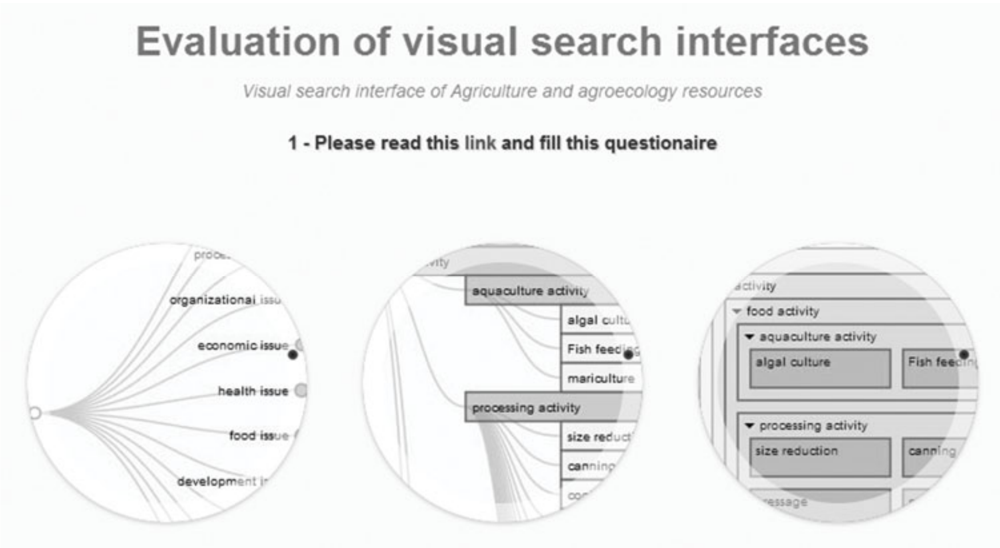


Figure 4. Evaluation of visual search interfaces.

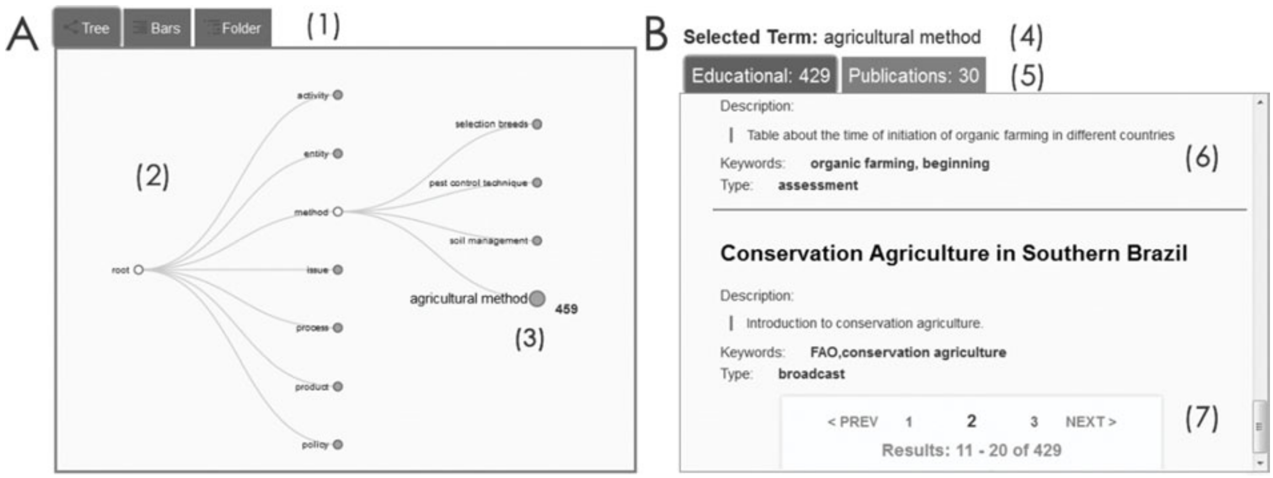


Figure 5. (A) Tree navigational search (B) Learning objects found in both repositories.

to collect information about their user profiles, experience and basic demographic data (Appendix 1).

3.3.2 Evaluation phase

The second phase consisted of 15-minute sessions in which participants interacted with the visual search tool. Participants used visual interfaces to search learning objects based on topics relating to agriculture and agroecology defined in the OA-EA ontology. Following the session, a questionnaire was given to participants to gather information about perception of user satisfaction and perceived utility of the visual framework as a whole. Figure 4 presents the tool designed to carry out the evaluation of visual interfaces.

A TAM questionnaire was adapted to the purpose of evaluation of the visual search tool, enabling participants to describe their experience in concrete terms and make suggestions for additional features. The results of this questionnaire were then compared to analyse the potential benefits and limitations of a visual search.

We adapted the TAM questionnaire according to the recommendations of Tsakonas and Papatheodoru (2008) and attributes of user perceptions based on Heradio et al. (2012), using 26 questions based on three attributes: "usefulness," "usability" and "performance" (Appendix 2). However, we designed the questions to further evaluate two aspects: the "precision" and "understandability" of visual search interfaces. We examined the whole visual framework in order to assess aspects of the visual navigational search and precision of learning objects found in both repositories. We designed the questions to evaluate the visual search interfaces in order to identify the most suitable visual search interface. In Figure 5, we present an

	1	2	3	4	5	Mean	Standard Deviation (SD)
	(%)	(%)	(%)	(%)	(%)		(%)
Usefulness							
Relevance	0	0	16.7	66.7	16.7	4.00	0.590
Coverage	0	0	8.3	33.3	58.3	4.50	0.659
Taxonomy	0	0	8.3	66.7	25.0	4.08	0.654
Usability							
Learnability	0	0	25.0	50.0	25.0	4.04	0.722
Terminology	0	0	16.7	50.0	33.3	4.17	0.702
Aesthetics	0	0	0	50.0	50.0	4.50	0.511
Performance							
Response time	0	0	8.3	50.0	41.7	4.17	0.702
Precision	0	0	16.7	58.3	25.0	4.04	0.690

Table 1. Descriptive statistical analysis for visual framework (1=disagree, 5=agree).

example of the use of one navigational search ("tree interface"). Figure 5(A) illustrates the integration of visual search interfaces, in this case the tree interface, and Figure 5(B) presents the results of a search of educational and scientific publications associated with the concept "agricultural method."

Figure 5(A) depicts a representation of the navigational structure of the tree interface.

1. Users can select a navigational view: "tree" (tree layout), "bars" (indented tree) and "folders" (flow tree layout).
2. It presents the navigational search for the "tree" interface.
3. The user selected the concept "agricultural method" to display the number of materials, 489, found in repositories for both educational and scientific publications of learning objects.

Figure 5(B) presents the results—the learning objects found in both repositories.

4. Shows the concept selected, "agricultural method."
5. Presents the learning objects for educational publications, 429, and scientific publications, 30.
6. Presents the metadata used to display learning objects, and, finally,
7. Presents a pagination system for navigating through all found learning objects.

4.0 Results

The first part of the questionnaire (11 questions) covers the usefulness, usability and performance attributes of the whole visual framework, including traits for resources such as relevance, coverage, taxonomic hierarchy, learnability, terminology, response time and precision. The second part of the questionnaire (15 questions) evaluates the same attributes as the first, only this time in relation to the visual search interfaces rather than the whole visual framework. The second part of the questionnaire also examines additional traits such as ease of use, aesthetic, navigation, reliability and efficiency.

The next section presents the results of the evaluation. We first present the results related to the whole visual framework (section 4.1) associated with navigational search and precision of learning objects with topics selected from both repositories. We then analyse the aspects of the evaluation that relate to the visual search interfaces (section 4.2).

4.1 Visual framework as a whole

This section presents the results of the first part of the questionnaire, which addresses aspects of usefulness, usability and performance. Table 1 shows the participant survey results from our study, using a five-point scale (1=strongly disagree; 2=disagree; 3=neutral; 4=agree; 5=strongly agree). The five scale values represent the subjective satisfaction of the users with regard to the visualisation framework and its functionality for accessing academic learning objects and scientific publications.

According to visual perception by all participants, the whole visual framework is considered a generally good tool for processing the search and access of learning objects. However, there still exist some general issues in the use of these visual interfaces according to the results by user profiles presented in Table 2.

		Usefulness			Usability			Performance	
User Profile		**Relevance**	**Cover-age**	**Taxon-omy**	**Learnability**	**Terminol-ogy**	**Aesthet-ics**	**Response Time**	**Preci-sion**
Researcher	Mean	3.75	4.375	4.125	3.75	3.875	4.5	3.875	4
	SD	0.707	0.744	0.64	0.707	0.834	0.534	0.834	0.755
Librarian	Mean	4	4.75	3.75	4.25	4.5	4.5	4.25	4
	SD	0.816	0.5	0.957	0.957	0.577	0.577	0.5	0.816
Undergrad	Mean	4.166	4.5	4.166	4.166	4.166	4.5	4.333	4.083
	SD	0.389	0.674	0.577	0.5773	0.717	0.522	0.651	0.668
Total	Mean	4.00	4.50	4.08	4.04	4.13	4.50	4.17	4.04
	SD	.589	.659	.653	.690	.740	.510	.701	.690

Table 2. Summary for interactions according to user profile (1=low satisfaction, 5=high satisfaction).

In the next section, we describe, in general, the results according to the attributes of usefulness, usability and performance.

4.1.1 Usefulness results

According to Table 1 in the "usefulness" category, relevance received a high level of agreement (66.7%). This result indicates that a high percentage of participants felt that the visual framework provided good levels of helpful information, e.g., abstracts, descriptions, formats, etc., for search tasks. In the "coverage category," a large number of participants (58.3%) agreed that the visual framework provided a high number of learning objects covering all topics of the knowledge representation scheme used for the visual search. However, in Table 2, researchers indicated that the information provided by the visual search tool for searching scientific publications was not completely relevant (mean=3.75; SD=0.707), because there were few options for refining searches, e.g., by title, type of publication, language, etc. Undergraduate students, meanwhile, were completely satisfied with the quality of the retrieved content (mean=4.17, SD=0.389). The category of "taxonomy" showed similar results for both undergraduate students (mean=4.17; SD=0.577) and researchers (mean=4.125; SD=0.640). Librarians, however, demonstrated more neutral opinions (mean=3.75; SD=0.957), particularly because the majority of them were not familiar with knowledge representation schemes. We will discuss this further in the next section.

4.1.2 Usability results

Although the navigation structure had a high rate of agreement for "usefulness," participants agreed that it was necessary to have prior knowledge of the OA-EA ontology in order to perform exploration and search processes within the navigation structure. Researchers felt it necessary to have more time to understand and learn the visual framework in order to search learning objects (mean=3.75; SD=0.707). However, undergraduate students (mean=4.166; SD=0.573) and librarians found the visual search tool easy to learn ("learnability") in the time allotted (mean=4.25; SD=0.957). The "aesthetic" attributes of the visual search tool were rated highly across researchers (mean=4.5; SD=0.535), librarians (mean=4.5; SD=0.577) and undergraduate students (mean=4.5; SD=0.522). A small percentage of participants (20.8%) were not completely familiar with the terminology used by the OA-EA ontology for searching learning objects. Although through the use of navigation taxonomy, participants later obtained good results as presented in Section 4.2.

4.1.2 Performance results

In terms of performance, participants' subjective perception of response-time was positive (mean=4.17; SD=0.702) according to Table 1. Participants similarly indicated that the visual search tool presented results that were very precisely ("precision") related to the topic or knowledge area selected in the knowledge representation scheme for both educational and scientific publications (mean=4.04; SD=0.609). However, there were results for visual interfaces where users obtained an increase of response time for retrieval learning objects. These results are presented in the next section.

4.2 Suitable visual search interface

Building on the results of the visual search tool survey questions, we here evaluate user perceptions of the suit-

		Usefulness	Usability			Performance
		Reliability	Ease of Use	Aesthetics	Navigation	Effectiveness
Tree	Mean	4.6667	4.5833	4.7500	4.6667	4.6667
	SD	0.4815	0.5036	0.4423	0.4815	0.4815
Bars	Mean	3.9167	4.2500	3.9167	4.1667	4.0833
	SD	0.5036	0.7372	0.6539	0.5647	0.6539
Folder	Mean	3.3333	3.0000	3.1667	2.9167	3.6667
	SD	0.9631	0.9325	0.8165	0.8805	0.6370
TOTAL	Mean	3.9722	3.9444	3.9444	3.9167	4.1389
	SD	0.8717	1.0055	0.9176	0.9894	0.7181
Notes: 1=low satisfaction, 5=high satisfaction						

Table 3. Perception of visual search interfaces.

able visual search interface for accessing learning objects. Table 3 displays these results.

As shown in Table 3, the tree interface was generally rated as the most suitable visual search interface on all attributes. The attributes scored as follows: "reliability" (mean=4.6667; SD=0.4815), "ease of use" (mean=4.5833; SD=0.5036), "aesthetic" (mean=4.7500; SD=0.4423), "navigation" (mean=4.6667; SD=0.4815) and "effectiveness" (mean=4.6667; SD=0.4815). Table 4 present results of perception by user profile.

According to the user profile shown in Table 4, researchers preferred the "bars" interface (mean=4.104; SD=0.501) to the "tree" interface (mean=3.845; SD= 0.451), because the bar interface allowed the display of more terms and concepts associated with one narrower search term (the root term of the structure). Nevertheless, for undergraduate students, the tree interface had a better ease of use (mean=4.583; SD=0.514) than the bars interface by librarians who had a low validation (mean=3.705; SD=0.957).

Finally, as shown in Table 5, we studied correlation in order to determine whether the visual perception of some attributes influenced the assessment of other evaluation criteria in the use of visual search interfaces.

According to the Pearson correlation of Table 3, there are highly significant correlations between reliability and navigation (r=0.814) and "aesthetic" and "navigation" (r=0.708). These correlations were highly moderate and considerably positive; this means that participants in general were influenced by reliability and aesthetic attributes in their evaluation of the navigation of visual search interfaces.

5.0 Discussion and implications

According to Gaona et al. (2014), visual search interfaces generally allow users to build on their knowledge, without deliberate effort, to carry out search processes through the use of a knowledge representation scheme. However, based on the results of this research some problems still exist in the capacity for exploring concepts within a simple knowledge representation scheme. These problems include: 1) terminologies associated with related terms or non-preferred terms in different hierarchical categories; 2) classification schemes—sometimes it is complicated for end-users to understand the context of a classification scheme concept and the relationships that link the terms (therefore, it is necessary to carry out tutorial support within the visual framework to allow the end-user to have a better understanding of the knowledge representation scheme that is being used); 3) mapping of a knowledge representation scheme—to improve the access of several repositories through the use of a simple knowledge representation scheme, it is necessary to carry out a complete mapping of concepts and terms of all SKOS formats. If there are limitations to these mapping vocabularies, the visual framework cannot visualise resources by external repositories. Such problems may affect the system's usability if visual interfaces and the creators of repositories cannot provide methods to guide participants within a navigation structure.

Although our research has proven the "effectiveness" of visual interfaces through visual perception of participants, it is necessary to validate these findings by employing various complementary research techniques and by experimenting with adaptations of this promising visual search tool. It is necessary, then, to carry out usability studies with specialised techniques such as eye-tracking (Rosch and Vogel-Walcutt 2013) and holistic models (Zhang 2010; Bertot et al. 2006; Heradio et al. 2012) to obtain a careful user analysis through observation methods. These studies will facilitate the design of new easy-to-learn functionalities, such as providing controls where

		Tree interface					Bars interface					Folder interface				
User Profile		Reliability	Ease of Use	Navigation	Aesthetics	Effectiveness	Reliability	Ease of Use	Navigation	Aesthetics	Effectiveness	Reliability	Ease of Use	Navigation	Aesthetics	Effectiveness
Researcher	Mean	4.5000	4.5000	4.5000	4.7500	4.5000	4.0000	4.5000	4.1250	3.8750	3.8750	3.2500	3.2500	3.1250	3.2500	3.5000
	SD	.53452	.53452	.53452	.46291	.53452	.53452	.53452	.64087	.64087	.64087	1.03510	1.03510	.99103	.88641	.53452
Librarian	Mean	5.0000	4.7500	5.0000	4.7500	5.0000	3.7500	3.7500	4.2500	4.0000	4.5000	3.5000	2.5000	2.5000	3.0000	4.0000
	SD	0.00000	.50000	0.00000	.50000	0.00000	.50000	.95743	.50000	.81650	.57735	1.00000	.57735	.57735	.81650	.81650
Undergrad	Mean	4.6667	4.5833	4.6667	4.7500	4.6667	3.9167	4.2500	4.1667	3.9167	4.0833	3.3333	3.0000	2.9167	3.1667	3.6667
	SD	.49237	.51493	.49237	.45227	.49237	.51493	.75378	.57735	.66856	.66856	.98473	.95346	.90034	.83485	.65134
Total	Mean	4.6667	4.5833	4.6667	4.7500	4.6667	3.9167	4.2500	4.1667	3.9167	4.0833	3.3333	3.0000	2.9167	3.1667	3.6667
	SD	.48154	.50361	.48154	.44233	.48154	.50361	.73721	.56466	.65386	.65386	.96309	.93250	.88055	.81650	.63702

Table 4. Summary of user perception by user profile (1=low satisfaction, 5=high satisfaction).

	Reliability	Ease of Use	Navigation	Aesthetics	Effectiveness
Reliability	1				
Ease of Use	0,352**	1			
Navigation	**0,814****	0,618**	1		
Aesthetics	0,562**	0,577**	**0,708****	1	
Effectiveness	0,591**	0,401**	0,611**	0,568**	1
** The correlation is significant at a level of 0.01 (bilateral).					

Table 5. Pearson correlation of attributes for visual search interfaces.

the user expects them to be and reducing external instructions or inconsistencies resulting from unnecessary additional functions. It is also necessary, according to Heradio et al. (2012), to establish a consensus on standard definitions and methods for carrying out complete usability and usefulness studies in repositories.

In relation to the "effectiveness" of visual search interfaces, it is important to note that, if the description fields of digital objects in repositories are not well described, this limitation in the metadata has a very negative impact on the search process for digital resources (Cechinel, Sánchez-Alonso and Sicilia 2009; Park 2009). High-quality resources cannot be located easily by end-users if they are not well defined. The exclusion of the use of metadata in repositories would not facilitate the search processes for learning objects, e.g., within a specific thematic area defined in a knowledge representation scheme; and therefore, the efforts to integrate visualisation techniques to repositories would be unsuccessful.

In summary, this may indicate that information visualisation allows rapid location of resources within a taxonomic structure by using search criteria based on knowledge representation schemes. However, in order to be able to understand the use of visual interfaces, it is important to note that the learning curve is one of the factors, if not the only, which plays an important role to perform appropriate use of visual search interfaces. Therefore, it is essential to define usability studies which combine the use of knowledge representation schemes and effective search interfaces aimed at promoting resource exploration processes within a digital library or repository according to the purposes thereof.

6.0 Conclusions and recommendations

Results presented useful visual search interfaces with a consistent terminology thanks to the use of a mature knowledge representation scheme by using OA-EA ontology. It is important to remark the design of elements and controls placed in familiar locations in order to provide a usable visual framework to search learning objects. In this direction and according to the results of our study, information visualisation in digital repositories could improve access and location to learning objects in both academic and scientific repositories given the increase of users, who are demanding better service and functionalities in repositories. Therefore, visual search interfaces based on knowledge representation schemes allow users, with minimal effort, to build on their knowledge to search learning objects.

Based on our study results, it is clear that digital repositories should work on strategies to facilitate the interoperability and re-use of digital resources such as semantic enrichment defined by metadata. However, creators of repositories focus further efforts on facilitating access to large collections of digital resources by linking learning objects based on interoperability standards such as linked data. There are several studies (Rajabi, Sicilia and Sanchez-Alonso 2015; Ren et al. 2010; Zhang 2014) based on structure linked to a series of semantic enrichment strategies over educational resources. These strategies of linking would facilitate the management and maintenance of digital resources through good design practices and by linking learning objects to the areas of knowledge stored in external repositories.

The successful use of knowledge representation schemes in visual search interfaces depends largely on several aspects defined by Gaona-García, Martín-Moncunill and Montenegro Marín (in press), which has not been fully included in this study but is necessary to mention the most important factors in order to improve the conditions of access to digital resources, e.g., firstly, creators should include a usefulness knowledge representation scheme. Visual frameworks should have several knowledge representation schemes based on user profiles (secondary students, undergraduate students, professionals or researchers). These tools could facilitate the use of navigational search interfaces and improve the learning of end-users seeking to understand complex relationships according to the term or concept selected. Secondly, effectiveness visual search interfaces should be considered; this selection depends on complete usability studies related to the knowledge representation scheme selected including: taxonomy classification, levels of depth of KOSs, relations and mappings by terms and concepts related to other KOSs (ontologies, thesauri), response time of queries made at different classification levels and terms or concepts. These aspects are necessary conditions in an educational scenario for creating a collaborative work environment in order to favour processes to find educational material and categorically cover knowledge areas of interest by end users like students or teachers.

Future work should involve the analysis and visualisation evaluation of learning objects through the use of services. Future projects should use multilingual knowledge representation schemes. These schemes define visualisation strategies for the deployment of learning objects in several languages from the same SKOS format. Future projects also should include visual analytics of links to learning objects that are mapped within the knowledge representation scheme through external repositories. Visual analytics of the frequency of access to academic repositories and a history of the learning objects queried should be available to provide relevant resources to end-users. Finally, the inclusion of the user interface as a Service UIaaS (Sherchan et al. 2012) in order to obtain better search results and generate context-aware interface services like the multilingual services, favourite learning objects, rankings in the use of repositories, and enrich learning objects through the use of peer-reviewers.

References

Agrovoc. 2016. "AGROVOC Multilingual Agricultural Thesaurus." http://aims.fao.org/vest-registry/vocabularies/agrovoc-multilingual-agricultural-thesaurus

API-Organic.Edunet. 2016. "Ontology Service API." http://wiki.organic-lingua.eu/APIs#Ontology_Service_API

Barton, Jane, Sarah Currier and Jessie M. Hey. 2003. "Building Quality Assurance into Metadata Creation: An Analysis Based on the Learning Objects and E-Prints Communities of Practice." In *DC-2003—Seattle Proceedings: Papers and Project Reports for DC-2003 in Seattle, 28 September - 2 October 2003*, 39-48.

Bertot, John Carlo, John T. Snead, Paul T. Jaeger and Charles R. McClure. 2006. "Functionality, Usability, and Accessibility: Iterative User-Centered Evaluation Strategies for Digital Libraries." *Performance Measurement and Metrics* 7:17-28. doi:10.1108/14678040610654828

Bizer, Christian, Tom Heath and Tim Berners-Lee. 2009. "Linked Data - The Story so Far." *International Journal on Semantic Web and Information Systems* 5:1-22. doi:10.4018/jswis.2009081901

Bostock, Michael and Jeffrey Heer. 2009. "Protovis: A Graphical Toolkit for Visualization." *IEEE Transactions on Visualization and Computer Graphics* 15:1121–28. doi:10.1109/TVCG.2009.174

Buchanan, Steven and Adeola Salako. 2009. "Evaluating the Usability and Usefulness of a Digital Library." *Library Review* 58:638-51. doi:10.1108/00242530910997928

Cechinel, Cristian, Sandro Da, Silva Camargo, Xavier Ochoa, Salvador Sanchez-Alonso and Miguel-Ángel Sicilia. 2012. "Populating Learning Object Repositories with Hidden Internal Quality Information." In *Proceedings of the 2nd Workshop on Recommender Systems for Technology Enhanced Learning (RecSysTEL 2012),* ed. Nikos Manouselis, Hendrik Drachsler, Katrien Verbert and Olga Santos. CEUR Workshop Proceedings 896:11-22.

Cechinel, Cristian, Salvador Sánchez-Alonso and Miguel-Ángel Sicilia. 2009. "Empirical Analysis of Errors on Human-Generated Learning Objects Metadata." *Communications in Computer and Information Science* 46:60-70. doi:10.1007/978-3-642-04590-5_6

Cervera, Juan F., Maria G. López-López, Cristina Fernández and Salvador Sánchez-Alonso. 2009. "Quality Metrics in Learning Objects." In *Metadata and Semantics,* ed. Miguel-Angel Sicilia and Miltiadis D. Lytras, 135-41. New York: Springer. doi:10.1007/978-0-387-77745-0_13

Chrysafiadi, Konstantina and Maria Virvou. 2013. "A Knowledge Representation Approach Using Fuzzy Cognitive Maps for Better Navigation Support in an Adaptive Learning System." *SpringerPlus* 2:1-3. doi:10.1186/2193-1801-2-81

D3js. 2016. "D3 Data-Driven Documents." http://d3js.org/

Dinkla, K., M. A. Westenberg, H. M. Timmerman, S.A.F.T. Van Hijum and J. J. Van Wijk. 2011. "Comparison of Multiple Weighted Hierarchies: Visual Analytics for Microbe Community Profiling." *Computer Graphics Forum* 30:1141-50. doi:10.1111/j.1467-8659.2011.01963.x

Dörk, Marian, Sheelagh Carpendale and Carey Williamson. 2012. "Fluid Views: A Zoomable Search Environment." In *Proceedings of the International Working Conference on Advanced Visual Interfaces, May 22-25 2012, Capri Island, Italy,* ed. Genny Tortora, Stefano Levialdi and Maurizio Tucci. NY: ACM, 233-40. doi:10.1145/2254556.2254599

Dork, Marian, Nathalie Henry Riche, Gonzalo Ramos and Susan Dumais. 2012. "Pivot Paths: Strolling through Faceted Information Spaces." *IEEE Transactions on Visualization and Computer Graphics* 18:2709-18. doi:10.1109/TVCG.2012.252.

Draper, Geoffrey M., Yarden Livnat and Richard F. Riesenfeld. 2009. "A Survey of Radial Methods for Information Visualization." *IEEE Transactions on Visualization and Computer Graphics* 15:759-76. doi:10.1109/TVCG.2009.23

Ferré, Sébastien. 2008. "Agile Browsing of a Document Collection with Dynamic Taxonomies." In *Proceedings of International Workshop on Database and Expert Systems Applications, DEXA*, *September 01-05 2008, Turin, Italy,* ed. International Workshop on Database and Expert Systems Applications. Los Alamitos, Calif.: IEEE Computer Society, 377-81. doi:10.1109/DEXA.2008.28

Flouris, Giorgos, Dimitris Plexousakis and Grigoris Antoniou. 2003. "Describing Knowledge Representation Schemes: A Formal Account." Technical Rep. No. TR-320. Heraklion: Institute of Computer Science. Foundation for Research and Technology (ICS-FORTH). https://www.ics.forth.gr/tech-reports/2003/2003.TR320.Knowledge_Representation_Schemes.pdf

Fuhr, Norbert, Giannis Tsakonas, Trond Aalberg, Maristella Agosti, Preben Hansen, Sarantos Kapidakis and Claus-Peter Klas.2007. "Evaluation of Digital Libraries." *International Journal on Digital Libraries* 8:21-38. doi:10.1007/s00799-007-0011-z

Gaona-García, P. A., David Martín-Moncunill and Carlos Montenegro Marín. "Trends and Challenges of Visual

Search Interfaces in Digital Libraries and Repositories." *The Electronic Library* forthcoming.

Gaona-García, Paulo Alonso, David Martín-Moncunill, Salvador Sánchez-Alonso and Ana Fermoso García. 2014. "A Usability Study of Taxonomy Visualisation User Interfaces in Digital Repositories." *Online Information Review* 38:284-304. doi:10.1108/OIR-03-2013-0051

Gaona-García, Paulo Alonso, Salvador Sánchez-Alonso and Carlos E. Montenegro Marín. 2014. "Visualization of Information: A Proposal to Improve the Search and Access to Digital Resources in Repositories." *Revista Ingenieria e Investigacion* 34:83-9.

Gašević, Dragan, Dragan Djurić and Vladan Devedžić. 2009. *Model Driven Engineering and Ontology Development*. 2nd ed. Dordrecht; New York: Springer.

Gleicher, Michael, Rick Walker, Ilir Jusufi, Charles D. Hansen and Jonathan C. Roberts. 2011. "Visual Comparison for Information Visualization." *Information Visualization* 10:289–309. doi:10.1177/1473871611416549

Gomez-Perez, Asuncion. 1999. "Evaluation of Taxonomic Knowledge in Ontologies and Knowledge Bases." In *Proceedings of the 12th Workshop for Knowledge Acquisition, Modeling and Management (KAW'99), October 16-21 1999, Banff, Canada,* ed. B. R. Gaines, R. Kremer and M. Musen. Alberta, Canada: University of Calgary, 1-18.Graham, Martin, Jessie Kennedy and David Benyon. 2000. "Towards a Methodology for Developing Visualizations." *International Journal of Human Computer Studies* 53:789-807. doi:10.1006/ijhc.2000.0415

Griffiths, Jillian R., Frances Johnson and Richard J. Hartley. 2007. "User Satisfaction as a Measure of System Performance." *Journal of Librarianship and Information Science* 39:142-52. doi:10.1177/0961000607080417

Hartson, H. Rex, Priya Shivakumar and Manuel A. Pérez-Quiñones. 2004. "Usability Inspection of Digital Libraries: A Case Study." *International Journal on Digital Libraries* 4:108-23. doi:10.1007/s00799-003-0074-4

Hearst, Marti A. 2006. "Design Recommendations for Hierarchical Faceted Search Interfaces." In *Proceedings of 29th Annual International ACM SIGIRConference on Research and Development in Information Retrieval.* New York: ACM.

Conference on Research & Development on Information Retrieval, August 10-11 2006, Seattle, ed. Susan Dumais, Efthimis Nikolaos Efthimiadis, David Hawking and Jaȑvelin Kalervo. New York, N.Y.: ACM, 26-30.

Kim, Hyung Hee and Yong Ho Kim. 2008. "Usability Study of Digital Institutional Repositories." *Electronic Library* 26:863-81. doi:10.1108/02640470810921637

Heradio, Ruben, Davide Fernández-Amorós, Francisco Javier Cabrerizo and Enrique Herrera-Viedma. 2012. "A Review of Quality Evaluation of Digital Libraries Based on Users' Perceptions." *Journal of Information Science* 38:269-83. doi:10.1177/0165551512438359

Hitchcock, Steve, Arouna Woukeu, Tim Brody, Les Carr, Wendy Hall and Stevan Harnad. 2003. "Evaluating Citebase, An Open Access Web-Based Citation-Ranked Search and Impact Discovery Service." http://opcit.eprints.org/evaluation/Citebase-evaluation/evaluation-report.html

Jeng, Judy. 2005. "Usability Assessment of Academic Digital Libraries: Effectiveness, Efficiency, Satisfaction, and Learnability." *Libri* 55:96-121.

Jeong, Hanho. 2011. "An Investigation of User Perceptions and Behavioral Intentions towards the E-Library." *Library Collections, Acquisition and Technical Services* 35 nos. 2/3:45-60. doi:10.1016/j.lcats.2011.03.018

Kumar, V., John Nesbit and Kate Han. 2005. "Rating Learning Object Quality with Distributed Bayesian Belief Networks: The Why and the How." In *Proceedings of 5th IEEE International Conference on Advanced Learning Technologies, ICALT 2005, 5-8 July 2005, Kaohsiung, Taiwan,* ed. Peter Goodyear, Demetrios G. Sampson, David Jin-Tan, Yang Kinshuk, Toshio Okamoto, Roger Hartley and Nian-Shing Chen. Washington, DC: IEEE Computer Society, 685-7. doi:10.1109/ICALT.2005.230

Lytras, Miltiadis D and Miguel-Angel Sicilia. 2007. "Where Is the Value in Metadata?" *International Journal of Metadata, Semantics and Ontologie* 2:235-41.

Manouselis, Nikos, Kostas Kastrantas, Salvador Sanchez-Alonso, Jesus Cáceres, Hannes Ebner and Matthais Palmer. 2009. "Architecture of the Organic.Edunet Web Portal." *International Journal of Web Portals* 1, no. 1:71-91.

Martín-Moncunill, David, Elena García-Barriocanal, Miguel-Angel Sicilia and Salvador Sánchez-Alonso. 2015. "Evaluating the Practical Applicability of Thesaurus-Based Keyphrase Extraction in the Agricultural Domain: Insights from the VOA3R Projectt." *Knowledge Organization* 42:76-89.

Matejka, Justin, Tovi Grossman and George Fitzmaurice. 2014. "Video Lens: Rapid Playback and Exploration of Large Video Collections and Associated Metadata." In *UIST 2014 - Proceedings of the 27th Annual ACM Symposium on User Interface Software and Technology, October 5-8, 2014, Honolulu, HI.* New York, NY: ACM, 541–50. doi:10.1145/2642918.2647366

Merčun, Tanja and Maja Žumer. 2010. "Visualizing for Explorations and Discovery." In *Proceedings of the conference on Libraries in the Digital Age*, *May 24 – 28 2010, Zadar, Croatia,* ed. Clément Arsenault. [Osijek]: [Filozofski fakultet Osijek (FFOS)], 104–15.

Merčun, Tanja, Maja Žumer and Trond Aalberg. 2012. "FrbrVis: An Information Visualization Approach to Presenting FRBR Work Families." In *Implementation and*

Application of Functional Languages 23rd International Symposium, IFL 2011, October 3-5, 2011, Lawrence, KS, ed. Andy Gill and Jurriaan Hage. Lecture Notes in Computer Science 7489. Berlin: Springer, 504-7. doi:10.1007/978-3-642-33290-6_60

Mooki-Tool. 2016. "Moki the Modelling Wiki." https://dkmtools.fbk.eu/moki/multilingual/organiclingua/

Nash, Susan Smith. 2005. "Learning Objects, Learning Object Repositories, and Learning Theory: Preliminary Best Practices for Online Courses." *Interdisciplinary Journal of Knowledge and Learning Objects* 1:217-28.

Nielsen, Jakob. 1994. *Usability Engineering*. San Francisco: Morgan Kaufmann Publishers Inc.

Noshairwan, Wajahat, Muhammad Abdul Qadir and Muhammad Fahad. 2007. "Sufficient Knowledge Omission Error and Redundant Disjoint Relation in Ontology." In *Advances in Intelligent Web Mastering Proceedings of the 5th Atlantic Web Intelligence Conference—AWIC'2007, June 25-27, 2007, Fontainebleau, France,* ed. Katarzyna M. Wegrzyn-Wolska and Piotr S. Szczepaniak. Advances in Soft Computing 43. Berlin; New York: Springer, 260-65. doi:10.1007/978-3-540-72575-6_42

Ochoa, Xavier and Erik Duval. 2009. "Automatic Evaluation of Metadata Quality in Digital Repositories." *International Journal on Digital Libraries* 10:67-91. doi:10.1007/s00799-009-0054-4

Ochoa, Xavier and Erick. Duval. 2006. "Quality Metrics for Learning Object Metadata." In *Proceedings of EdMedia: World Conference on Educational Media and Technology, June 2006,, Orlando,* ed. Elaine Pearson and Paul Bohman. Association for the Advancement of Computing in Education, 1004-11.

Organic-Lingua. 2016. "Organic.Lingua Portal." http://www.organic-edunet.eu/

Palavitsinis, Nikos, Nikos Manouselis and Charalampos Karagiannidis. 2013. "Applying the Nominal Group Technique for Metadata Training of Domain Experts." In *Proceedings of Metadata and Semantics Research: 7th Research Conference, MTSR 2013, November 19-22, 2013, Thessaloniki, Greece,* ed. Emmanouel Garoufallou and Jane Greenberg. *Communications in Computer and Information Science* 390. Cham: Springer, 111-22. doi:10.1007/978-3-319-03437-9_12

Park, Jung-Ran. 2009. "Metadata Quality in Digital Repositories: A Survey of the Current State of the Art." *Cataloging and Classification Quarterly* 47, nos 3/4:213-28. doi:10.1080/01639370902737240

Park, Namkee, Raul Roman, Seungyoon Lee and Jae Eun Chung. 2009. "User Acceptance of a Digital Library System in Developing Countries: An Application of the Technology Acceptance Model." *International Journal of Information Management* 29:196-209. doi:10.1016/j.ijinfomgt.2008.07.001

Petrelli, Daniela. 2008. "On the Role of User-Centred Evaluation in the Advancement of Interactive Information Retrieval." *Information Processing and Management* 44:22-38. doi:10.1016/j.ipm.2007.01.024

Polowinski, J. 2009. "Widgets for Faceted Browsing." In Procedings of *Human Interface and the Management of Information Symposium on Human Interface 2009, held as part of HCI International 2009, July 19-24, 2009, San Diego, CA, USA*, ed. M. J. Smith and G. Salvendy. Lecture Notes in Computer Science 5617. Berlin: Springer, 601-10. doi:10.1007/978-3-642-02556-3_68

Rajabi, Enayat, Sicilia Miguel-Angel and Sanchez-Alonso Salvador. 2015. "Interlinking Educational Resources to Web of Data through IEEE LOM." *Computer Science and Information Systems* 12:233-55. doi:10.2298/CSIS 140330088R

Ren, Lei, Feng Tian, Xiaolong Zhang and Lin Zhang. 2010. "DaisyViz: A Model-Based User Interface Toolkit for Interactive Information Visualization Systems." *Journal of Visual Languages and Computing* 21:209-29. doi:10.1016/j.jvlc.2010.05.003

Rho, Jee-Hyun. 2014. "Limits and Problems of the Current OPACs for Digital Kids." *Journal of Korean Library and Information Science Society* 45:337-64. http://www.dbpia.co.kr/Article/3565718

Rosch, Jonathan L. and Jennifer J. Vogel-Walcutt. 2013. "A Review of Eye-Tracking Applications as Tools for Training." *Cognition, Technology and Work* 15:313-27. doi:10.1007/s10111-012-0234-7

Russell, Alistair, Paul R. Smart, Dave Braines and Nigel R. Shadbolt. 2009. "NITELIGHT: A Graphical Tool for Semantic Query Construction." In*Proceedings of the Fifth International Workshop on Semantic Web User Interaction (SWUI 2008), collocated with CHI 2008, April 5, 2008, Florence, Italy,* ed. Duan Degler, Mc Schraefel, Jennifer Golbeck, Abraham Bernstein and Lloyd Rutledge. CEUR Workshop Proceedings 543. http://ceur-ws.org/Vol-543/russell_swui2008.pdf

Russell, Daniel M., Jaime Teevan, Meredith Ringel Morris, Marti Hearst and Ed H. Chi. 2015. "Design for Searching & Finding." In *Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems,* ed. Bo Begole. New York, NY: ACM, 2457-58. doi:10.1145/2702613.2706692

Sánchez-Alonso, Salvador and Miguel-Angel Sicilia. 2009. "Using an AGROVOC-Based Ontology for the Description of Learning Resources on Organic Agriculture." In *Metadata and Semantics,* ed. Miguel-Angel Sicilia, Miltiadis D. Lytras, 481-92. New York: Springer. doi:10.1007/978-0-387-77745-0_47

Sanz-Rodriguez, Javier, Juan Manuel Dodero and Salvador Sanchez-Alonso. 2011. "Metrics-Based Evaluation of Learning Object Reusability." *Software Quality Journal* 19:121-40. doi:10.1007/s11219-010-9108-5

Sherchan, Wanita, Surya Nepal, Athman Bouguettaya and Shiping Chen. 2012. "Context-Sensitive User Interfaces for Semantic Services." *ACM Transactions on Internet Technology* 11, no. 3. doi:10.1145/2078316.2078322

Shneiderman, Ben and Catherine Plaisant. 2004. *Designing the User Interface: Strategies for Effective Human-Computer Interaction*, 4th ed. Boston: /Adison Wesley.

Shreeves, Sarah L., Ellen M. Knutson, Besiki Stvilia, Carole L. Palmer, Michael B. Twidale and Timothy W. Cole. 2005. "Is 'quality' Metadata 'shareable' Metadata? The Implications of Local Metadata Practices for Federated Collections." In *Proceedings of the Twelfth National Conference of the Association of College and Research Libraries, Association of College and Research Libraries*. Chicago: Association of College and Research Libraries, 223–37.

Silvis, Emile and Patricia M. Alexander. 2014. "A Study Using a Graphical Syntax for Actor-Network Theory." *Information Technology and People* 27:110-28. doi:10.1108/ITP-06-2013-0101

Šimek, Pavel, Jiri Vaněk, Vladimir Očenásek, Michal Stočes and Tereza Vogeltanzová. 2012. "Using Metadata Description for Agriculture and Aquaculture Papers." *Agris On-Line Papers in Economics and Informatics* 4:79-90.

Smart, Paul R., Alistair Russell, Dave Braines, Yannis Kalfoglou, Jie Bao, Nigel R. Shadbolt. 2008. "A Visual Approach to Semantic Query Design Using a Web-Based Graphical Query Designer." In *Proceedings of Knowledge Engineering Practice and Patterns: 16th International Conference, EKAW 2008, September 29-October 2 2008, Acitrezza, Italy*, ed. Aldo Gangemi and Jerome Euzenat. Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics 5268. Berlin: Springer, 275-91. doi:10.1007/978-3-540-87696-0-25

Stafford, Amy, Ali Shiri, Stan Ruecker, Matthew Bouchard, Paras Mehta, Karl Anvik, Ximena Rossello. 2008. "Searchling: User-Centered Evaluation of a Visual Thesaurus-Enhanced Interface for Bilingual Digital Libraries." In *Proceedings of Research and Advanced Technology for Digital Libraries 12th European Conference, ECDL 2008, September 14-19, 2008, Aarhus, Denmark,* edited by Birte Christensen-Dalsgaard. Lecture Notes in Computer Science 5173. Berlin: Springer, 117-21. doi:10.1007/978-3-540-87599-4_13

Stefaner, Moritz, Thomas Urban and Marc Seefelder. 2008. "Elastic Lists for Facet Browsing and Resource Analysis in the Enterprise." In *Proceedings of 19th International Workshop on Database and Expert Systems Applications, DEXA, September 1-5 2008, Turin, Italy,* ed. Patrick Kellenberger. Los Alamitos, CA: IEEE Computer Society, 397-401. doi:10.1109/DEXA.2008.108

Stefaner, Moritz, Elisa Dalla Vecchia, Massimiliano Condotta, Martin Wolpers, Marcus Specht, Stefan Apelt and Erik Duval. 2007. "MACE - Enriching Architectural Learning Objects for Experience Multiplication." In *Proceedings of Creating New Learning Experiences On A Global Scale Second European Conference on Technology Enhanced Learning, EC-TEL 2007, September 2007, Crete, Greece,* ed. Erik Duval, Ralf Klamma and Martin Wolpers. Lecture Notes in Computer Science 4753. Berlin; New York: Springer, 322-36.

Stuckenschmidt, Heiner and Frank Van Harmelen. 2004. "Generating and Managing Metadata for Web-Based Information Systems." *Knowledge-Based Systems* 17:201-6. doi:10.1016/j.knosys.2004.04.004

Tatnall, Arthur. 2009. "Gateways to Portals Research." *International Journal of Web Portals* 1:1-15.

Tenopir, Carol. 2003. *Use and Users of Electronic Library Resources: An Overview and Analysis of Recent Research Studies*. Washington, DC: Council on Library and Information Resources.

Thong, James Y. L., Weiyin Hong and Kar-Yan Tam. 2002. "Understanding User Acceptance of Digital Libraries: What Are the Roles of Interface Characteristics, Organizational Context, and Individual Differences?" *International Journal of Human Computer Studies* 57:215-42. doi:10.1016/S1071-5819(02)91024-4

Tsakonas, Giannis and Christos Papatheodorou. 2006. "Analysing and Evaluating Usefulness and Usability in Electronic Information Services." *Journal of Information Science* 32:400-419. doi:10.1177/0165551506065934

Tsakonas, Giannis and ChristosPapatheodorou. 2007. "Critical Constructs of Digital Library Interaction." In *Using Linkage Information to Approximate the Distribution of Relevant Documents in DIR: Proceedings of 11th Panhellenic Conference on Informatics (PCI 2007), May 18-20 2007,* ed. Georgios Paltoglou, Michail Salampasis, Maria Satratzemi and George Evagelidis. [N.p.]: New Technologies Publications, 93-102.

Tsakonas, Giannis and Christos Papatheodorou. 2008. "Exploring Usefulness and Usability in the Evaluation of Open Access Digital Libraries." *Information Processing and Management* 44: 1234-50. doi:10.1016/j.ipm.2007.07.008

Tunkelang, Daniel. 2009. *Faceted Search*. Synthesis Lectures on Information Concepts, Retrieval, and Services 1947-945x. San Rafael: Morgan and Claypool.

Uddin, M N, and P Janecek. 2007. "Performance and Usability Testing of Multidimensional Taxonomy in Web Site Search and Navigation." *Performance Measurement and Metrics* 8: 18-33. doi:10.1108/14678040710748058

VOA3R-Agris. 2016. "Virtual Open Access Agriculture & Aquaculture Repository." http://voa3r.eu/

Voigt, Martin, Artur Werstler, Jan Polowinski and Klaus Meißner. 2012. "Weighted Faceted Browsing for Characteristics-Based Visualization Selection through End Users." In *EICS'12 - Proceedings of the 2012 ACM SIGCHI Symposium on Engineering Interactive Computing Systems*. New York: ACM, 151-56. doi:10.1145/2305484.2305509

Wang, Zhonghang, Abdus Sattar Chaudhry, and Christopher S.G. Khoo. 2008. "Using Classification Schemes and Thesauri to Build an Organizational Taxonomy for Organizing Content and Aiding Navigation." *Journal of Documentation* 64: 842-76. doi:10.1108/00220410810912424

White, Bill. 2016. "D3 Wrapping Flow Tree Layout." Blogpost. http://www.billdwhite.com/wordpress/2013/10/11/d3-flow-tree-layout/

White, Ryen W and Resa A. Roth. 2009. "Exploratory Search: Beyond the Query-Response Paradigm." *Synthesis Lectures on Information Concepts, Retrieval, and Services* 1:1-98.

Wolpers, Martin, Martin Memmel and Moritz Stefaner. 2010. "Supporting Architecture Education Using the MACE System." *International Journal of Technology Enhanced Learning* 2, no. 1/2: 132-44. doi:10.1504/IJTEL.2010.031264

Zhang, Lei. 2014. "Linking Information through Function." *Journal of the Association for Information Science and Technology* 65:2293-2305. doi:10.1002/asi.23123

Zhang, Tao, Deborah J. Maron and Christopher C. Charles. 2013. "Usability Evaluation of a Research Repository and Collaboration Web Site." *Journal of Web Librarianship* 7: 58-82. doi:10.1080/19322909.2013.739041

Zhang, Ying. 2010. "Developing a Holistic Model for Digital Library Evaluation." *Journal of the American Society for Information Science and Technology* 61: 88-110. doi:10.1002/asi.21220

Appendix 1

This questionnaire helps us to define your user profile, please be sincere in your answers. No personal information will be stored, remember we are testing the software, not you ☺.

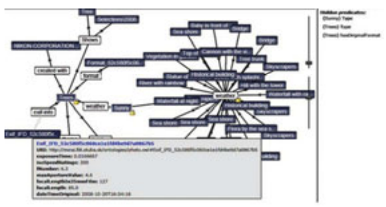
Are you familiar with these terms? ( ) Metadata ( ) Semantic ( ) Thesaurus ( ) Ontology

Profession: ____________________ Working at: ____________________

Country: ____________________

What do you know about these searching interfaces?

	**Textual Search** Never used ( ) I've used it, but I don't know when using this searching method is more useful than using others. ( ) I've used it, know how it works and when to use it instead other searching methods. **( )**
	**Directory / Categories Browsing** Never used ( ) I've used it, but I don't know when using this searching method is more useful than using others. ( ) I've used it, know how it works and when to use it instead other searching methods. ( )

	**<u>Tags Search</u>** Never used **( )** I've used it, but I don't know when using this searching method is more useful than using others. **( )** I've used it, know how it works and when to use it instead other searching methods. **( )**
	**<u>Semantic Search</u>** Never used **( )** I've used it, but I don't know when using this searching method is more useful than using others. **( )** I've used it, know how it works and when to use it instead other searching methods. **( )**

Please provide us an email in case we've to contact you for further information about this trial:

EMAIL: ______________________________

Appendix 2

This online questionnaire serves research aims of the AGROKNOW Technologies, laboratory of Viticulture at Agricultural University of Athens and Laboratory IERU, Dpt. of Computer Science, University of Alcalá, Spain. More specific it aims to gather data (opinions) for the evaluation of VISUAL SEARCH INTERFACES through the aspects of usefulness and ease of use.

Please reply to the following statements by providing your rate of agreement. The scale employed runs from one (1) to five (5), directed from negative to positive.

The conductors of this research guarantee the safekeeping and anonymity of the gathered data. For any enquiries please contact us through mail at xxxx@xxxx.com

Thank you very much for your interest and your participation.

General aspects of VISUAL FRAMEWORK					
I believe that the VISUAL FRAMEWORK provides all levels of information (e.g. abstracts, descriptions, etc.) that I need for my information seeking tasks.	Disagree 1	2	3	4	5 Agree
I believe that is easy to see, the number of digital resources in the VISUAL FRAMEWORK (It refers to the number of digital resources of each concept)	Disagree 1	2	3	4	5 Agree
I believe that the sources in the VISUAL FRAMEWORK are reliable to support my works tasks. (sources refers to the resources of content providers)	Disagree 1	2	3	4	5 Agree
I believe that the formats of sources in the VISUAL FRAMEWORK are suitable for my work tasks. (formats: text, sound, image, videos)	Disagree 1	2	3	4	5 Agree

In general I find the VISUAL FRAMEWORK as a useful system for my work tasks.	Disagree 1	2	3	4	5 Agree
I believe that the VISUAL FRAMEWORK has a pleasant aesthetic appearance	Disagree 1	2	3	4	5 Agree
I believe that the VISUAL FRAMEWORK offers easy methods to navigate in the system	Disagree 1	2	3	4	5 Agree
I believe that the VISUAL FRAMEWORK uses understandable terminology. (Terminology refers to concepts and terms in navigation structure)	Disagree 1	2	3	4	5 Agree
I believe that the VISUAL FRAMEWORK is a learnable system	Disagree 1	2	3	4	5 Agree
I believe in general that the VISUAL FRAMEWORK responds very quickly my search	Disagree 1	2	3	4	5 Agree
In general I find the VISUAL FRAMEWORK as a well performing system for my work tasks	Disagree 1	2	3	4	5 Agree

About NAVIGATION Please mark one (1) to five (5) from negative to positive aspects related to usability attributes					
Tree	Disagree 1	2	3	4	5 Agree
Bars	Disagree 1	2	3	4	5 Agree
Folders	Disagree 1	2	3	4	5 Agree

About USEFULNESS Please mark one (1) to five (5) from negative to positive aspects related to usability attributes					
Tree	Disagree 1	2	3	4	5 Agree
Bars	Disagree 1	2	3	4	5 Agree
Folders	Disagree 1	2	3	4	5 Agree

About EASY OF USE Please mark one (1) to five (5) from negative to positive aspects related to usability attributes					
Tree	Disagree 1	2	3	4	5 Agree
Bars	Disagree 1	2	3	4	5 Agree
Folders	Disagree 1	2	3	4	5 Agree

About PERFORMANCE Please mark one (1) to five (5) from negative to positive aspects related to usability attributes					
Tree	Disagree 1	2	3	4	5 Agree
Bars	Disagree 1	2	3	4	5 Agree
Folders	Disagree 1	2	3	4	5 Agree
About AESTHETIC Please mark one (1) to five (5) from negative to positive aspects related to usability attributes					
Tree	Disagree 1	2	3	4	5 Agree
Bars	Disagree 1	2	3	4	5 Agree
Folders	Disagree 1	2	3	4	5 Agree