D3.3.3 Prototype of advanced learning platform (ASPL-v1)

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Abstract.
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The following partners have taken an active part in the work leading to the elaboration of this document, even if they might not have directly contributed writing parts of this document:

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We gratefully acknowledge their assistance contribution to the discussion regarding ASPL scenarios, functionality and tool usability.

Changes

Version	Date	Author	Changes
0.9	25-06-2005	Martin Dzbor, Arthur Stutt	First draft of manual
1.0	01-08-2005	Martin Dzbor, Arthur Stutt	Final version

Executive Summary

The intention of this deliverable is to describe the first, prototype version of the advanced semantic platform for learning (ASPL-v1). While we expect future versions of ASPL to have increased functionality, ASPL-v1 is confined to that provided by Magpie — a prototype semantic browser framework which has been developed at the Knowledge Media Institute at the Open University. In the report we give a brief overview of the rationale behind Magpie and describe the architecture of ASPL-v1 before providing a brief user manual for the system. We conclude with future plans for additional functionality and for the evaluation of ASPL-v1. Relevant research papers are (Domingue, J., Dzbor, M. *et al.* 2003; Dzbor, M., Domingue, J. *et al.* 2003; Dzbor, M., Motta, E. *et al.* 2004; Dzbor, M., Motta, E. *et al.* 2005). More information about Magpie is available from the project's home page:

http://kmi.open.ac.uk/projects/magpie

or

http://kmi.open.ac.uk/projects/kweb

Contents

Introduction – Our goals

According to the annex:

> Setting up an infrastructure for learning resource delivery will be a two-phase process. In the first phase, we will select and set up a conventional e-learning delivery platform and course management system. In the second phase, our primary goal will be to investigate the application of Semantic Web technology to e-learning and academic research, with the aim of developing concrete demonstrators of the added value that Semantic Web technology can provide in these areas, by enabling smart access, customisation and interpretation of web resources. The final delivery vehicle will be a combination of Semantic Web based and more traditional tools and environments for learning.

See reports D3.3.2v1 and v2 for the results of the first phase. In essence for strategic reasons (mainly to do with the multiplicity of possible end-users of the material and because we want to be free to experiment with the form of the final platform) we decided to implement a repository for learning resources rather than a fully-fledged learning management system. In the current, second, phase (which lasts until M48) our goal is to augment this with what we refer to as the advanced semantic platform for learning (ASPL). This goal has been made more specific in the revised JPA:

> The goal of this work package is to provide a delivery platform for the content stored in REASE ... REASE is a portal repository system where learning resources can be uploaded and annotated by their authors.
>
> In the remainder of the lifetime of the NoE we will concentrate on augmenting this with what we refer to as an advanced semantic platform for learning (ASPL) with two phases of implementation and evaluation before the final version to be delivered in Month 48.

In line with this, the intention of this deliverable is to describe the first, prototype version of the advanced semantic platform for learning (ASPL-v1). While we expect future versions of ASPL to have increased functionality, ASPL-v1 is confined to that provided by Magpie — a prototype semantic browser framework which has been developed at the Knowledge Media Institute at the Open University. In the report we give a brief overview of the rationale behind Magpie and describe the architecture of ASPL-v1 before providing a brief user manual for the system. We conclude with future plans for additional functionality and for the evaluation of ASPL-v1.

What ASPL-v1 does

From user's point of view, ASPL-v1 provides a means of accessing a range of services including simple glossaries and more sophisticated search services. These services are contextualised to highlighted text fragments on a web page. The text fragments are representations of instances of classes in a user-selected ontology. The user has control

over which particular subset of the ontology's terms the system highlights. Services are accessed from pop-up menus associated with highlighted terms.

ASPL-v1 thus provides a richer browsing experience, which is not tied to a pre-defined set of navigational links and which gives access to additional information about concept instances as represented as text fragments in a page as well as a range of alternative material on related topics or by related authors.

It is important to point out that while ASPL can and does operate over the REASE repository we have gone beyond the goals mentioned in the JPA. While the current version of ASPL can search the REASE repository it can also search and retrieve material from a variety of other sources such as CiteSeer, DBLP and Google.

ASPL/Magpie

The new JPA continues:

> Note that we are not committed to any particular mode of implementation or definition of 'delivery' as yet. The 'platform' may take the form of an application, a portal, a distributed semantic meta-service or some combination of these.

This means that while this version of ASPL only includes the Magpie semantic browser framework, we may, in future, develop a completely different architecture. In order to manage the costs of developing ASPL and balancing efficiency with effectiveness, we chose to build on top of Magpie's framework for developing semantic web applications. Magpie has been designed at OU with exactly this objective – serve as a platform on which more sophisticated and specialized infrastructures and applications can be build.

Magpie is available as a plug-in for a number of browsers. It operates by making use of domain ontologies to dynamically annotate texts. Users can make use of the web services which have been associated with classes in the domain ontology to access a range of relevant resources and activities. These are accessed via right clicking a highlighted instance. For example, we might have services which provide access to glossary entries using the keywords that are highlighted in the web page. These lexical keywords are derived from a domain ontology, which is serialized or 'flattened'. Thus, by starting with published teaching and research materials, we move from the closed world of the REASE repository towards more open interaction with the deposited materials and other material not held in the repository.

Magpie supports the user in interpreting complex scientific and other texts by extracting key aspects of that text relevant to a specific course or topic, and dynamically linking the text to resources which capture declarative knowledge agreed to be of significance by the particular knowledge community – in this case that of Semantic Web Studies. Further information and a walkthrough in using ASPL/Magpie to navigate using semantic links in the domain of Semantic Web Studies are given further in this document.

Benefits of ASPL

As indicated in deliverable D3.1.4, REASE provides ready access to a wide range of material via its search mechanism and a topic index. However the latter could be regarded as inadequate and to some extent misleading. This is because the ontology underlying the index has not been based on any principled ontology development. The inadequacies in the design may be overcome when we move to a taxonomy based on the REWERSE curriculum. However, this does bring with it the danger that while learners using the REWERSE curriculum will find the new taxonomy easier to navigate, others will find it harder. ASPL should overcome these sorts of difficulties by providing:

Truly contextualised search Magpie's contextual menu system provides access to a range of services linked to particular class instances. These services are thus contextualised to particular text fragments. While these services may be arbitrary in function, our current emphasis is on a range of search services.

Multiple viewpoints Since Magpie can use any ontology (and its associated lexicon) to find and highlight class instances in a text, and since an ontology provides a viewpoint or frame on a domain, ASPL is able to provide multiple alternative ways of browsing/viewing learning material in REASE using any available ontology (providing, of course, that associated services are available).

URL for ASPL-v1

Generic Magpie plug-ins (including sample lexicons for learning) are currently available from http://kmi.open.ac.uk/projects/magpie/main.html. ASPL-v1 will shortly be available from the same URL, as well as from the OU's web site dedicated to the KnowledgeWeb (URL: http://kmi.open.ac.uk/projects/kweb). In the future we intend to make the ASPL-v1 prototype available on the main project portal; however, this needs to be consulted and agreed upon with partners responsible for managing the KnowledgeWeb portal.

ASPL architecture

In principle, ASPL-v1 can be seen as a multi-tiered application comprising several layers, as shown in Figure 1. From the bottom, these include:

- A ***range of user interfaces***, mostly based on web mark-up language and current (i.e. common) web browser technology
- The interfaces interact with the ***knowledge level*** of ASPL, which comprises various ontologies and their instances. In ASPL, we distinguish between domain ontologies, social ontologies and other infrastructure ontologies[1].
- Finally, there is ***data level*** on which ASPL semantic services draw in order to populate and instantiate the knowledge level and deliver semantically relevant information to the user. The data sources include both *internal* (e.g. REASE or explanation glossaries) and *external* data sources (CiteSeer, DBPL).

[1] More on the different ontologies appears further in the document.

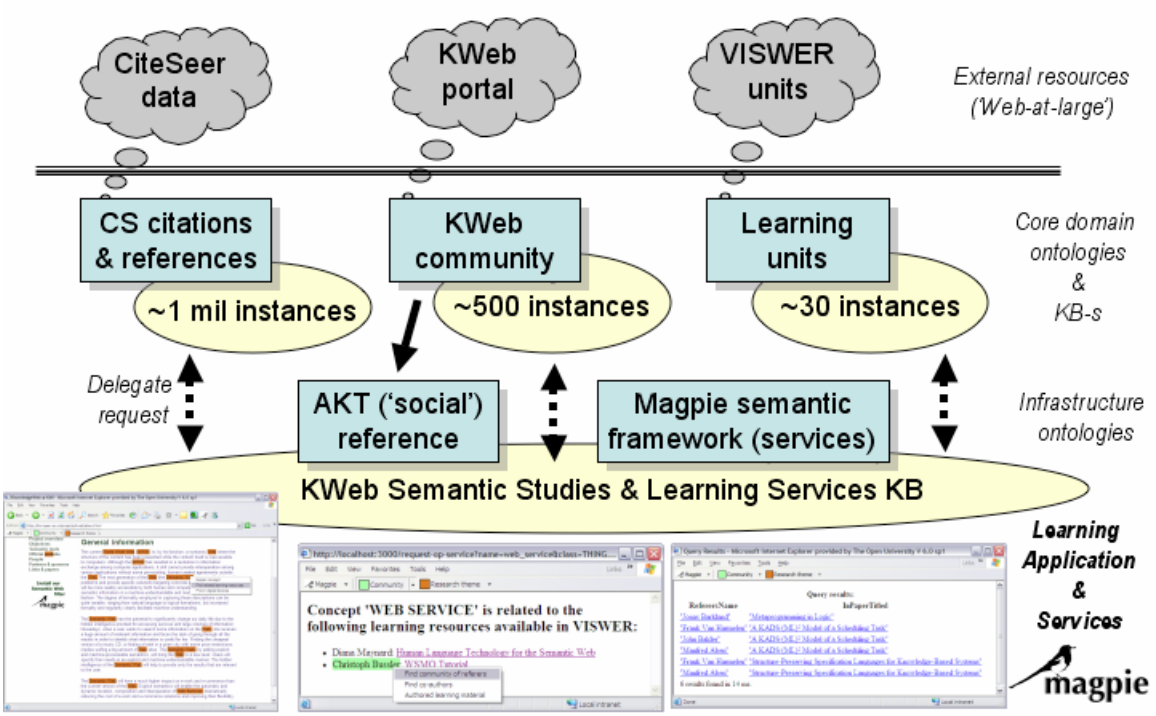

Figure 1. ASPL-v1 showing the relations among ontologies, services and resources

We have identified three types of ontologies as relevant for ASPL development (domain/Semantic Web Studies related; learning service related; social/community-related), ASPL-v1 is based on (a) an embryonic Semantic Web Studies domain ontology, and (b) an ontology for academic research/the academic community derived from the AKT Reference ontology[2] and the KnowledgeWeb portal ontology. What we refer to here as "embryonic Semantic Web Studies ontology" comprises a set of most common concepts and objects retrieved from the web using OU's information extraction tools and subsequent manual knowledge-level modelling. In the future we intend to have more 'semantic' processes of creating and maintaining domain ontologies; i.e. making their design more dynamic, more automated and less ad-hoc, subjective exercise.

Conceptual Background for ASPL-v1

Before discussing the capacities of ASPL-v1, its underlying technology – Magpie, is briefly reviewed. Magpie is a tool that plugs into a standard web browser – Microsoft Internet Explorer or Mozilla/Firefox. Its novelty comes from the fact that through Magpie, the web user can access not only the information provided by web page authors, but also a significant amount of background information and semantically relevant knowledge. Typically, it is this 'background information' the users are seeking on the web, and sometimes, it takes long time to find appropriate and *relevant* information (Dzbor, M., Domingue, J. *et al.* 2003). While there is a lot of information on the web, it becomes increasingly difficult to:

[2] http://www.aktors.org/publications/ontology/

- Make sense of large amount of information,
- Formulate the search engine queries so that they find reliable and relevant information, and
- Filter out reliable and useful information from the vast amount available.

The issue of sense-making may seem to be fairly straightforward for most people who interacted with the web-based resources. We simply 'know' whether a particular link proposed by a search engine makes sense in relation to our intention. With Magpie, we suggest a strategy how such a sense-making capability could be built into a web browser. Before discussing the details of how this is accomplished, let us mention what Magpie is and is not:

- Magpie is an *enhancement* to the standard browsers rather than replacement!
- Magpie works with the *explicit* information that appears on the web pages and in various knowledge repositories. It only associates explicit information at one end with a potentially relevant one at another place. It does not 'read in between the lines' or 'second guess' the authors' intentions.
- Magpie provides *means* for a structured and informed exploration of the web resources. It helps with complex reasoning but is not 'omniscient'.

In addition to seeing Magpie as a single-purpose document interpretation tool, it can also be seen as a prototypic semantic web browser, and in its most general, as a service-based framework for developing semantic web applications. It is this last view that has been used as a foundation for evolving a Magpie-based application in a learning domain into an advanced semantic platform for learning (ASPL-v1).

According to this view, the Magpie suite of tools can be seen as a 'shell' for building semantic web applications, which provides generic mechanisms for bringing together ontologies, web resources and (semantic) web services. For example, in the context of KnowledgeWeb, we developed a scenario for supporting online students who are carrying out the task of writing a research field review or literature review; e.g. for the purpose of their PhD. The conceptual details of achieving this objective are provided in the following section. These are then followed by an account of system requirements and the document concludes with a brief user guide to interacting with the key aspects of ASPL-v1.

ASPL-v1 – towards situated learning

Conceptual frame and a process of framing are known in the cognitive literature for some time (Schön, D.A. 1983), and recently makes a steady advance to the literature on organizational theory (Nonaka, I., Toyama, R. *et al.* 2000) and theory of learning (Polsani, P.R. 2003). A frame is a perspective or a point of view, which implies that certain goals exist, certain bodies knowledge are relevant, and certain solution forms amending the uncertain situation are preferred (Dzbor, M. and Zdrahal, Z. 2002). Empirical evidence suggests that in any activity that involves conceptual interpretation

(or 'sensemaking') framing is an important reasoning step that precedes the actual problem solving and essentially guides it (Schön, D.A. 1983; Reddy, M.J. 1988; Nakakoji, K., Sumner, T. *et al.* 1994).

Construction of conceptual frames comes more or less automatically in face-to-face learning through various prompts, definitions or formulated assumptions of the teacher, mentor or instructor. In the context of web-based and electronic media, framing is pushed into more tacit levels. The user still needs to use some form of frame to interpret the documents and knowledge chunks, but there is little opportunity in the existing browsing paradigms to do it explicitly. The important facet of framing is that it should provide conceptual "hooks" for grounding the interpretation and sense making, yet must not be too rigid and restrictive.

Learning is as much social and cognitive activity as it is interpretative and consensual. If we want to support these multiple faces of learning we need to have appropriate vocabularies and activities that are sufficiently unambiguous and more importantly, are shared within a particular user community. We are deliberately splitting the more declarative and passive content from more procedural and active aspects of interacting with learning materials. To illustrate the benefits, consider a simple example from a scenario of researching the web for literature review.

ASPL scenario: Preparing literature review

A semantic application supporting learning, e.g. in the domain of semantic web studies itself, normally has a range of users. The users share the high-level objective of acquiring new domain knowledge; however, their learning activities might vary. For instance, we can take two extreme cases:

1. Introducing a naïve learner into domain, and
2. Guiding an advanced research student in preparing a critical literature review

The two cases can be seen as distinct learning tasks. We need to be aware of these differences when developing semantic applications in this area. Aim 1 is mostly conceptual and comprises a capability to explain concepts or to generalize them. In aim 2, semantic application supports a reasonably skilled user in solving a problem – e.g. critically reviewing literature on semantic formalisms. aim 1 is about semantic recall, whereas aim 2 is about semantic analysis, synthesis and judgment (Dzbor, M., Motta, E. *et al.* 2005).

Semantic support for aim 2 concerns not only the rules and style of review writing. The user has to acquire knowledge of what actually constitutes a good review, how to collect and process information to be reviewed. The task of reviewing also involves such skills as critiquing, judging relevance or contribution. In order to support a complex activity using semantic technologies, the activity needs to be decomposed from the primary and abstract learning task to a sequence of sub-tasks, which in turn could be mapped to learning services.

A learning service is a web application that can be invoked by the user when performing a particular sub-task. It assists the user in generating a solution. In our case, the

application is semantically grounded and would be accessible on the web. A breakdown for the task of critically reviewing literature is shown in Figure 2. The task-based approach to designing applications has two benefits. First, by splitting a complex activity into a series of simpler ones we operationalise the abstract notion of supporting a user reviewing literature. Second, based on the needs of the users we create a set of reusable components – still on the level of tasks and sub-tasks, rather than actual objects or web resources. Using the activity-centred approach to developing semantic applications, we are encouraging the developers and application designers to re-use (our analysis of) processes rather than specific documents or chunks of information.

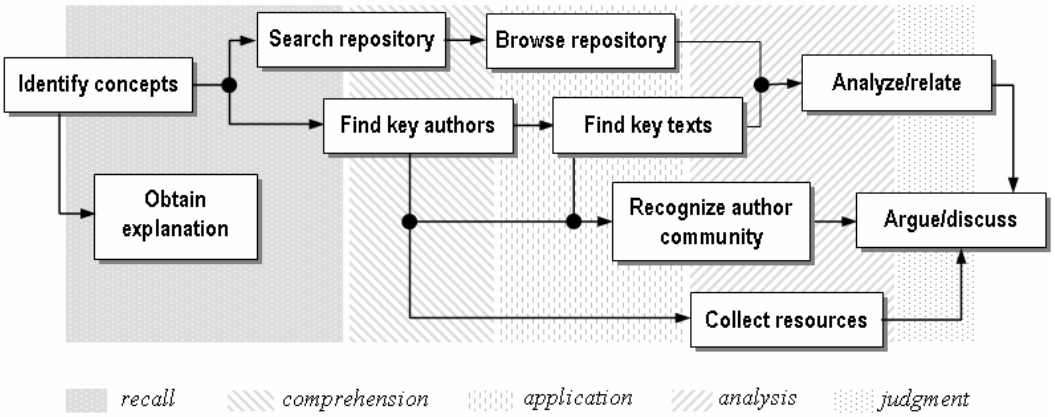

Figure 2. Decomposition of a complex learning task from the scenario of preparing a critical literature review

Our approach enables the re-use of sub-task and associated semantic services in the context of several learning tasks. For example, the '*Obtain explanations*' box applies to both cases mentioned above. For the naïve user it reflects the primary learning objective; for the research student, it is one step en-route to critically reviewing the subject.

Table 1. Domain conceptualization by design (D) and emergence (E)

D

E

Level	Constituents	Purpose and uses
Conceptual foundations	Key domain concepts in a taxonomic or lexical classification with few descriptive attributes	- ontology in its philosophical sense; - includes concepts learners need to be aware of after studying a course in the domain
'Social' foundations	People, projects, links among them & various descriptive attributes	- presents subject domain as a living research community - "who is doing what, where, with whom, etc."
Resources with meta-description	Argumentative structures, connotation, correlations	- expresses relations among concepts - conceptualizes higher cognitive levels of learning - forms basis for the implementation of a range of semantic learning services

Multiple ontological levels, frames and views

In the process of deploying a semantic web application, several steps must be performed. The core ones include development of semantic services and domain ontologies. Once knowledge of a learning task is formalized as a sequence of simpler sub-tasks, it is possible to start creating semantic meaning and annotating available services. It is often

assumed that creation of semantic meanings equates to developing appropriate domain ontology. For an application supporting learning about the semantic web, we would need domain ontology of semantic web studies.

However, what is really needed is a set of conceptualizations that enable the users of the application to carry out the sub-tasks identified above. More than one conceptual frame is often necessary; each subscribing to a different ontology; where an ontology is viewed as an explicit conceptualisation of knowledge in a particular domain (Gruber, T.R. 1993). Relying on several frames or ontologies is common in the real world, where we apply several perspectives on a resource in order to make sense of it. For a discussion on how multiple perspectives can be realized in a semantic web application, see (Dzbor, M., Domingue, J. *et al.* 2003).

The notion of conceptual frames and framing were analysed in design (Schön, D.A. 1983), organizational knowledge (Nonaka, I., Toyama, R. *et al.* 2000) and in theory of learning (Polsani, P.R. 2003). A frame is a perspective or a point of view, which implies that certain goals exist, certain bodies of knowledge are relevant to be highlighted and annotated, and certain responses and solutions originating in the annotations are preferred (Dzbor, M., Motta, E. *et al.* 2005). Thus, each of our sub-tasks is actually a different (partial) perspective on reviewing the literature.

Usually, a commitment to a particular ontology defines what particular frames can be constructed. However, in reality, the relationship between a frame and ontology is reversed. We should be choosing those ontologies that are needed in order to facilitate particular frames, which in turn would enable semantic support for particular sub-tasks. As a result, ontology for grounding a semantic application is *less a matter of design or selection, and more a matter of consensus*. The choice of ontologies is given by what we want the user to achieve, not merely by the domain we work with.

Many writers argue that it is the formalism, which makes ontologies useful. However, how much formalism is necessary to develop a semantic application, for example, in the domain of semantic web studies? How much of the conceptualisation needs designing and how much can emerge from the user's perusal of the designed, seeded domain ontology? In our approach, balance between the designed and emerging is given by the tasks we want to support (see Figure 2). We found that we needed several ontologies to address different facets of learning to review literature in the domain of semantic web studies (summary in

).

The three semantic groundings of an application may be extended and/or modified. For different applications one level may be more prominent than another. The social level is useful if the domain refers to knowledge authorities or 'must-know-about' projects, tools and technologies. Rapidly evolving or establishing domains might depend more on the fluid social aspects than on the formal and objective conceptual vocabulary. The correlation between the level of domain establishment and constitution of an ontological framework would need more investigation.

Broadly, we distinguish different levels based on a prevailing conceptualisation style. The ontology of conceptual foundations tends to be created *by denotation*; i.e. by declaring

certain terms being relevant and classifying them in some taxonomy. This level is typically rich in terms of defined instances rather than classes, attributes or relations. We denote the core domain terms without trying to tie them into a too formal framework of causal or subsumption ("is-a") relations. Such instances enable us to talk about a subject, and in this sense, they form ontology in its philosophical sense – i.e. what kinds of entities exist in (a given domain).

The social level is mixed; only a small part is created by denotation. The concepts on this level tend to be defined using a rich set of attributes and properties, such as '*works-for*' or '*is-author-of*'. Using the attributes we can start interacting with the instances of such ontology not only "by denotation" but also (and perhaps mainly) *by connotation*. The difference between the two styles is that in addition to enumerating instances of a particular class (e.g. '*Author*'), it is possible (and more interesting) to recall instances sharing a particular attribute or relation. All items e.g. with attribute '*works-for*' being '*SomeUniversity*' essentially define a concept of co-workers – by connotation and co-reference. A '*Publication*' class with properties '*has-author*' and '*cited_by*' may define the concept of a community of practice (authors/referrers) – by reasoning rather than by declaration.

The opportunistic use of ontological frameworks is also visible on the level of meta-data for resource annotation in

. This level contributes not by defining new classes or well-structured hierarchies, but rather its defining feature is to fill in the attributes of the instances and to establish relations among them. Because of its nature, this level is often defined by rules or heuristics for reasoning that link existing concepts by co-reference rather than populate the knowledge base by definition. Heuristics applicable at this level and illustrated in Figure 3 are expressed in a schematic language based on RDF Query Languages (Frasincar, F. 2003):

```
{Author} <is-expert-in> {Concept} ←
    {Publication} <has-author> {Author},
    {Publication} <has-abstract> {Abstract},
    {Concept} <has-description> {ConceptDef}
where   (Abstract like "keyword")
        and   (ConceptDef like "keyword")
```

Figure 3. Example heuristic rule using domain concept

We illustrate the principles for constructing this layer using a trivial example of hypothesizing an attribute value for an object based on the co-location of semantic terms. The heuristic rule in the example above asserts that co-location of a given keyword (e.g. '*RDF*') in an abstract of a publication (say '*SomeReport*'), as well as in the conceptual definition of (say) the concept '*semantic web mark-up*' enables our application to hypothesize that the author/s of '*SomeReport*' is/are experts in the area of '*semantic web mark-up*'.

While the conceptual and social ontologies are important and form the backbone of a semantic application, we believe the real benefits of semantic web applications are in the dynamic population of the third ontological level in our framework. In other words, a semantic application is not only designed by definition (i.e., the denotation of static

domain concepts). Equally, if not more, important is the support for the *application evolution* by formulating (and discovering) heuristics for reasoning by connotation.

Relationship between the scenario and ASPL-v1

ASPL is intended to support a reasonably skilled user in solving a problem of critically reviewing literature on, for example, semantic formalisms. The task involves semantic analysis, synthesis and judgment (Dzbor et al., 2005), as described earlier. There are many specialized tasks and activities involved in collecting, processing, recalling, comparing or judging the information to be reviewed. ASPL-v1 currently supports a sub-set of sub-tasks by creating early versions of learning services.

In ASPL, a learning service is a web application that can be invoked by the user when performing a particular sub-task. In ASPL-v1 we equate learning services with the services associated with classes in Magpie. A service assists the user in generating a solution. A breakdown of the task of critically reviewing literature has been shown in Figure 2. The items along the bottom of the figure are drawn from relevant parts of Bloom's taxonomy of cognitive skills (Bloom, 1965), which ASPL aims to target.

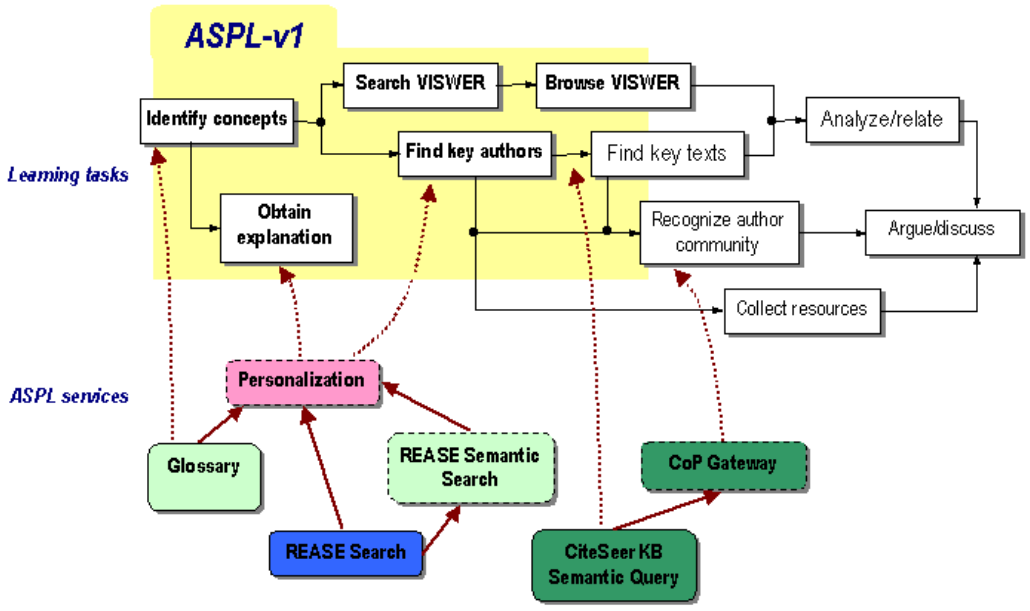

Figure 4. Mapping between learning task and ASPL-v1 services

While we are currently unable to support all the sub-tasks in the scenario we can at least support sub-tasks such as *identify concepts* and *recognize known authors*, fully or partially, with current ASPL-v1 learning services, as Figure 4 indicates. The shaded area in the background indicates how large portion of our ambitions has been accomplished in producing ASPL-v1 as a prototypic support for semantic web applications used in the educational setting.

System requirements for ASPL/Magpie

ASPL is based on the Magpie framework, which is essentially a plug-in suitable for Microsoft Internet Explorer or Mozilla/Firefox browsers, and this fact determines most of the requirements your system must satisfy to use Magpie and thus semantic browsing effectively:

- Operating system: *MS Windows* (Win32 platform) … this constraint only applies to the Internet Explorer version and is due to the fact that Magpie is shipped as DLL, which only runs on Win32 systems. We have tested the plug-in on the following operating systems: *Windows 2000 Pro*, *Windows XP Home* and *Pro*. For the Mozilla-based web browsers, the plug-in has been successfully deployed on *Windows*, *Mac OS X* and *Linux* systems.
- Web browser: *MS Internet Explorer*, releases 5.5 or higher. We strongly recommend using currently most up-to-date *Internet Explorer 6*. Alternatively, *Mozilla* release 1.7 or higher and *Firefox* release 1.0 or higher are suitable platforms for the Mozilla/Firefox version.
- Hard disk space: At least *20MB free space* on your C: drive.
- Connection to Internet: This is not needed if you wish to only highlight the ontological entities on off-line web pages. However, Internet link *is essential* if you want to take advantage of ontology-supported semantic browsing and semantic services.

Magpie has been tested on all systems and applications mentioned above. Please, inform us if you find additional operating systems or IE versions where it works.

ASPL/Magpie in action

The background information mentioned in the previous section is essential for semantic browsing. In case of Magpie, this information is stored by means of ontologies (Gruber, T.R. 1993), which are formalized explicit representations of domains and/or problem matters. In order to provide the full functionality, the user has to have access to one or more ontologies s/he intends to use to make sense of browsed web pages.

To achieve as high flexibility as possible, Magpie has been designed modularly. This means that only a relatively small part resides locally in the user's web browser. Majority of the functionality is provided remotely by accessing various semantic services, knowledge-based reasoning tools, and data over the network. Two standard parts of Magpie needed for a basic operation include:

- Magpie toolbar loadable into a web browser; this is delivered as a dynamically loaded library (DLL) or JavaScript XMI bundle.

- Ontology-based lexicon that can reside on the local computer (e.g. user's 'private' representation of a problem domain) or can be loaded from a shared location on the web (e.g. from a study group a particular user participates in)[3].

Installation and basic setup

We start with the installation and setup of ASPL/Magpie extension on the user's computer. The current configuration of ASPL/Magpie prototype assumes that working folder is "C:\Magpie". While the user may change the settings, this folder will be used for the storage of web page snapshots, as well as ontology storage. The entire functionality of Magpie is implemented as dynamically loaded library (DLL). This library has to be registered with your operating system before anything can be tested. In the case you are installing Magpie from an executable installer (`magpie-setup.exe`), the registration should happen automatically.

However, the DLL registration may fail in the case you have a running instance of Internet Explorer! If this happens, follow the instructions below to find out whether a running instance of Internet Explorer is a problem. Once there are no applications or processes of Internet Explorer running, go to the directory you installed Magpie to (e.g. C:\Magpie), and run/double-click on the file:

```
register-magpie-dll.bat
```

Alternatively, you may do the registration manually. The following command must be executed in the DOS prompt (launch the DOS prompt window using `Start` → `Run...` and type "`cmd`" – a DOS window with a prompt should show):

```
regsvr32 C:\Magpie\Magpie.dll
```

The only significant difference in setting up ASPL/Magpie for Mozilla is that the installer (*.xmi file downloadable from the web site) shall be opened inside a Mozilla browser's window. XMI is a simple scripting support for installing plug-ins, which has a fairly straightforward sequence of steps. Note the troubleshooting advice further down, which is particularly likely to help in case of Mac OS X and Linux.

If the DLL registration was accomplished successfully, a window with a respective system message should appear on your screen. Similarly for Mozilla/Firefox, the message on screen would inform the user about successful setup. In case that Magpie registration with the system was not successful, the most typical reasons are:

- You don't have sufficient privileges to install/register a new application.

  Resolution: Please log in as 'Administrator', or ask your system administrator for assistance. This applies to both, IE and Mozilla version. In case of IE, one needs to have permission to register new dynamic library. In case of Mozilla, one needs the right to write into a shared folder (e.g. /usr/local/bin) if a shared mode of ASPL/Magpie installation is chosen.

[3] We are currently developing functionality that would enable users to subscribe to shared, public ontological lexicons stored e.g. in XML/RDF or OWL formats.

- You have an Internet Explorer and/or Mozilla application open, and the system cannot modify its settings while running. A similar error may occur when the system reports that installation was successful but ASPL/Magpie is not visible in the browser.

  Resolution: Close all windows of your web browser, and re-run the above registration command if necessary. Since Internet Explorer occasionally stays in the computer memory as a process (with no visible windows showing), it may be necessary to have a look at the running processes, too.

- I see no Internet Explorer windows on my desktop, what about the processes?

  Resolution: Right-click on your system bar (the one where '`Start`' button is), and in the menu choose option '`Task Manager...`'. In the Task Manager window, go to tab labelled '`Processes`', find one called 'IEXPLORE.EXE', and highlight it. Next, click on button '`End Process`', and confirm it.

These are the most common reasons for failing to operate Magpie extension properly. If you encounter anything else, please, let us know. To test whether Magpie really is in your web browser, launch Internet Explorer or Mozilla – depending on which version you installed. Both versions have 90% the same functionality and appearance so steps/figures applicable to one browser also apply to the other. Once your browser starts up, you should see a little button (usually towards the right-hand end of the Internet Explorer's button bar). The button is depicted using marker A in Figure 5, and if you click on it an initial Magpie toolbar appears showing a single button labelled "Magpie" and a little arrow (pointer B).

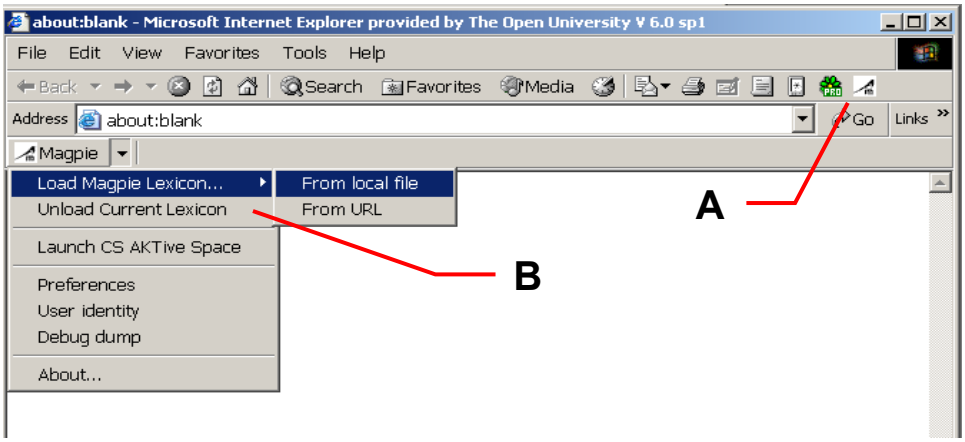

Figure 5. Magpie toolbar as an integral part of Internet Explorer showing a button for activating and deactivating the Magpie toolbar (A) and the initial appearance of the toolbar with menu (B)

Preparation – ontology definition/download

Once you can get as far as described in the previous section, ASPL/Magpie is likely to be installed and registered correctly. To test its functionality, you will need to load at least one ontological lexicon. A lexicon is a serialized version of an ontological network or

simply, a mapping from strings to entities within an ontology (Domingue, J., Dzbor, M. *et al.* 2003). Each entity in the ontology is referred by its instance name and class. Instances may have more than one lexical representation. For instance, assume there is an instance known as "`JOE-DOE`". This would translate to different strings, incl. "`Joe Doe`", "`J Doe`", "`Doe J`", "`Doe Joe`", etc.

Lexicon containing the instances such as those mentioned earlier represents items the Magpie extension would be able to work with and find in the web page. Moreover, thanks to the lexicon and underlying ontology, Magpie is able to offer a suite of semantic services that are dependent on a class of a particular instance. For example, our "`JOE-DOE`" is classified as a "`RESEARCHER-AUTHOR`", which reflects the focus of ASPL application on supporting literature review, or more generally as a "`PERSON`". Hence, semantic services related to the "`PERSON`" class would show when clicked on "`Joe Doe`" in the web page.

Lexicons currently come (i.e. in this beta release) in form of two files. The main lexicon has the extension "`*.onto`", and contains the actual instances from the ontology. The second file – with the extension "`*.menu`" is self-explanatory; it contains the definitions and labelling of the semantic menus associated with the classes from this particular ontological lexicon. Unless you want to create your own ontology, you do not need to worry too much about the syntax of each file. In the future releases, we shall move towards standard web language such as RDF for lexicon definition. Similarly, we will try to offer a web service creating a Magpie-compatible lexicon from 'any' arbitrary ontology submitted as an input. Nonetheless, these are future extensions!

In order to test your Magpie, you need to load the lexicon first. Assuming you have downloaded/installed the default Magpie application, follow these steps:

1. Click on Magpie button to show the Magpie toolbar in your web browser. You should see a situation similar to that in Figure 5.
2. Next, click on the little arrow next to the label "`Magpie`" on the Magpie toolbar (see pointer B in Figure 5). A menu similar to that depicted in the figure should appear.
3. Choose the first option labelled "`Load Ontology`"; and then "`From local file`". A file selection dialog window appears, letting you choose the lexicon (with `*.onto` extension). Alternatively, you may obtain the latest update of this lexicon from a shared web location by choosing option "`From URL`" and typing the following address: *http://kmi.open.ac.uk/projects/kweb/resources/semweb-studies.onto*
4. Navigate to the location (folder) where you stored the lexicon; usually it would be found in "C:\Magpie" or "Ontology Store" sub-folder of the main installation directory (mostly "C:\Magpie").
5. Choose "semweb-studies.onto" for the purposes of interacting with a knowledge management application of Magpie.

6. Clicking on "`Open`" button Magpie starts loading lexicon. Note that this may take a while (around 2-5 seconds for "semweb-studies.onto" lexicon) depending on the size of the lexicon, number of instances, and of course computer power.
7. If the loading and lexicon initialisation is successful, you should see the Magpie toolbar changing its appearance and showing the top-level classes/categories from a particular ontology. Each class is a button with a different colour label. For details of the screen, see Figure 6.

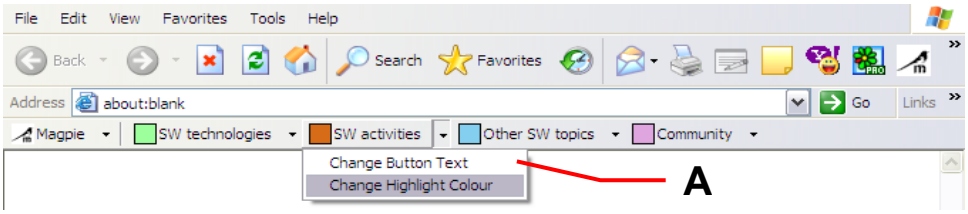

Figure 6. Magpie toolbar after loading a lexicon and showing the top-level classes

Having come so far means that the ASPL/Magpie extension is properly set up and ready to be used for browsing. Now you may start browsing the web by typing a URL (web address) in your web browser, or by searching your favourite web engine. We shall look at the actual behaviour during browsing in the next section, and we shall use the W3C as a starting web site (http://www.w3c.org). However, let us mention two simple configuration changes you can perform at this stage first with the Internet Explorer version of ASPL/Magpie.

First, you can change a button label for each of the top-level classes/categories by using the first option ("`Change Button Text`") in the pull-down menu shown by pointer A in Figure 6. To access the pull-down menu, you click on the little arrow next to the button you want configure, and then choose the option you want.

Similarly, you may want to change the colours used by ASPL to highlight entities of a particular class found in the web page. Currently, all research areas that are known within the loaded ontological lexicon would be highlighted in sky blue. While this is a good colour for a page with white background, it may be inappropriate for say light blue background. In such a case, you may easily change the colour of highlighters. To perform the change, access the pull-down menu for a particular button/category, and choose second option ("`Change Highlight Colour`") as shown in Figure 6. A colour picker dialog would show allowing you to choose your preferred shade.

Using ASPL/Magpie while browsing

In order to get in grips with ASPL/Magpie functionality, we suggest starting with the organizational memory lexicon (semweb-studies.onto file). This file provides a sample lexicon for the semantic web studies ontology[4], which describes concepts relevant to the studied domain; e.g. paper authors, research themes, key concepts, etc. To see Magpie

[4] Available in several formats from http://www.aktors.org/publications/ontology

with the semantic web studies lexicon in its 'native' environment we suggest using the http://www.w3c.org web site. Type this URL into your Magpie-enabled browser, and wait until it appears on screen. Once the site is visible, you may load the semantic studies lexicon if you haven't done so yet (see previous section for how to go about it).

There are essentially two basic ways for a user to interact with ASPL/Magpie and any web page enrichments facilitated by the ASPL/Magpie extension:

- First, the user may highlight concepts of any particular class/category shown in the ASPL toolbar that happen to appear in the web page.
- Second, for each highlighted item or phrase, the user may invoke a semantic or contextual menu for browsing the value-added information about the instance.

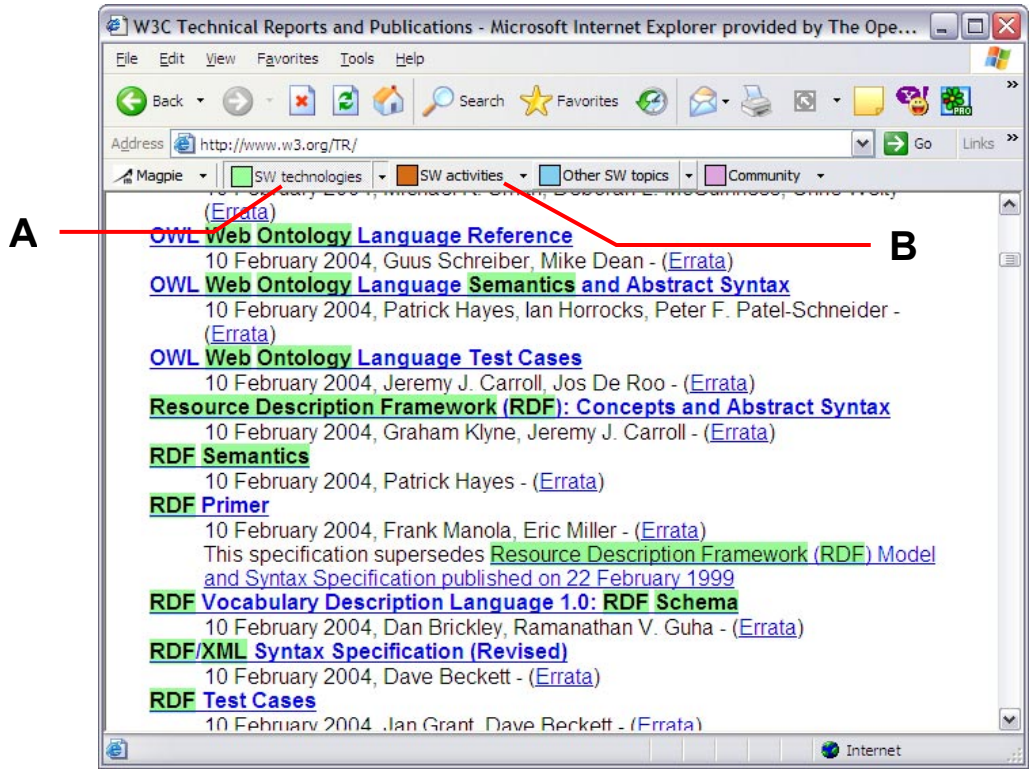

Figure 7. Web page after clicking on button "`SW technologies`"; i.e. highlighting semantic technologies in the page that are known in the ontological lexicon (semweb-studies.onto)

Concept highlighting

As we mentioned above, we explain the highlighting functionality on W3C's technical report web page. Assuming you already navigated to the appropriate URL[5], and loaded semweb-studies.onto lexicon, start with clicking on button labelled "`SW Technologies`" on the ASPL/Magpie toolbar (see pointer A in Figure 7). This button instructs ASPL/Magpie to find any phrase on the page that might be considered as a

[5] http://www.w3c.org/TR

semantic web technology (in this constrained lexicon). By default, the button highlights concepts with light green colour (see snapshot in Figure 7). As could be expected, ASPL/Magpie found and highlighted such concepts as RDF or schema.

Before we start exploring the semantic menus and associated semantic services, we can highlight other – perhaps less obvious concepts and phrases on the web page or concepts that are more distant to the core theme of semantic web studies. For example, to annotate activities one can perform on the semantic web, click on the appropriate button. This one has an orange icon and is labelled "`SW activities`" (see pointer B in Figure 7). One can repeat the same clicking action on each ASPL button. Each button would highlight instances from the respective category in the web page. The fully annotated web page is shown in Figure 8, and shows technologies, activities and other themes broadly related to semantic web studies.

More specifically, ASPL/Magpie correctly recognized phrase "`Resource`" as a concept frequently seen in the context of semantic web (see pointer A in Figure 8), and "`Resource Description Framework`" as one of key technologies one needs to know about (see pointer B in Figure 8). The fact that a particular category is actually highlighted is shown on ASPL/Magpie toolbar by a 'relief button' (see compressed buttons pointed by C in Figure 8).

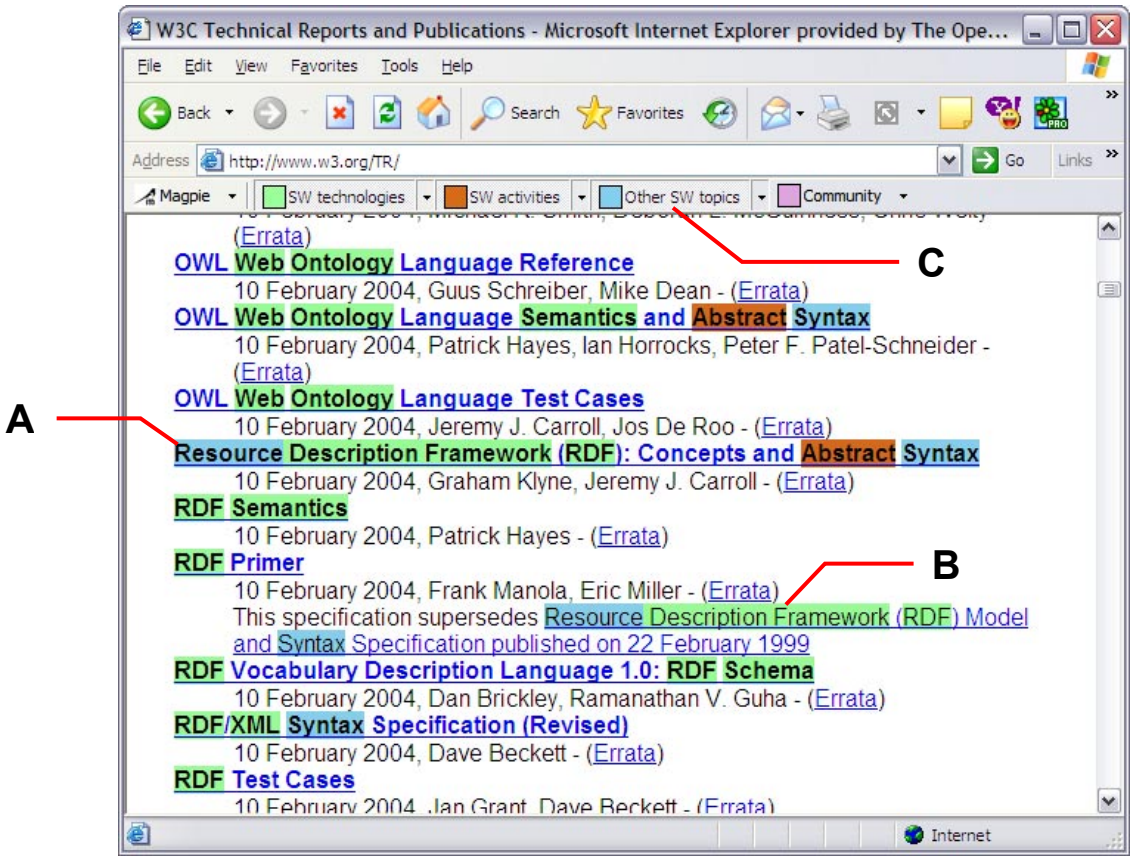

Figure 8. Fully annotated web page showing several categories turned on and highlighted in appropriate colours: technologies – light green, activities – orange, and other themes – sky blue.

The current release of ASPL-v1 contains a limited number of concepts as it is intended as a proof of concept application. For the future, we are developing techniques that would enable us to automatically harvest and maintain lexicons, ontological instances and their relationships.

Contextual, semantic menus

The next functionality the user of ASPL/Magpie can interact with – after successfully highlighting concepts and phrases in the text – is to invoke some of the semantic services. The adjective 'semantic' means that the actual suite of services is chosen based on the class membership of a clicked-on phrase. Please, note that only phrases that were highlighted by Magpie would respond with a menu of semantic services! To invoke a semantic menu, you need to move with the mouse pointer over a particular entity, and click with the *right button* in Internet Explorer and with the *left button* in Mozilla. The current selection of services available for the semantic web studies domain reflects the scenario of writing a literature review. For the semweb-studies.onto lexicon that comes with ASPL-v1, two distinct semantic menus could appear depending on the category membership of a particular entity. They are shown in Figure 9.

Figure 9. Two basic types of semantic menus defined for the semweb-studies.onto lexicon in ASPL-v1 prototype: (A) for the categories "`SW technologies`", "`SW activities`", and "`SW other topics`", and (B) for the category "`Community`".

Now, click on one entity/phrase in the text denoting a technology. For example, let us assume right-clicking on highlighted phrase "`Resource Description Framework`". Since this phrase became visible after pressing the button "`SW technologies`", we expect a menu with semantic services specific for this category (option A in Figure 9). The actual appearance of what your Internet Explorer may look like is shown in Figure 10. As you see, the menu appears exactly where the user clicked with the mouse. It has a usual appearance of contextual menus under given operating system[6].

The next step is choosing one of the options in the displayed semantic menu. Let us start with the simple one first: *How do we define/explain [Resource Description Framework]?* Translated and abbreviated into semantic services labels, this question corresponds to the first option in the menu, which is shown by pointer A in Figure 10. In response to requesting this particular semantic information about "`Resource Description Framework`", a small window pops up resembling the one in Figure 11. According to

[6] Note that the style may differ if you choose a different scheme or fonts in your Windows settings.

the Semantic Web Studies ontology, a relevant definition of what constitutes RDF displays. Since the response to the semantic query is shown as an ordinary web page, it can be annotated exactly in the same way as the main web site, on which the semantic browsing started. An example of such additional annotation is shown in Figure 12 using category "`Community`".

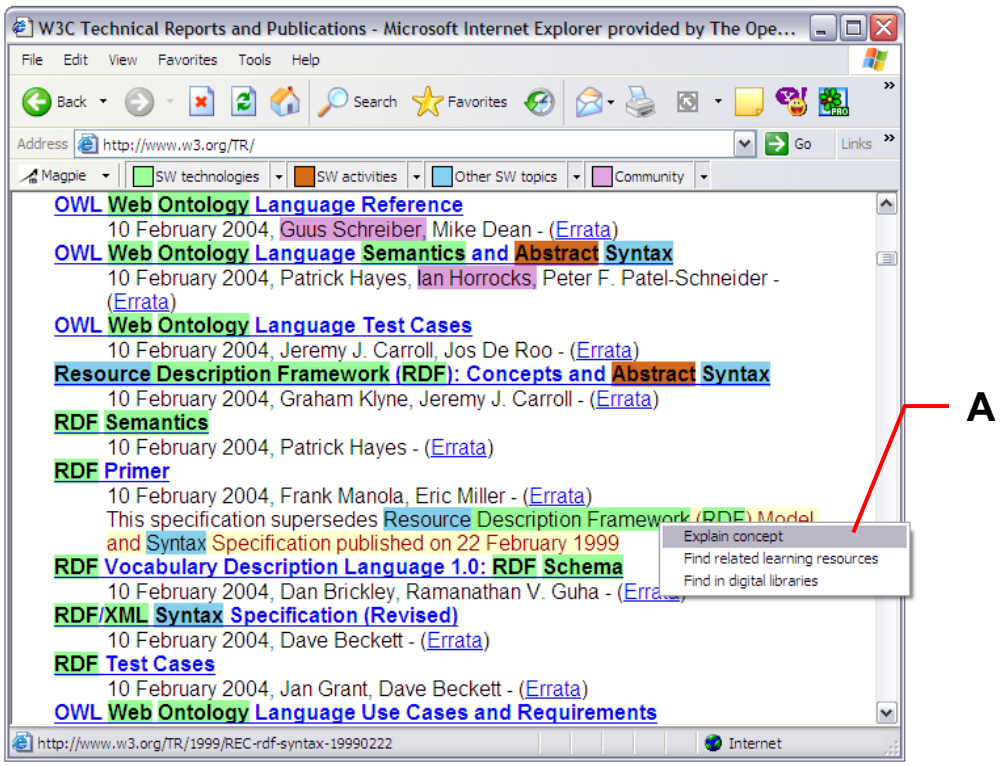

Figure 10. Web page with entities of two categories annotated, and semantic menu invoked over phrase "`Resource Description Framework`".

For slightly more sophisticated reasoning, we may now invoke a request for finding semantically close learning materials from REASE – the repository of learning materials developed as a part of KnowledgeWeb. Right-click on any highlighted occurrence of "`RDF`", and menu shown in Figure 9A should appear. Choose menu option "`Find related learning resources`". Translated into human-friendly language, this semantic service requests a list of all learning materials and papers that discuss or are otherwise related to RDF. The answer is given in Figure 12.

As we can see from the figure, some of the responses of the ontological reasoning engine (esp. those related to the properties of instances) come back as a plain text (see Figure 11). Other response (especially those related to the relationships among entities that have their own URI-s) come back as URLs. You may therefore click on any of the learning materials listed in Figure 12 to access them. The ASPL/Magpie toolbar can be setup so that it loads automatically whenever a new window opens. The setup of this behaviour will be discussed further down. Before getting there, we show a few services specifically designed for exploring the research field through social networks.

Social networks are particularly rich sources of information for building up reviews. Hence, a separate category has been introduced in the semantic web studies ontology that comprises key individuals from the field. The key idea of providing services based on communal relationships – e.g. paper co-authorship and co-references – is to enable the user to explore potentially similar papers, which may extend the review.

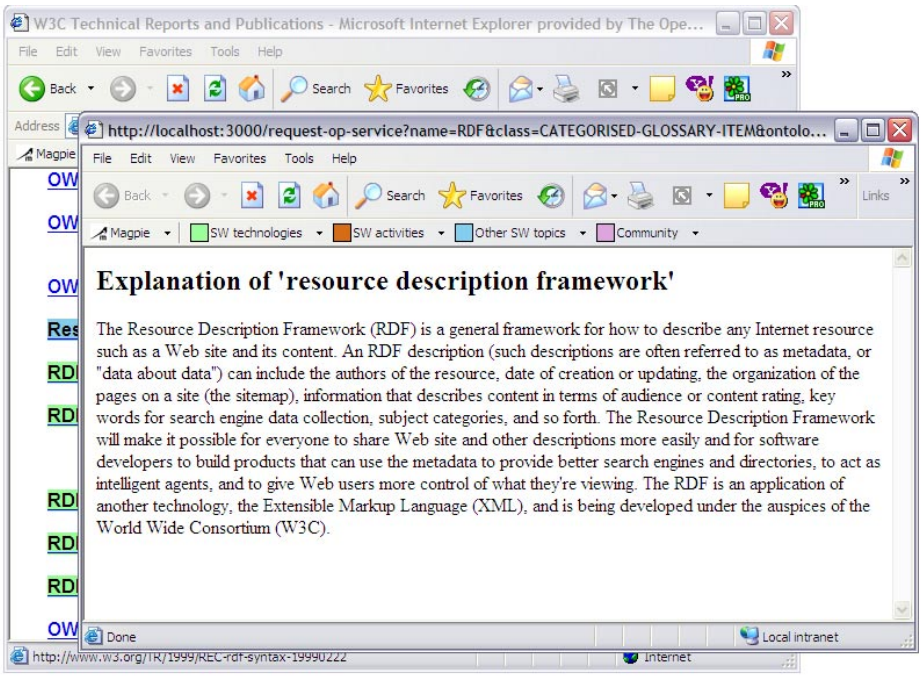

Figure 11. Response from an ontological reasoning engine to the query about explaining concept "`Resource Description Framework (RDF)`"

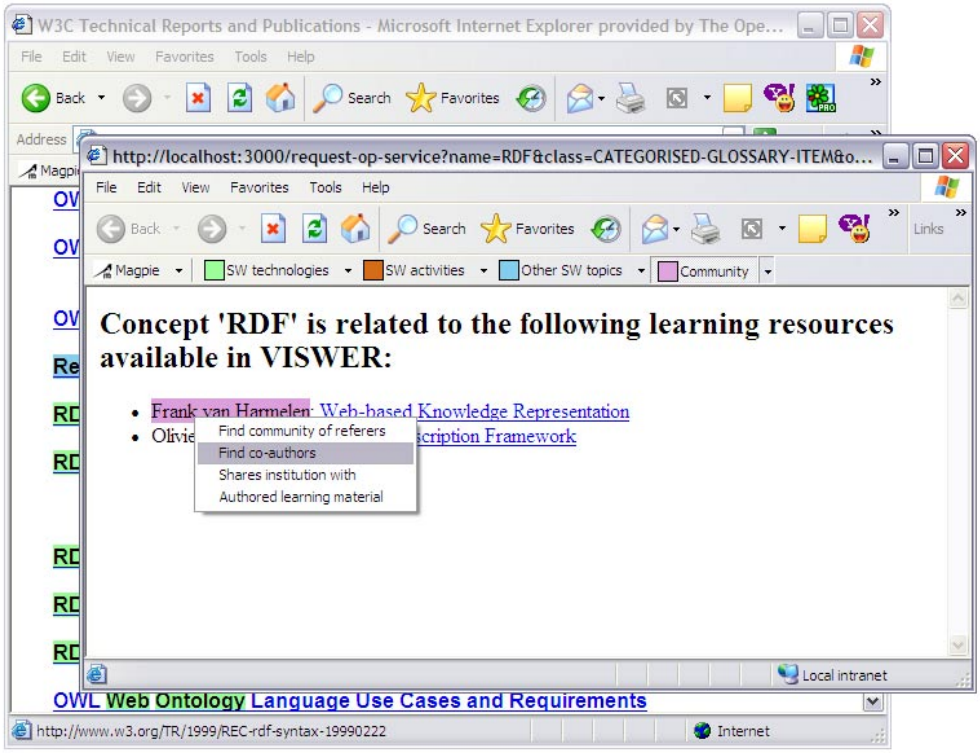

Figure 12. A semantic response related to the instance "Resource Description Framework" showing a list of learning materials that are semantically close with additional highlights

Currently, three simple aggregating services drawing on communal links are implemented in ASPL-v1; namely, "`Find co-authors`", "`Find community of co-referers`", and "`Shares institution with`". A screenshot in Figure 13 shows a list of van Harmelen's co-authors found in CiteSeer.

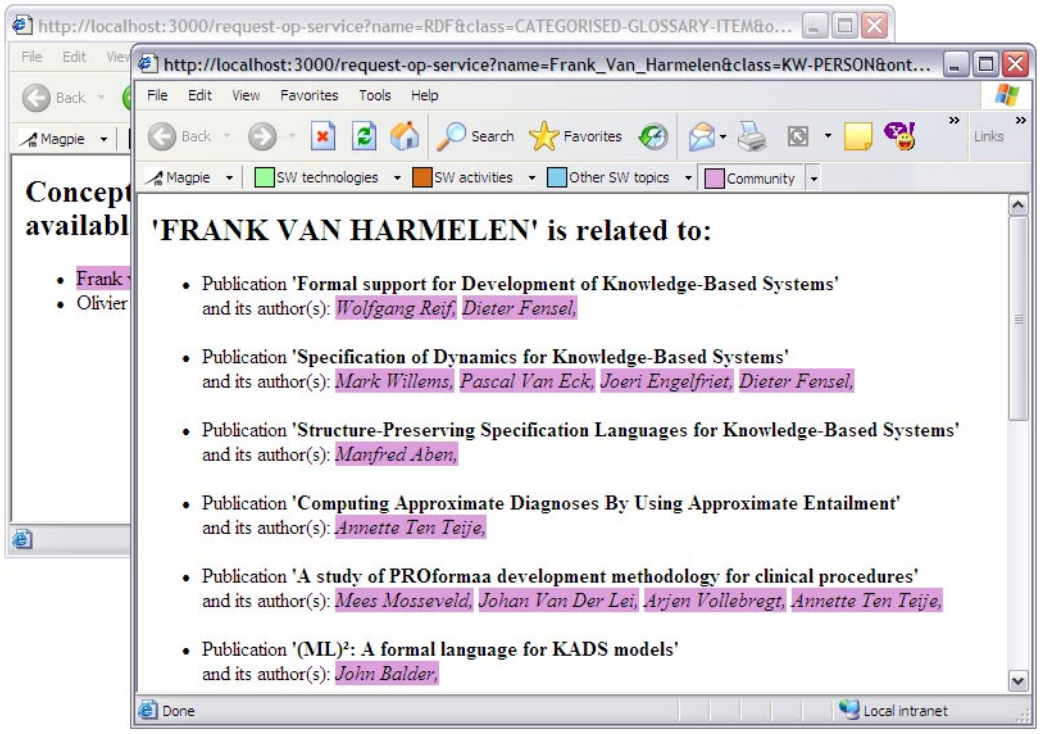

Figure 13. Response from an ontological reasoning engine to the query requesting to find other people who typically author papers with "`Frank van Harmelen`"

An interesting point is that all communal service relate to third-party knowledge and data repositories, such as CiteSeer. What ASPL-v1 is doing in this case is re-using knowledge that has been captured for one purpose to formulate response to a range of semantic queries. Furthermore, ASPL and Magpie framework take care of translating and communicating with the data repository. The user only sees the outcome of this interaction. Thus, different services can be plugged into the ASPL-v1 framework by simply instructing the underlying Magpie framework to wrap requests and results appropriately. For instance, in case of co-authorship, the service communicates with an RDF Sesame Store.

Nevertheless, the semantic search for related educational materials, from where further semantic exploration is possible, would lead to REASE – the repository of European Association for Semantic Web Education. A screenshot of a typical record in REASE related to RDF and Frank van Harmelen is shown in Figure 14.

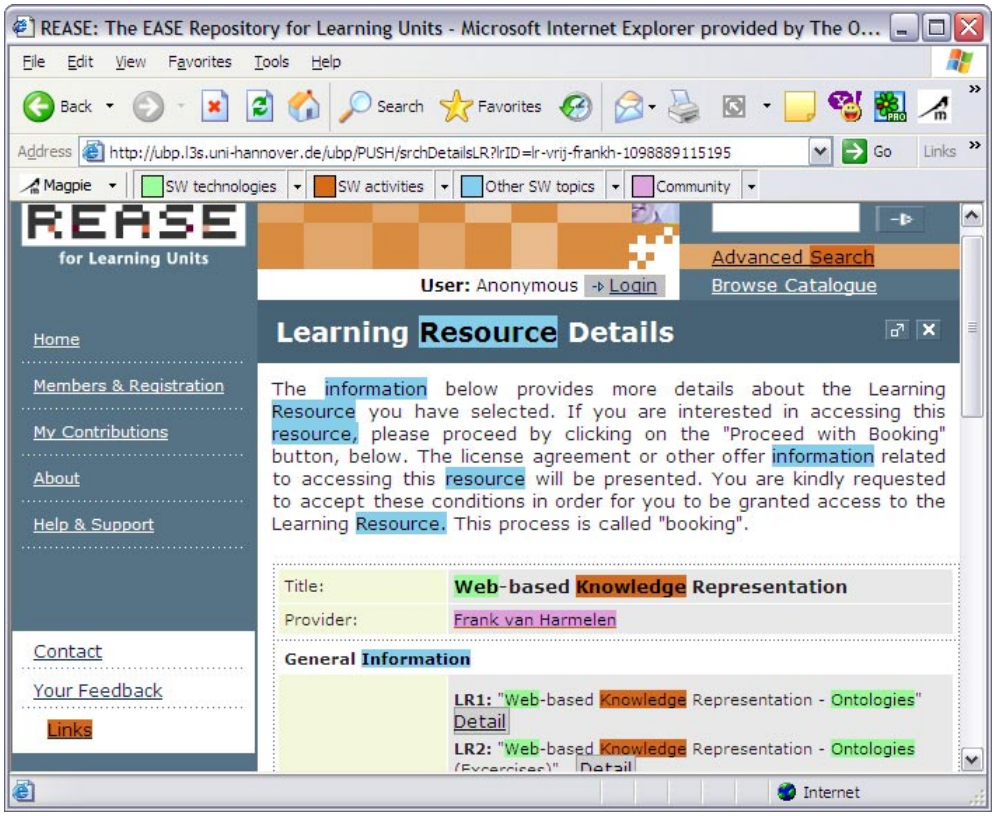

Figure 14. Typical record of an educational material in REASE accessible via ASPL-v1

Setting up ASPL/Magpie functionalities

In addition to the basic functionality of highlighting ontological entities and providing additional information about them, the ASPL/Magpie plug-in can be customized – either on the level of knowledge presentation or on the level of communication with semantic services. The following are the most frequently used options of the original Magpie framework that are applicable to ASPL-v1:

- Mechanism for remembering last used lexicon,
- Mechanism for user identification,
- Mechanism for browser customisation

Remembering last lexicon

The functionality of loading a lexicon and using it to interpret the web page to start semantically driven exploration of applicable knowledge space is the core aspect of ASPL and Magpie. However, the browsing process is very dynamic and our initial studies showed that the need to reinitialise the plug-in with the same lexicon each time the user moves in the semantic space adds to the cognitive costs and affects the usability and acceptability of the tool.

Therefore, a simple measure has been put in place enabling the user to express his or her preferences and store these persistently in (semantically marked-up) preference file. The file being annotated can be easily edited manually or the user may use ASPL/Magpie dialog boxes to set the preference. The preference setting dialog is accessible by clicking on the little arrow next to the "Magpie" logo in the toolbar and choosing the option "Preferences" (see marker A in Figure 15). As shown in Figure 15, to remember the currently loaded lexicon, the user ticks the box labelled with marker B.

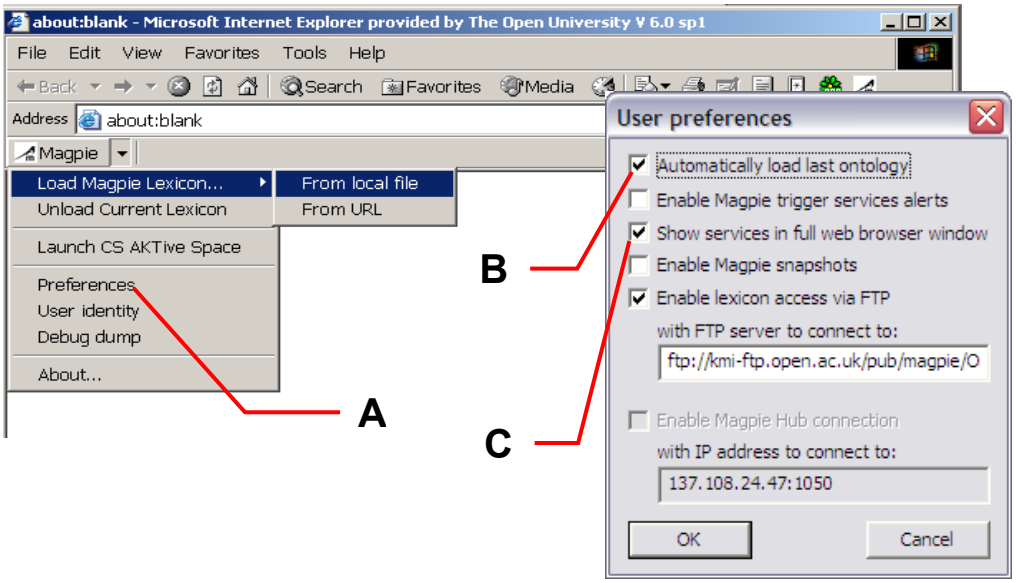

Figure 15. (A) Invoking preference dialog and (B) remembering the last used lexicon.

Browser window customisation

In addition to loading the last available lexicon, ASPL/Magpie also enable to alter the way responses from the semantic services are presented. The option marked by C in Figure 15 shows the responses in normal-size web browser windows, the size of which depends on the user's general settings of their browser. This functionality is very simple and its sole purpose is to improve the usability of the tool – by reducing the need to constantly resize the dialogs with responses to fit all the response in one proper window.

The other options seen in the preferences dialog relate to more specialized Magpie functionality, which includes trigger services, visual bookmarking, user alerts, etc. These functionalities were not incorporated into ASPL-v1; however, the conceptual and implementation details can be found in (Dzbor, M., Domingue, J. *et al.* 2003; Domingue, J., Dzbor, M. *et al.* 2004; Dzbor, M., Motta, E. *et al.* 2004; Dzbor, M., Motta, E. *et al.* 2005).

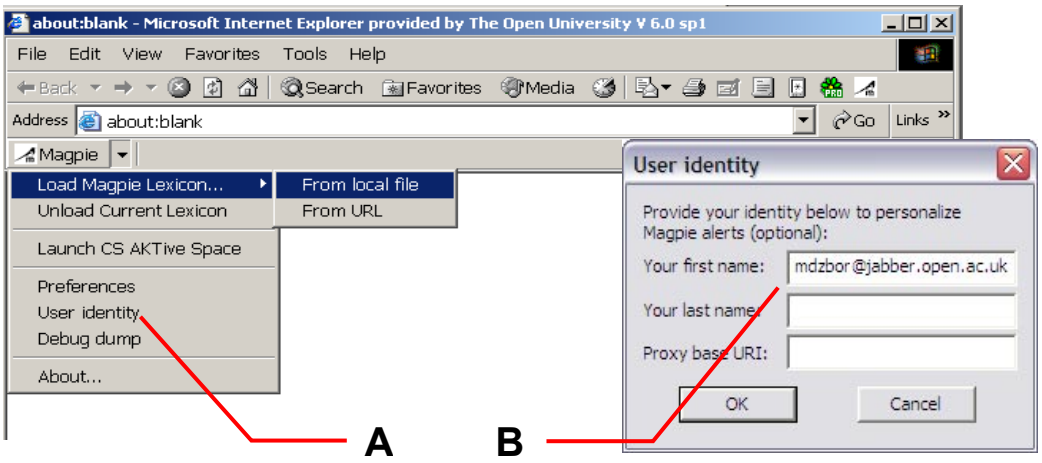

Figure 16. "Who am I" – ASPL/Magpie support for service personalization via user identities

User identity and personalization in ASPL

Finally, one aspect of Magpie framework that is enabled in ASPL-v1 is user's identity. Presently, none of the services as demonstrated above makes any use of the user identification. However, the concept of a user's ID is necessary to satisfy one of our objectives for the future releases – personalization. When talking about personalizing the user interaction with ASPL/Magpie, we mean customizing the responses of the semantic services based on knowledge the system may have about the particular user. For example, material on an appropriate level of difficulty or in a particular language might be preferred or highlighted in the responses.

The user identity is set up in a dialog accessible from the main Magpie menu and after choosing the option "User identity" as indicated by marker A in Figure 16. Marker B in the same figure then shows how the dialog appears. Nevertheless, note that this is a highly prototypic functionality, and we have currently no publicly available services that are truly capable of processing this information. In any case, should the user decide to enter this information about him- or herself, the inputs would be used each time a semantic service is requested from any semantic menu. On the server side, this would be ignored; however, this does not affect any user-side aspects of ASPL.

Future work

In the next six months we will conduct an evaluation of ASPL-v1. It is planned that this should include an informal questionnaire designed to capture impressions of the system and to indicate what functionality may be missing. This will be largely aimed at peer researchers from the KnowledgeWeb community. We will also conduct a more formal, experimental evaluation centred on a particular learning task or set of tasks and designed primarily to assess ASPL's efficacy as a learning tool. This will be aimed at PhD students. We hope that the evaluation will indicate if the emphasis on the use of Magpie in ASPL-V1 is warranted. It will also indicate which new functionalities we should include.

After that, our work will focus, firstly, on the development of the ontologies needed by ASPL-2 (a deliverable in M30), and, secondly, on the development of a range of new semantic web services for learning (learning services for short) for ASPL-2 (M36).

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