

We-Share: a social annotation application that publishes and retrieves information about educational ICT tools from the Web of Data

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ABSTRACT

This paper presents the design and development of We-Share, a social annotation application that allows educators to search, create and enrich descriptions of Information and Communication Technologies (ICT) tools from the Web of Data. As many others social applications, We-Share allows educators to publish information about the ICT tools they use in their classrooms. Further, We-Share also enables educators to relate tool descriptions to the educational contexts where the tools were employed, thus gathering educational-specific knowledge about the use of ICT tools. A distinctive feature of We-Share is that it relies on SEEK-AT-WD, a Linked-Data-based infrastructure that keeps updated a collection of thousands of descriptions of educational ICT tools on the Web by periodically gathering data from third parties. Hence, We-Share can make use of the data gathered by SEEK-AT-WD to create an initial collection of tool descriptions that can overcome the cold-start problem that other registries suffer. Further, as SEEK-AT-WD updates the tool descriptions it publishes, this same data will be updated on We-Share. Finally, as the data published on We-Share will be available as Linked Open Data its potential impact is higher and it contributes to the development of an educational Web of Data. All in all, We-Share combines the affordances of social annotation applications, which can gather domain-specific knowledge about educational ICT tools, with the affordances of Linked-Data-based applications, which promote the sharing of data with third parties.

Categories and Subject Descriptors

H.3.5 [Information Systems]: Information Storage and Retrieval Online Information Services

Keywords

Web of Data, educational ICT tools, Linked dataset, social annotation

1. INTRODUCTION

Educational registries of ICT tools are commonly employed to support educators when discovering and selecting tools for their classrooms. A common problem these registries face is how to gather and update descriptions of ICT tools that are useful and understandable by educators. Some of these registries, such as Ontoolsearch [19], follow a traditional approach, where the registry administrator is in charge of publishing and updating all the data contained in the registries. Others, such as the ROLE Widget Store¹ or Cool Tools For Schools², follow a social approach involving their communities of users in their data sustainment. It is well known that these social registries have data sustainability advantages with respect to the traditional ones since more people can contribute to their data sustainment. Nonetheless, three important drawbacks can be found in these social registries. First, the cold-start problem [10] is present: it is hard to reach a critical mass of data that motivates users to contribute to the registry sustainment. Second, the information provided typically focuses on the functional characteristics of the tools, including very little information about their educational use, which is a key issue to help teachers decide whether they can apply these tools in their particular contexts [5]. Third, these registries are isolated data silos that need to create and keep updated all the data they manage, thus increasing the overall effort of sustaining educational ICT tool datasets.

In order to overcome these problems, we proposed the SEEK-

¹<http://www.role-widgetstore.eu>

²<http://cooltoolsforschools.wikispaces.com>

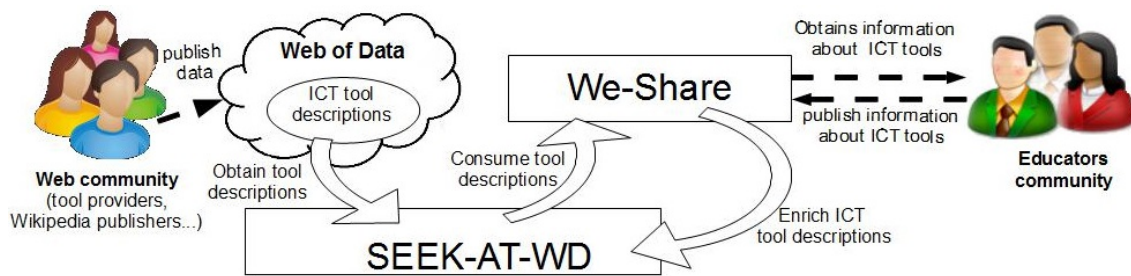


Figure 1: Typical scenario of We-Share as a social annotation application that collects tool data and publishes it on the Web.

AT-WD infrastructure [15]. This infrastructure automatically collects -and periodically updates- educational descriptions of ICT tools from several cross-domain datasets of the Web of Data. All the data collected by SEEK-AT-WD is publicly available and can be used, even by third parties, to developed educational applications. By September 2013 more than 7000 different educational descriptions of ICT tools were gathered by SEEK-AT-WD from the Web of Data. These descriptions include the functional and administrative characteristics of the ICT tools, but they do not provide information about their educational use, since nobody has published it on the Web of Data yet [14]. Instead, SEEK-AT-WD was designed to facilitate the development of educational applications on top of this infrastructure, for instance to allow educators to publish information about the use of ICT tools [15].

The present paper presents the design and development of We-Share, a social-semantic application that allows the community of educators to obtain, create and enrich descriptions of ICT tools from the Web of Data [7]. As visualized in Figure 1, We-Share would take advantage of the SEEK-AT-WD infrastructure to inform educators about ICT tools. More importantly, We-Share could be used by this same community of educators to publish information about ICT tools on SEEK-AT-WD out of their experience using them in their classrooms. This way, the tool descriptions that We-Share would gather from the Web of Data could be enriched with educational-specific information that would also be published as Linked Open Data on the Web, thus increasing its potential impact and contributing to the development of an educational Web of Data. Hence, We-Share should facilitate educators the interaction with Linked Data from non-educative sources and should provide a mean to publish on the Web of Data the information created by the educators.

In the rest of this paper we first briefly describe SEEK-AT-WD in section 2. Then, we present the design of We-Share in section 3, which includes both its architecture and its interface, while some implementation details are given in section 4. Finally, the main conclusions are drawn in section 5.

2. PUBLISHING AND RETRIEVING TOOL DESCRIPTIONS FROM SEEK-AT-WD

SEEK-AT-WD is a social-semantic infrastructure that sustains an educational ICT tool dataset on the Web of Data.

It offers updated information about educational ICT tools through a SPARQL endpoint [21] that can be accessed at <http://seek.rkbexplorer.com/sparql/>. In order to update its tool descriptions, SEEK-AT-WD counts with a set of crawlers that retrieve the information already published on the Web of Data by cross-domain datasets, such as DBpedia³ [1] or Factforge⁴. Then, these crawlers submit the ICT tool descriptions retrieved to SEEK-AT-WD using its data publication interface. In addition, this same interface can be used by other annotation applications of educational ICT tools to submit information to SEEK-AT-WD. Specifically, these annotation applications are expected to enrich the tool descriptions contained in SEEK-AT-WD with educational-specific information, which cannot be currently found on the Web of Data [14]. SEEK-AT-WD publishes all the data it manages as Linked Open Data on the Web through a web interface and a SPARQL endpoint that can be accessed at <http://seek.rkbexplorer.com>.

SEEK-AT-WD structures its information according to the SEEK Ontology [15], so the applications that publish data on SEEK-AT-WD are expected to align the data submitted to this ontology. The expected users of the SEEK Ontology are educators, that is, people who give lessons in educational institutions. The domain of the SEEK Ontology are educational ICT tools, which includes those tools specifically developed for educational purposes (e.g. Group Scribbles⁵) and those that are commonly employed in education even if they were not initially developed for educational purposes [3] (e.g. Google Drive⁶). The SEEK Ontology encompasses a set of ontologies for describing tools, educational contexts and reviews, such as Ontoolcole [18] and the Review Vocabulary [8]. The reviews published using the SEEK Ontology are composed by a text and a numerical rating, and they are also related to the description of the educational context [5] where the tool has been employed. These educational contexts include the information related to the educational use of the tools, such as the teaching technique employed, the learning goals or the name of the course. This way, the SEEK Ontology describes not only the ICT tools employed in education and the educators' opinions about them, but also what they have been used for.

Currently there is an educational ICT tool search system,

³<http://dbpedia.org/About>

⁴<http://factforge.net/>

⁵<http://groupscribbles.sri.com>

⁶<https://drive.google.com>

called U-Seek⁷ [20], that uses SEEK-AT-WD data and offers it to the educators for the discovery and selection of tools. U-Seek offers an end-user interface based on graphs that hinders the complexity of creating SPARQL queries and allows educators to create them manipulating a graphical interface. U-Seek submits the queries created to SEEK-AT-WD and the results obtained are presented to the educators in a simple and visual way.

3. WE-SHARE DEVELOPMENT

3.1 We-Share software requirements

We-Share is a social-web annotation application that allows educators to publish information about ICT tools on SEEK-AT-WD. For example, an educator may use We-Share to publish an ICT tool description (e.g. MediaWiki) that has not been published on SEEK-AT-WD. This same educator may also publish an educational context defining that a debate was carried out in a face-to-face learning situation and, after that, she may review MediaWiki relating her review to the educational context she has already published. This way, the description of MediaWiki is linked to the educator's review and to the educational context. Three days later another educator may visualize the description of MediaWiki and she may edit it in order to enrich this description. She may also review MediaWiki, relating this review to another educational context.

As seen in this example scenario, We-Share should allow to **publish** and edit educational ICT tools, educational reviews and educational contexts, as well as the submission of all the data published to SEEK-AT-WD. Hence, We-Share should structure its information according to the SEEK Ontology and should provide a mean to submit the information to SEEK-AT-WD. Moreover, as We-Share is expected to be used by educators it should hide the complexity of managing semantic information, which is the main challenge when designing its interface. As recommended for social annotation applications [11], We-Share should also allow educators to retrieve and visualize the data published on SEEK-AT-WD in a single environment. Specifically, it would be convenient for We-Share to allow educators to **query** and **browse** SEEK-AT-WD knowledge base, which are the two main interaction models where users access to information [2, chap. 10]. Finally, for the sake of data reliability, the information in We-Share should be related to the user who publishes it. So We-Share needs to **manage user accounts**, allowing educators to create and edit their user accounts as well as to log in and log out of the system.

3.2 We-Share software architecture

The logical architecture of We-Share is shown in Figure 2. It can be seen that its elements are arranged in a three-tier model, as it is usually the case when designing distributed applications [12]. According to this model, the upper tier, called "presentation tier", includes the elements that conform the user interface. We-Share presentation tier contains the interfaces that allow educators to publish and retrieve information. The intermediate tier, called "business logic", collects the elements that implement the processes needed for the system to provide its required functionality; in We-Share, its business logic provides the functionality to obtain

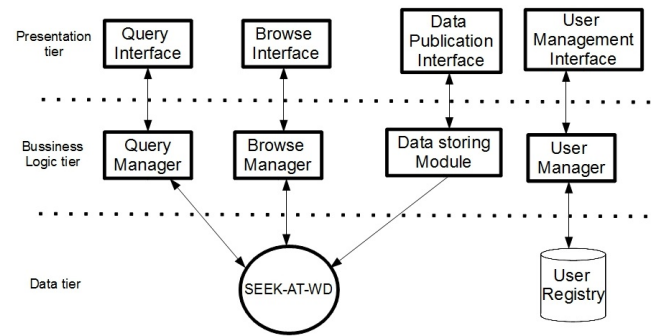


Figure 2: Logical architecture of We-Share.

and publish information on SEEK-AT-WD, as well as to manage user accounts. The last tier, called "data tier", includes the needed information for these processes to work properly; We-Share data tier is composed by the dataset of SEEK-AT-WD and the registry of We-Share users.

Figure 2 also shows that the logical architecture of We-Share defines an element in the presentation tier, and another one in the business logic tier, to support each of the four main functions of We-Share previously defined. It can also be seen that all the information about ICT tools is stored in SEEK-AT-WD, so the **Query Manager** and the **Browse Manager** access it to obtain information and provide it to the users. Similarly, the **Data storing Module** directly inserts the tool information published on We-Share to SEEK-AT-WD. Nonetheless, the information related to We-Share users is stored in a separate dataset since their privacy should be guaranteed.

3.3 We-Share user interface design

The interface of We-Share should allow educators to interact with SEEK-AT-WD data, hiding the complexity of publishing and retrieving semantic information. As Figure 2 depicts, four different interfaces are defined: a **Query Interface**, a **Browse Interface**, a **Data Publication Interface** and a **User Management Interface**.

With the aim of reducing the design and development effort of We-Share, U-Seek was integrated in it to provide its query functionality. Hence, the **Query Interface** (and also the **Query Manager**) is directly taken from U-Seek. As previously said, U-Seek defines an interface that allows educators to create semantic and keyword-based queries. It uses a graph abstraction that allows educators to browse the categories of tool types, educational tasks and artifacts defined by the SEEK Ontology. Educators can browse these categories in order to discover the concepts defined by SEEK Ontology and to select those concepts with which they want to filter results. Once they select all the concepts, they press the search button and We-Share submits a formal query to SEEK-AT-WD including all the concepts selected by the educator.

Figure 3 represents the search interface of We-Share, showing the graph of tool types. In the bottom left of the interface there are some concepts selected by the educator to filter the results obtained from SEEK-AT-WD. In this case

⁷<http://www.gsic.uva.es/seek/useek/>

the query asks for “tools that allows a group of students to write and has already been used to support a debate in a blended scenario”. The results retrieved from SEEK-AT-WD are shown on the bottom right area, where three results are obtained. When clicking on any of these results, more information about such tool is given.

The **Browse Interface** represents the information contained in SEEK-AT-WD in a user-friendly way and allows to browse the knowledge base. This interface allow users to retrieve the Concise Bounded Description [16] of each entity published by SEEK-AT-WD (either tool descriptions or educational contexts). Further, it allows users to access collections of entities, such as the list of tools that belong to a specific tool type or the ones that support a specific educational tasks. Figure 4 represents part of the description of MediaWiki, as represented by We-Share **Browse Interface**. As seen, the information related to MediaWiki includes a textual description of the tool, its functional and its technical characteristics. A tool description also includes all the reviews related to such tool. Figure 5 shows part of the reviews related to MediaWiki. It can be seen that a summary of the reviews is firstly represented while more details can be found for each of the reviews. A similar interface is provided for educational contexts, where the characteristics of the contexts, as well as the list of ICT tools employed in them, are represented. Thus, educators can also find out combinations of ICT tools that are employed in a particular context.

The **Data Publication Interface** is based on forms, which are commonly employed in social applications to facilitate end-users the submission of information to their knowledge base. Specifically, three different forms can be found in We-Share, which allow to publish educational ICT tools, educational contexts and educational reviews. Each form includes a set of boxes where the educator can include the different parameters of the entity she is describing. Once published, We-Share creates RDF triples out of the information submitted according to the SEEK Ontology (these triples are also sent to SEEK-AT-WD). Thus, the educators can publish complex descriptions of ICT tools, educational reviews and educational contexts manipulating simple forms. Figure 6 shows part of the interface of the form that allows end-users to publish educational contexts.

Finally, the **User Management Interface** includes a very simple interface to log in and log out of the system (see the bottom left side in Figures 3 and 4). In addition, another simple interface allows educators to create new accounts that should be confirmed by We-Share administrator.

4. WE-SHARE IMPLEMENTATION

When developing social applications that publish data on the Web, it is common to use a Content Management System (CMS) [9] that implements part of the functionality and that can be adapted to satisfy the needs of specific applications in order to reduce their development effort. Another possibility could be to employ Semantic MediaWiki as a development framework, but it has disadvantages with respect to CMSs to develop educational applications [4]. Among the different CMSs available, Drupal 7 was chosen for the development of We-Share since it is the only one that natively supports the publication of information on the Web

of Data so far (using the RDFa standard [22]). Drupal is distributed as open source and it counts with a very large community that uses it to build web applications and shares the code developed to extend Drupal functionality (these extensions are called “modules” in Drupal terminology). In fact, Drupal has already been used to build Linked-Data-based educational applications, such as the ROLE Widget Store or the one published on [4].

Drupal architecture [17] follows a three-tier architecture, as We-Share does. It natively includes user and data management facilities that can be easily adapted to We-Share needs. However, Drupal does not give support to publish Linked Data on external datasets, as We-Share requires (note in Figure 2 that We-Share element **Data storing module** directly inserts information in SEEK-AT-WD) and its support for the visualization of external data is limited⁸. These drawbacks hinder the federation of We-Share user registry to SEEK-AT-WD data, which is necessary for security reasons (e.g. to guarantee that each educator is only allowed to manage the data she has already published).

A possible solution for this problem is to make federated queries [6] over SEEK-AT-WD and We-Share user registries. However, this kind of federation is a problem by itself that is far from being solved and would have a significant impact on We-Share performance. Another possible solution is to duplicate the data contained in SEEK-AT-WD and store it in We-Share local dataset. This way, We-Share can independently obtain data from SEEK-AT-WD or from its internal database. This solution simplifies the data federation but moves the problem to the synchronization of both datasets. In order to guarantee their synchronization, each time an educator publishes, updates or removes a tool description, an educational context or an educational review, the data should be included both in We-Share and in SEEK-AT-WD datasets. Moreover, each time SEEK-AT-WD updates its ICT tool dataset with information from external sources of the Web of Data, We-Share dataset should also be updated.

For the synchronization of SEEK-AT-WD and We-Share internal datasets a new module was needed, which was designed as an independent process. Using Drupal Rules Module⁹, this process is launched and it submits to SEEK-AT-WD the data modified on We-Share (being it a tool, an educational review or an educational context). This process was coded using Java language and Jena API¹⁰. It also uses Apache Any23 service¹¹ to extract the RDF data published by We-Share and upload it to SEEK-AT-WD.

Nonetheless, the rest of the code required to implement We-Share could be adapted, or directly taken, from Drupal 7 distribution or from some Drupal modules. Specifically, Drupal 7 distribution provided all the functionality needed by We-Share to manage its user accounts and to store data locally. The interface of We-Share was developed using the Dru-

⁸see http://drupal.org/project/sparql_views

⁹<http://drupal.org/project/rules>

¹⁰<http://jena.apache.org>

¹¹<http://any23.org/>

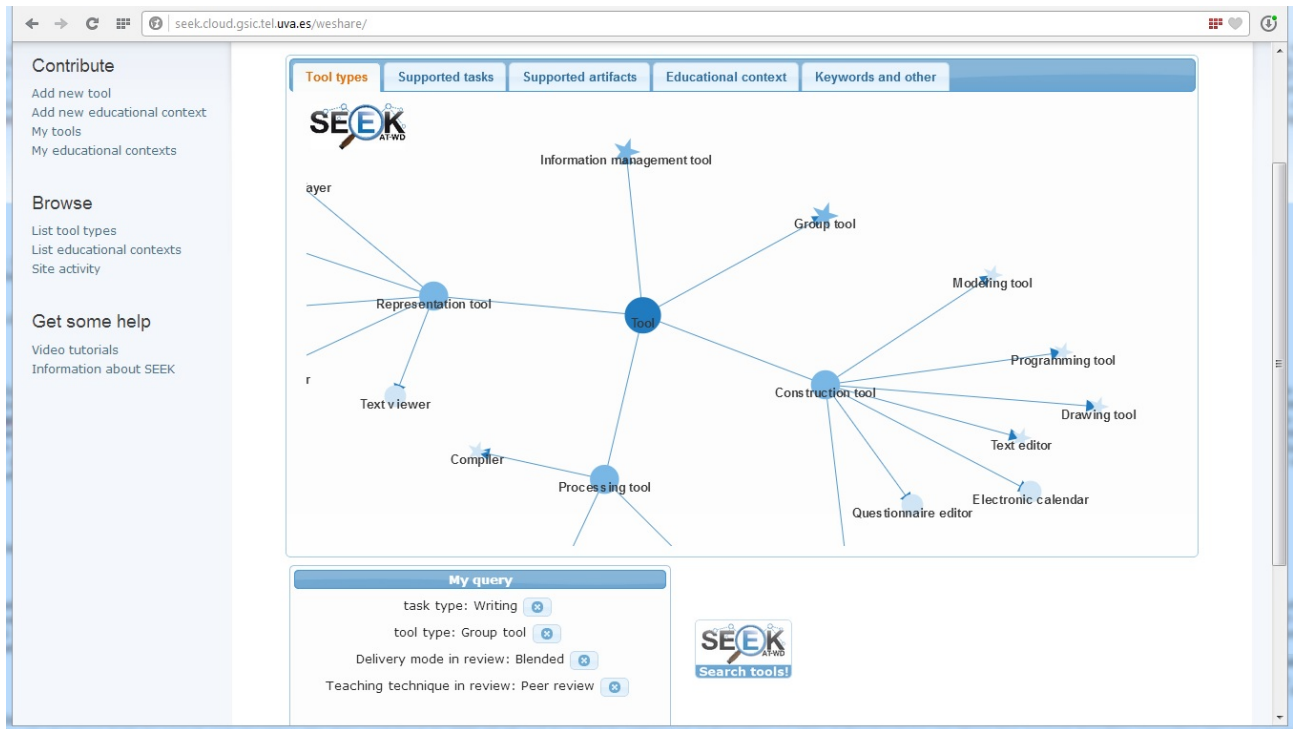


Figure 3: Search interface of We-Share.

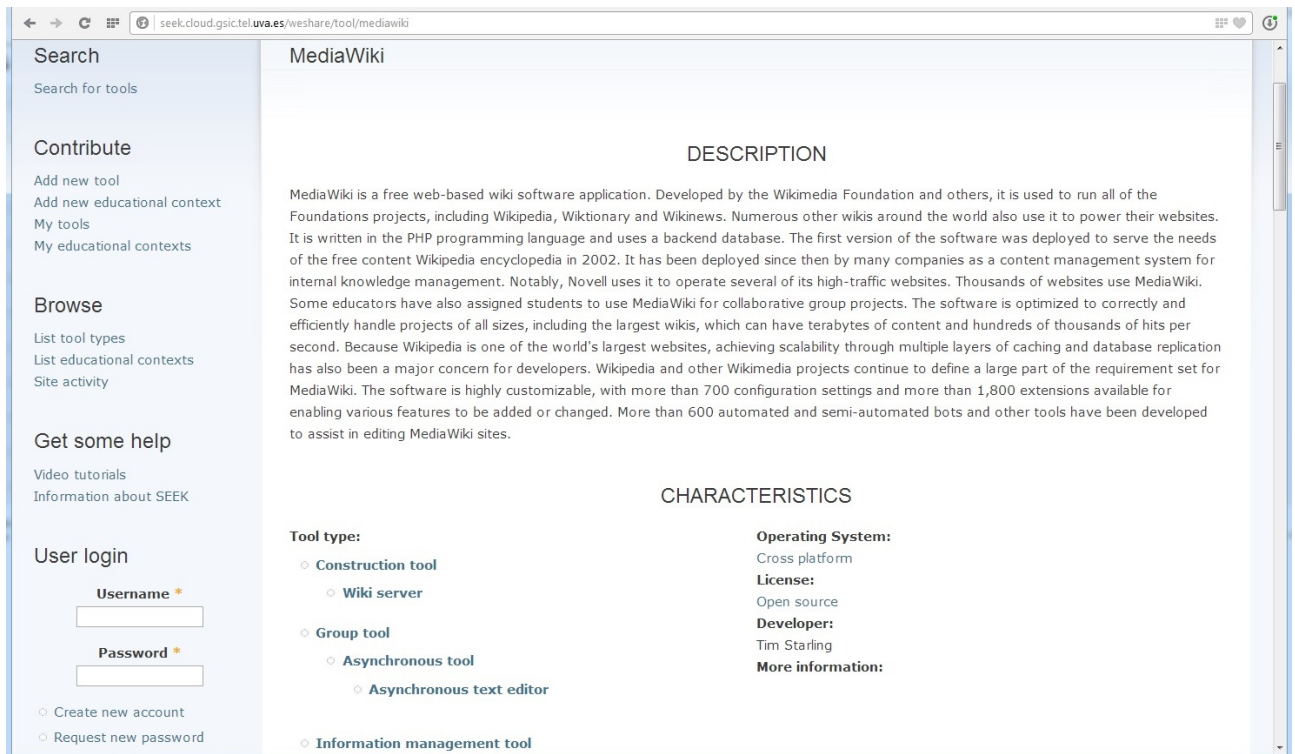


Figure 4: The Browsing Interface showing a fragment of the description of MediaWiki in We-Share.

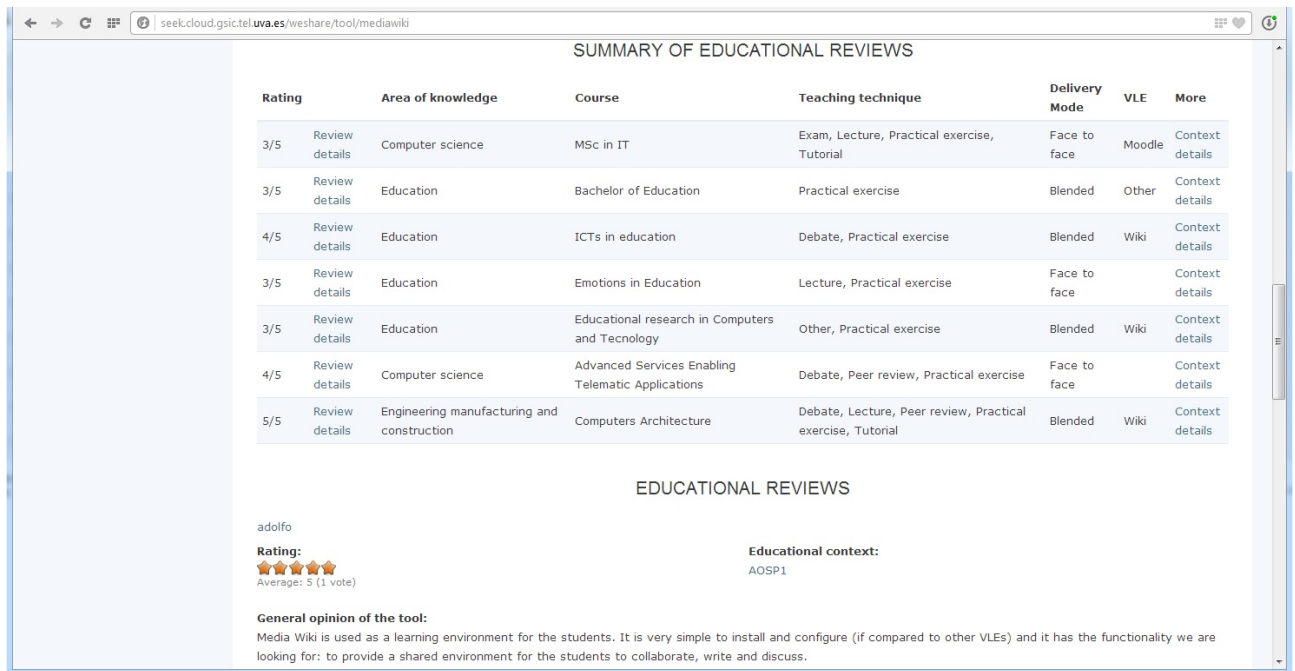


Figure 5: The Browsing Interface showing some reviews related to MediaWiki in We-Share.

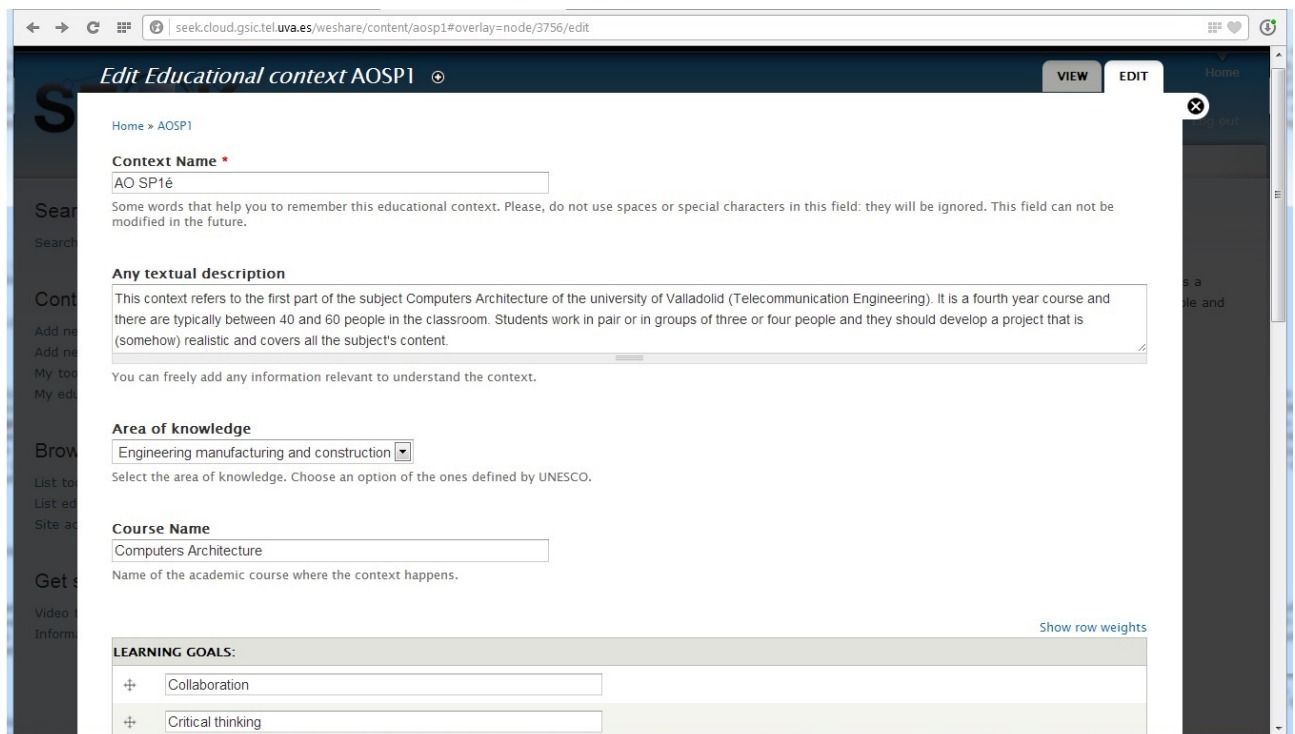


Figure 6: Fragment of the Publication Interface of educational contexts in We-Share.

pal Module Views¹² and EVA (Entity Views Attachment)¹³, which allow to define the information that should be presented in each of We-Share pages. Further, Drupal RDF support¹⁴ was exploited to publish information as Linked Data using the RDFa standard. With this aim, the data structure of We-Share was related to the SEEK Ontology, and thus We-Share pages publish RDF information about every entity they describe.

Current version of We-Share can be accessed at <http://seek.cloud.gsic.tel.uva.es/weshare/>

5. CONCLUSIONS AND FUTURE WORK

We-Share is a social-annotation application that allows educators both to publish and obtain descriptions of ICT tools from the Web of Data. It combines two complementary approaches to collect information and it exploits the advantages of both of them. On the one hand, its semantic approach enables We-Share to make use of thousands of tool descriptions that are available on SEEK-AT-WD; thus, it can overcome the cold-start problem that other registries of educational ICT tools suffer. On the other hand, its social approach enables We-Share to collect domain-specific information about the use of ICT tools in the classroom, thus allowing to find tools by their educational purpose.

We-Share was developed as a Drupal-based application. The use of a CMS like Drupal significantly reduces its design and implementation effort, since many functionalities could be directly reused (e.g. the user management) and others could be easily adapted (e.g. the publication of tool descriptions in RDFa format). In fact, the only code that needed to be implemented for We-Share was SEEK Publisher, the element that inserts the data created by We-Share into SEEK-AT-WD.

Our future research work focuses on the evaluation of We-Share with educators. Specifically, it would be interesting to assess whether the social information published on We-Share by the educators can be coherently combined with the tool descriptions obtained from the Web of Data and whether the collection of social information increases the utility of We-Share. Another line of future research work would be to further exploit the code generated by Drupal community in order to evolve We-Share: it could be possible to use already existing Drupal modules to evolve We-Share into a social recommender system [13] of educational ICT tools. Drupal modules give extensive support to develop this kind of applications even if the work already done does not exploits them yet.

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¹²<http://drupal.org/project/views>

¹³<http://drupal.org/project/eva>

¹⁴<http://drupal.org/node/574624>

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