Abstract: Within the TENCompetence project we aim to develop and integrate models and tools into an open source infrastructure for the creation, storage and exchange of learning objects, suitable knowledge resources as well as learning experiences. This paper analyzes the potential of social software tools for providing part of the required functionality using a detailed scenario. It then discusses the challenges involved, focusing on interoperability, identity management and providing the right Web 2.0 tools for the required functionalities. Finally, we sketch a possible infrastructure based on Facebook, providing information propagation along a social network graph.

Introduction

During the last three years, the Web has entered into a second phase, known as Web 2.0. New services and software have transformed the Web from being a predominantly read-only medium to one where anyone can publish and share web contents. Web 2.0 tools promote different types of communication: one-to-one, one-to-many, or many-to-many, synchronous and asynchronous, and can be used to search, share and create different media: from text (Blogs and Wikis) to images in Flickr, audio, podcasting and video in YouTube. Given the information overload that is created by the exponential growth of content on the Web, other tools help learners filter and manage information (social bookmarking and RSS feeds), and selectively propagate through social networks (Facebook). The use of these services provided new means to share knowledge, exchange ideas and publish work.

Social software at its core is based on supporting individuals to interact socially and to achieve their personal goals, together with people who have similar interests. It works bottom-up: people sign up to a system and form communities through personal choice and actions. Their desire to organize themselves into groups and to collaborate by advancing personal interests contrasts with more traditional approaches where people are placed into organizationally or functionally-defined groups.

In contrast, traditional LMS still approach group membership in a top-down fashion. In current learning environments and in corporate settings, it is hard to imagine a single person acting without some specifically assigned membership (in a class, a working group, a team or a division). Social software will change the traditional way in which learning systems, groupware and other project-oriented collaboration tools work. People start using social software individually; they advance their own biases and connections, and reflect them in social relationships in everyday life. This process is not organized in terms of a single, clearly defined project; rather, it is a people-driven world, in which social interactions are inductive, passing from individual to a group, to other people and other groups. This approach may appear untidy and approximate, but often is a better method towards forming strongly motivated groups and working teams.

In our project context we want to address the following questions: What happens, if social software is used in formal learning or work environments, and how can it extend the functionalities of traditional learning or work environments? How can the essential elements of social software be incorporated into more conventional software solutions, ultimately transforming learning communication and working collaboration, and which challenges do we have to address to achieve this integration?
The use of Blogs, Wikis, media-sharing services, and other social software, has been shown to create exciting new learning opportunities for people, and to support creation of social networks and communities of practice among company employees (Budznik & Hammond 1999, Schmidt & Braun 2006). The learner is seen as a participant who is actively engaged through a rich set of interactions within these communities. At the same time, the worker must fulfill three workplace roles: working, learning and collaborating with other colleagues. In this paper, we sketch, in a scenario-oriented way, how people can interact in their working environment to create, search and share knowledge resources (Eraut 2004, Rosenberg 2001, Schmidt & Braun 2006).

**TENCompetence Background**

TENCompetence\(^1\) addresses the need for flexible and effective lifelong competence development and aims at supporting individuals, groups and organizations by establishing the most appropriate technical and organizational infrastructure, using open source, standards-based, sustainable and innovative technology.

To integrate models and tools for creation, storage and exchange of knowledge resources, in the first project stage we implemented the KRSM infrastructure (Demidova et al. 2007) making information accessible to better support lifelong learning and enhance learning experience. This infrastructure brings together information stored on institutional servers, centralized repositories, locally on learner desktops (by means of P2P technology) and online community-sharing systems like *Flickr* and *YouTube*. The KRSM architecture is depicted in Fig. 1.

![KRSM Architecture](image)

In the next project phase we plan to extend the integration of Web 2.0 applications to support a variety of scenarios, some of which are described in the next section. Whereas in the current KRSM architecture Web 2.0 applications like *Flickr* and *YouTube* are only considered to be information sources for existing services, in the next project stage we aim to combine functionalities of existing Web 2.0 applications (tagging, bookmarking and commenting) into an integrated *LearnWeb 2.0* platform for sharing, discussing as well as for (possibly collaborative) creation of knowledge resources, and for information propagation along social networks.

\(^1\)TENCompetence project: [http://www.tencompetence.org](http://www.tencompetence.org)
Scenarios

We start with the observation that software development needs to be interpreted and described not from a technological standpoint, but in terms of potential use. Thus we start with three short scenarios and then analyze the challenges and design choices arising from these scenarios.

Higher Education / Strong and Weak Ties / Collaboration and the Need for Interoperability

Our main actors in this scenario are ICT technicians who support different projects and people in a university environment. ICT is used at different levels of the organization: work (store and share knowledge resources), teaching (present and provide learning materials), learning (for workers and students). Dynamic changes in the technical infrastructure, like e.g. hard- and software development require technicians to develop new competences to cope with a continuously evolving environment. Thereby information sharing plays a central role to allow for speed up of the required competence development.

Each technician works on several tasks, but communication among colleagues is only performed in person or via e-mail, without any synchronization or support. Too often, a technician does not know what the others are doing, even if their work is relevant for her tasks. Resources are stored in different databases, which are neither linked nor interoperable; discussions take place ad hoc and are not stored; best-practice transfer is manual and ad hoc, and is not supported by any system. McAfee describes different types of relations (ties) among such knowledge workers, which have an impact on the effectiveness of competence development in such groups. These ties include strong collaboration with colleagues as well as weak and potential relations. Dependent on the strength of a particular relation, different technology supporting information sharing needs to be provided. Whereas strong ties imply possible collaborative editing of documents using Wikis or similar tools, weak and potential ties imply information exchange via social networking software and search in the (larger) blogosphere, respectively. Fig. 2 depicts some of the technicians’ tasks and contextualizes some possible applications of Web 2.0 tools to foster information exchange and thus speed up competence development. For instance, Wikis and Blogs can provide project- and cross-project communication, creating a useful yet lightweight knowledge repository infrastructure that allows easier review,

Figure 2: Technicians’ Activities

http://blog.hbs.edu/faculty/amcafee/index.php/faculty_amcafee_v3/how_to_hit_the_enterprise_20_bullseye/
reporting and sharing of activities. A technician then browses and subscribes to them through RSS to keep updated on the news, or use a social networking platform like Facebook to be aware of his colleagues actions.

Other examples include the adoption of Instant Messaging to communicate and share information within the technicians' group at lower costs (compared with telephone calls) and the advantage of saving data in a chat supporting strong ties among technicians. RSS feeds and social bookmarking can help to track changes and news, replacing the staff newsletter informing about potentially useful ties. Blogs and social annotation tools support project discussions and development of technical plans. The instant, secure and constant accessibility of data in searchable format, which Blogs provide, can be a huge productivity improvement in sharing information. Wikis and mind mapping can help in creating a knowledge base of good practices and preparing the agenda for delivering the minutes. Forums can be used to keep track of courses and exams procedures as well as Podcasts as an alternative or supplement to traditional face-to-face training activities, to facilitate IT support for university employees and part-time students. Also using new means of sharing between institutions can provide useful insights by adapting new technologies:

- social bookmarking in existing online library services (including online catalogues and online information resources such as e-journals)
- video-conferencing and content sharing to customize university courses
- reuse and sharing knowledge resources and tools between different universities to improve learning quality
- forums to allow students to share their experiences with evolving learning environment
- social networking platforms to support communities of knowledge workers, learners, or other groups of people with common interests, through awareness and information propagation provided by the platform.

Traditional information systems like LMS should blend with Web 2.0 applications in order to create new environments that reshape information processes and flows and connect competences. The objective is to allow users to invest as much of the available effort as possible in the production of rich interaction, resulting in an optimal collaborative load. The use of social software applications fosters the sense of community and group motivation, supporting lifelong competence development.

Providing integration and sharing among these different kinds of tools is crucial, though. Already with current ERP solutions, integration of diverse systems turned out to be a challenge. Applications "do not converse"; they do not share data and do not concur to re-use services or applications in a uniform / interoperable way. With Web 2.0, we have to integrate new application types into this already complicated environment, to provide functionalities for knowledge resource sharing and exchange. Retrieval of heterogeneous knowledge resources among different tools and social network services is still too difficult. We would like to collect relevant information about different knowledge resources, gathering them in an integrated environment from where they can easily be accessed. This should be provided via a distributed and modularized infrastructure, but allow some means of centralized user authentication or Single Sign On (SSO) functionalities, to avoid logging in several times for each integrated tool.

**Informal Learning / Potential Ties / Providing Access to Relevant Experiences**

Marco has just finished his computer science study at the university and he is looking for a job: he wants to work as a software engineer. As a job seeker, he must arm himself with as much information as possible about potential jobs, including salary comparison data and company research along with tips on everything from writing his cover letter to nailing the first interview. He looks for job advertisements and information about companies’ requirements (knowledge and skills) and how much he has to learn to be fit for the role.

It is not difficult to find job offers in the computer science industry, but sometimes specific skills are required:

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Marco was a good student at the university, he had extensive Java courses and he learned GUI and software design, but he is not fully versed as regards acronyms or the required software skills and technologies (e.g. RDF, JESS, Cocoon, Apache Turbine, Enhydra). To deepen his knowledge about associated matters, he uses different tools to find the answers he needs. He is a scrupulous youngster and wants to verify every potential employer’s legitimacy whether at an individual or corporate level before submitting personal information via interviews or job applications. He searches the Internet to find information and sources about specialization/postgraduate courses, software and applications or Web agencies that offer advice and tips about career and salary. Besides searching the Internet, social network platforms supporting larger communities with weak ties (friendship networks) as well as discovering potentially useful ties in an even larger network (friends of a friend networks) are helpful to get in touch with people who can provide more information and background knowledge. Marco thus joins relevant developer communities to improve his knowledge on technologies and associated matters (Financial Services, Travel Services, Judicial, Government and features of the foreign country). He also realizes that social software is a good mean for sharing informal learning experiences and collecting information from other people.

Like many other university graduates Marco lacks the practical work experience and thus knowledge of what exactly an employee is supposed to do in a particular job, as such knowledge is usually not provided to students by the university courses. Marco realizes that traditional Internet searches give mostly formal data and a specific description of what a company needs (e.g. advertisement), but it is not easy to find detailed information about the job itself. Thanks to social network applications such as Facebook or LinkedIn, however, he now keeps in touch with many old and new friends and begins to learn about other people’s experiences. In this way he learns about interesting resources he failed to discover by himself (e.g. "A day in the life": an online collection of a great series of what various professionals do after they wake up, fall out of bed, and drag a comb across their heads).

Marco knows that social software is a powerful information and communication resource, but he finds it difficult to find relevant information distributed across different applications. There is no common rule for collecting and defining data, information is not well-indexed, so it is not possible to rank pages and make structured searches. And while social networks are good information propagation networks, Marco still has to join a larger number of social network platforms than he finds convenient.

Networking and Viral Marketing for a Small Company / The Value of Potential Ties

Finally, let us look at a small company, and the value of potential ties. As time goes by, the Marenzi Sweet Honey company opens more and more branches and the number of customers keeps increasing. From the early days, Mr Marenzi (the founder) paid a great deal of attention to his “faithful collaborators” (the bees), his employees and customers. He is dedicated to workers’ training, customers’ needs and tastes and features of the market. Initially, he lived on the hills and began to produce honey as a hobby. His friends liked his honey very much and more and more people asked to buy his pots of honey. He was also keen on video editing and so his first pots of honey were distributed with a free CD describing the life of bees and techniques of how to extract honey without getting stung. Then some of his friends joined him and they set up a small company. Now, Mr. Marenzi keeps close contact with

his friends and employees, using his Blog to ask for feedback and to give them advice and encouragement. His video-CDs on the life of bees have been transformed into interesting Podcasts in his Blog and this increases his employees’ interest in the secondary aspects of their activity. Social networks promise to offer an opportunity for sharing experiences and resources and to increase learning. In a short time, they have become a strongly motivated community, a Wiki has been created to gather different contributions and to maintain their know-how. Customers have begun to participate in the Forum and the Blog adding their impressions, suggestions and requirements.

Nowadays the goal of Mr. Marenzi is to enlarge the customer base of his small company. He knows that traditional advertising promotion would be too expensive for his small company, and he wants to take advantage of the satisfaction of his most affectionate customers. To find the right sales model, he uses forums, social network platforms and blogs to keep in contact with the growing community of his customers and spread his market. He supports the discussions in the Marenzi Forum and sets up a company Blog to promote the quality of their products, and encourages people to pass on news and marketing messages through on their social network platforms, to create self-replicating viral processes and information propagation. At the same time, Mr. Marenzi learns viral market techniques to use the right media to improve viral promotions; for example video clips can be inserted into the web site, as well as interactive Flash games, advergames, images, or even SMS, web pop-ups, instant messages and emails, and then propagated / discussed on social networking platforms to create viral messages that appeal to people and have a high probability of being passed along. He finds some sites such as www.videoegg.com that give advice on how to engage audiences through online advertising, member database integration, ratings, comments, Blogs. He also tries to identify individuals in his community who can influence other people in the network in an informal manner, in a social networking platform or in the Blogosphere.

He does a very good job, but he also faces some challenges. For example, it is difficult to get people to join their discussions, if they are already members of another community. It is not easy to share resources and communication strategies between different web applications, tools and platforms. It is not always clear how to use current viral marketing techniques, what kind of message is worthwhile and how to spread or where to put it in order to make it more incisive and as effective as possible.

**Integrated Infrastructure: Challenges**

Web 2.0 is a challenging environment, in which knowledge resources as well as collaboration and communication functionalities are distributed among a set of heterogeneous online applications, each providing specific functionalities. Whereas each online application supports a limited set of pre-defined tasks (like storage, editing or discussing of resources), our **LearnWeb 2.0** integrated environment aims at offering a rich set of functionalities over the whole virtual working space containing the entire set of distributed resources, without unnecessary boundaries, and supporting seamless collaboration and communication. Existing Web 2.0 tools differ in programming languages, granularity degree of their APIs, and licensing approach. Among the great number of available tools, only a few are delivered with an open source license, which allows them to be customized and seamlessly integrated in a centralized environment. Other tools and platforms are proprietary, but at least deliver their API allowing for integration of their services in **LearnWeb 2.0**. When neither the source code nor an API is available, they can only be linked as external tools. Our work on **LearnWeb 2.0** will address three main challenges in the coming months: a) Identifying which Web 2.0 tools have to be provided for which community, b) Integration and Interoperability of these tools, and c) Identity Management for seamless access to the integrated environment.

**Which Web 2.0 Tools for Which Community?**

Web 2.0 is not a term for one specific kind of application, but for a heterogeneous set of Web applications with one common characteristic: They all focus on social networks of people and how to support these people in connecting, communicating and collaborating.
Depending on the size of these networks, different tasks have to be supported:

- **Strong Ties – Group Collaboration.** For a small group, with *strong ties* between the group members, sharing files and jointly working on these documents is important. Conventional computer supported work tools such as BSCW (Bentley et al. 1995) to support shared work spaces and versioned documents are relevant for this group, as are Wikis that support joint work on a document by a (small) group of people.

- **Weak Ties – Information Propagation.** For a larger group of people, with *weak ties* between the group members, information exchange and about activities and events should be supported. Classic email is an appropriate tool, as are social networking platforms such as *Facebook* that propagate information about events, activities, and new information from one person to his/her friends. These tools are useful for small groups as well, but not vice versa: joint editing of a document by a large group of people does not work.

- **Potential Ties – Information Search and Instantiation of Connections.** In even large groups of people, such as an enterprise or a larger community, group members do not really know each other – we have *potential ties* between group members, which should be instantiated if useful. Communication and provision of information therefore is not directed to specific people, and the challenge there is to provide tools for finding relevant people or information for a given person and task. Conventional discussion forums are one appropriate tool in this context, in the Web 2.0 context we have the Blogosphere (a large number of blogs supported by search functionalities) and Web 2.0 discussion forums like Yahoo Answers.

- **Collective Intelligence - Statistics.** Finally, we can exploit the *collective intelligence* of a very large number of people (Surowiecki 2004) statistically. The most important example is collaborative tagging, where we can observe surprising regularities, leading to a shared vocabulary without the need to predefine it in advance (Halpin et al. 2007) or to semantically meaningful concepts and classes, without the need to specify these in ontologies beforehand (a striking example are the *Flickr* clusters, which yield semantically meaningful classes and disambiguation of tag meanings based on tag co-occurrence).

### Integration and Interoperability

Content provided on Wikis, Blogs, Forums, Podcasts and other tools need to be integrated in a way that makes access to these distributed resources as easy as to learning materials in a conventional LMS, and also provide the entire set of collaboration and communication functionalities provided by these tools. Technical integration of different Web 2.0 applications can be performed at different levels. We consider three possible integration degrees: basic, partial and complete. An example of basic integration is linkage of resources provided by one application (for example, a photo in *Flickr*) from another application (such as a document in *Google docs*). This basic integration level does not require lots of implementation effort (in fact some existing Web 2.0 applications provide such basic integration by means of links to external resources), but does not really help the user to reduce manual efforts, as all references need to be created manually. A more tight (partial) integration can be achieved by putting one common application on top of the APIs provided by the different Web 2.0 tools. Unfortunately, most of the available APIs are application specific and functionally limited, making even partial integration difficult.

Full integration (the most difficult to achieve) would result in a common system that provides the entire set of functionalities of all applications in an integrated manner. For example, in such a fully integrated system we could drag and drop a *Flickr* picture to a document written in *Google docs*. Although full integration seems to be the most preferable choice, it should be performed in a modular way, preserving the future updateability of the tools.

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[6] Wikipedia is no counterexample to this, as each article is only edited by a limited amount of people (Adler & Alfaro 2007), though in the case of Wikipedia, these groups of people are dynamically formed, based on interested and background, and not specified in advance.

Technical integration of resources and functionalities is possible through the definition of a set of common interfaces for the core services, such as SQI (Simon et al. 2005) for search. However, heterogeneous APIs require creating specific wrappers, like SQI wrappers implemented in the KRSM system for YouTube and Flickr integration. A disadvantage of this approach is that such wrappers need to be created for every application to be included. Another problem is that not all required functionality of the Web 2.0 applications can be accessed through their APIs. For instance, the YouTube API does not allow for video upload.

To address this problem in LearnWeb 2.0, we currently investigate a set of core services and available APIs for integrating different Web 2.0 tools and platforms. To support the core discussion functionality described in our scenario, we will first install freely available Wiki and Forum software on a LearnWeb 2.0 server and then connect services of the other tools like Flickr using their APIs. As an alternative, we are looking at the APIs provided by social networking platforms such as Facebook and OpenSocial® and their suitability as integration platforms.

Apart from integrating components on an operational level, semantic interoperability has to be provided. Currently, most of the search facilities of the available Web 2.0 applications rely on keyword search using tags. We expect more semantic search features to be added in the future, raising the question of semantic interoperability. Also, some of the tools provide more expressive query languages than the others. Some allow only retrieving single resources, whereas others like Flickr or GroupMe® support resource aggregation.

Identity Management

LearnWeb 2.0 will need to provide means of seamless user authentication for every application it integrates. Having to log into a multitude of separate applications would, besides the generated nuisance, slow down search and learning processes significantly. One of the popular approaches for Single Sign On in a university environment is Shibboleth®, which supports cross-institutional sharing of access controlled web resources. Unfortunately, most Web 2.0 tools as well as the users of the LearnWeb 2.0 are typically not a part of any specific organization, reducing the applicability of Shibboleth as a solution candidate.

A more appropriate approach for SSO in a Web environment is provided by OpenID®, an open, decentralized, free SSO system for user-centric digital identity. Using OpenID-enabled sites, Web users do not need to remember traditional authentication tokens (username, password) for every site they want to visit. Instead, they only need to be previously registered on a Website with an OpenID identity provider. As OpenID is decentralized, any Website – regardless its institutional affiliation – can employ OpenID for users to sign in. OpenID takes advantage of already existing Internet technology (URI, HTTP, SSL, etc.) and employs identities that people have already created for themselves in their blog, photostream, profile page, etc. OpenID does not solve all problems, though. Although many sites already support it, in order to be useful for a fully integrated environment, OpenID needs to be integrated in every included site. Thus selecting OpenID still restricts possible choices for the integrated tools.

An important consideration for designing LearnWeb 2.0 is that most users already have their personal accounts with many applications to be integrated. These user accounts can be accessed through the Web interface of the specific tool. Users need to access their own resources, contacts, and bookmarks already available in the Web 2.0 applications through the new integrated environment. One possibility to provide SSO for LearnWeb 2.0 is to keep authentication data required by each application encrypted in a single place (locally by the user or on a trusted server). In this way, the data for a specific application can be decrypted and used to authenticate the user, only requiring the user to provide one password for decryption. The advantages of this approach are its simplicity and independence of the target application.

Social Networking Platforms as Web 2.0 Integration Infrastructure

Social Networking platforms like Facebook, MySpace, Xing and others are built around the central notion of social networks. Facebook is an especially interesting case, as it provides rather sophisticated notification and information propagation mechanisms along this social network and, with the recent extended opening of the Facebook platform and API[12] is aiming to position itself as a kind of Web 2.0 operating system, integrating Web and Web 2.0 applications in a more or less seamless way. We will give an overview over Facebook in this section and discuss advantages and disadvantages of the Facebook approach as possible LearnWeb 2.0 environment.

Facebook[13], which started as a social networking site for a university environment, currently evolved into a rich application platform which provides means of user interaction through a set of evolving networks. It follows a bottom-up approach such that users can subscribe to the groups they are interested in. Whereas previously groups were defined locally based on the institutional affiliation of the user, the current Facebook platform allows creation of virtual groups, connecting users by interests, which is a necessary requirement for the platform applicability in the context of lifelong competence development, where groups need to be created dynamically addressing educational needs of the user at a given time point. Currently, more than 60 million people use Facebook, and the number of users is still increasing rapidly. With the opening up of the Facebook platform, Facebook is positioning itself as a Web 2.0 operation system, allowing the integration of other applications built on top of it. It provides a Web 2.0 application platform, which already integrates a social community layer, accessible by every Facebook application built on top of it, as well as the extensible Facebook user interface. This way Facebook can provide a remedy for interoperability problem and a common user interface for a LearnWeb 2.0 environment. Other Web 2.0 applications can be integrated into the platform through the Facebook API (based on the REST paradigm), access the Facebook user interface through the Facebook Markup Language FBML, get access to the social network information in Facebook through the Facebook Query Language FQL or integrate with Facebook using Facebook Javascript FBJS. Some examples of already integrated and widely used applications include Books iRead with nearly 200K users, MyFlickr allowing for import Flickr resources with 20K users, Slideshows, Slideshare, del.icio.us and many others. Currently, already more than 15.000 applications are available through the Facebook application directory.

Facebook by itself is built as an information propagation platform for social networks. It allows propagating news, actions and information along the social network. Changes in the Facebook profile such as usage of the new applications are made explicitly visible as messages sent to friends, making Facebook to sharing and awareness platform, which easily supports our viral marketing scenario, and provides excellent support for weak and potential tie interaction. For Facebook applications like twitter and del.icio.us, this mechanism provides an easy way to make friends aware of each others additions and changes. A Facebook user can participate in a number of groups selectively sharing information among them. Facebook supports sophisticated access control mechanisms, which allow users specifying a fine-grained access to their profile information and resources. It also allows for privacy settings to avoid overflooding as information is propagated through the social network.

While Facebook thus provides sophisticated access control mechanisms to restrict information access through the social network, all information stored on the Facebook server remains available for the service provider and can potentially be misused, raising privacy issues as main concern against the Facebook platform. Although some solutions for privacy-preserving Facebook usage in enterprise settings like e.g. WorkBook[14] exist, lifelong learning scenarios considered in the TENCompetence project do not imply availability of an institutional infrastructure required by WorkBook. Thus aspects of user privacy protection, especially in the context of preventing data mining through a Facebook server need to be considered in our future work.

Finally, a related solution to interconnect different Web 2.0 applications is the recently introduced OpenSocial initiative. OpenSocial is a set of common interfaces proposed by Google in order to allow for interoperability among

different social network applications. Although this solution aims at integration of common features shared across
different social network applications and platforms, and is supported by quite a few social networking, smooth
integration of the advanced features provided by each specific platform/application is difficult, and only the next
year will show whether OpenSocial will develop into a viable alternative to the Facebook platform or remain an
interesting specification without real implementation.

Conclusions

Internet has changed the way people acquire and share knowledge. Web 2.0 infrastructures will change the way
people exchange knowledge and interact. In this paper we used some scenarios to find and discuss some challenges
for integrating social software tools in our LearnWeb 2.0 infrastructure, and sketched some ideas towards
implementing this infrastructure, including a discussion of the Facebook platform as integration infrastructure.

References

Society for Information Science.
Knowledge Resource Sharing & Management in an Open Source Infrastructure for Lifelong Competence Development. The 7th
First European Conference on Technology Enhanced Learning (EC-TEL).

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