LIVEMAPPERS: A LEARNING ENVIRONMENT FOR CONCEPT MAP-BASED COLLABORATIVE PROJECTS

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Abstract. Collaborative learning is accepted as an effective means of offering students a stimulating and challenging environment where they can learn from each other, at their own pace, through research and questioning. Within a concept-map based learning environment, collaborative projects offer the opportunity for sharing among students in their meaning making and understanding while jointly building concept maps. CmapTools offers a broad range of tools to support collaborative concept mapping. However, we find few cases where meaningful collaborative projects are being carried out between schools. We believe that more technological infrastructure beyond that provided by the CmapServer is necessary to support collaborative concept mapping in schools. In this paper we present LiveMappers.net, a Web-based learning environment integrated with CmapTools that supports concept map-based collaborative projects. LiveMappers offers teachers a set of Project descriptions to choose from and the opportunity to join an Instance or execution of a Project, or teachers can design their own Project and invite colleagues to join. LiveMappers provides each Instance or execution of a project with an environment for students to collaborate supported by Web-based access to shared folders on a CmapServer preset with permissions for sharing among students, the ability to launch CmapTools from those folders to construct and share Cmaps, a common Blog and a Discussion Forum for students and teachers. LiveMappers.net scales up to support thousands of teachers and students participating in collaborative projects.

1 Introduction

Vygotsky (1978) stressed the importance of social exchange in learning, especially with learners who are at about the same Zone of Proximal Development (ZPD). That is, students who are at about the same level of cognitive development (same ZPD) on a given topic will enhance each other's learning if they engage in active exchange of ideas. It is not until recently that educational systems have begun to comprehend and put into practice the benefits of collaborative learning. While some years ago any type of "help" that students would be provide each other was seen as cheating, now teachers promote students learning from each other and working in teams.

The push for collaborative learning has come not only from the theoretical work by Vygotsky and others and the practice of teachers, but also from the workplace: organizations and corporations require knowledge workers that have experience in working with peers. Within the current fad of teaching competencies, "collaboration" is included as one of the key competencies that students must achieve as part of their education (e.g., Jerald, 2009).

Collaboration and project-based learning are a natural blend (Coffey, 2010). Together they provide a comprehensive approach where students can learn together, exchange ideas, integrate subjects and advance at their own pace. And when the project is executed within a concept map-centered learning environment (Cañas & Novak, 2005; Novak & Cañas, 2004) students get involved in meaning negotiation and discussions while they collaborate in the construction of their concept maps.

The CmapTools software (Cañas, et al., 2004) was designed to support collaboration, both synchronous and asynchronous, through tools and functionalities such as shared folders in servers, annotations, discussion threads, knowledge soups and asynchronous collaboration. Tifi & Lombardi (2006) report on the use of the software in an international collaboration community, and others have reported the use of the tools for collaboration (Correia, Infante-Malachias, & Godoy, 2008; Torres & Marriott, 2010).

Even though collaboration among students is widely accepted as an educational activity that fosters meaningful learning, and combining collaboration with Project Based Learning results in motivating activities for students, we find few cases of effective collaborative projects among schools, and even less of concept map-based collaborative projects. Even though CmapTools provides the environment and tools for collaborative construction of concept maps it does not include the complete environment necessary for collaborative projects, particularly when the projects involve more than one school. In this paper we present LiveMappers.net, a learning environment that supports collaborative concept map-based projects among schools.

2   Characteristics of Collaborative Projects

2.1   The Challenges of Collaborative Projects

Carrying out a collaborative project involving students from different schools, and particularly from different countries, is a challenge. First, coming up with a well-structured project that lends itself to collaboration is harder than it seems, particularly one where students really require of the collaboration with students in the other schools to perform their work. Monitoring students and their progress is not easy: three collaborating classrooms each with 25 students require managing the work of 75 students. When the schools are from different countries or regions, the coordination becomes more complex. There will be differences in curriculum (each teacher will want to cover the material that is included in his/her curriculum, which is most likely not the same), culture (how important is it in each culture to keep deadlines during exchanges with other students?), calendar year (Northern and Southern Hemisphere schools tend to have few overlapping weeks of classes once one removes unproductive periods such as the beginning of the semester, the end of the semester, mid-semester breaks, long holidays, etc.). As a result of these challenges, the collaborations between schools are often either:

a) Trivial in content, where the benefits derive mainly from getting to know the other students, understand their differences and commonalities, and not from engaging in some in-depth activity, such as those involving research or problem solving.
b) An exchange where no *real* collaboration takes place, and the process consists mainly of each classroom doing its own work and exchanging results or ideas at the end through some forum, videoconference or chat.
c) The effort never reaches a conclusion: the collaboration does involve problem solving or research, but it never reaches a conclusion; time tends to drag on, the students and teachers lose interest, stop communicating, and the project never reaches the end.

It is clear that the interaction of students with peers from other regions or countries offers learning experiences that can lead to increased tolerance and comprehension among cultures with long-term implications for society, and we are not trying to discourage it. However, so much more can be additionally achieved through in-depth collaboration that our effort goes in the direction of investigating what issues prevent it and how to overcome them.

2.2   Difficulties in Executing Collaborative Projects

As mentioned above, there are known challenges that teachers and students must overcome when organizing and participating in collaborative projects. In this section we extend our discussion of these challenges.

2.2.1   Lack of experience on the part of the teacher

Few teachers have experience participating in collaborative projects, and for many a collaborative project is also their first attempt at project-based learning. As such, teachers (and students) don't really know what to expect, what is involved in participating, and the challenges ahead. This lack of experience becomes a real issue when combined with the other challenges below.

2.2.2   Where to find a project and a teacher or school willing to collaborate

Because teachers have little experience carrying out collaborative projects involving other teachers, most don't know where to start. What projects can they participate in? Where do they find a teacher or a school willing to

collaborate? How do they get the project going? In most cases, collaborative projects take place among schools under the umbrella of an existing organization. The facilitators for the organization set up the projects and invite the teachers, taking the role of coordinators. However, many teachers don't have this support organization (or their umbrella organization may be, for example, the Ministry of Education of their country/region which does not facilitate collaboration), and therefore have to look for themselves for projects in which to participate.

2.2.3   Project not well defined or organized

Delineating a collaborative project is not easy. These are aspects that are often lacking in collaborative projects:

a) Well-delineated collaborative activities that involve a collaborative effort among students, where students cannot perform their work without the collaboration of their peers from other schools.

b) Lack of a predefined schedule agreed upon by the teachers, and a commitment by all of them (and their students) to comply with the dates. If students depend on their peers to be able to complete their own work, they need to understand the importance of keeping with dates and interactions.

c) Outcomes and deliverables not well defined. The agreed-upon schedule must be linked to expected outcomes and deliverables, so its clear what will be done by whom by when. In the case of projects involving collaborative concept mapping, the outcome and scheduled would include the dates by which concept maps or knowledge models (Cañas, Hill, & Lott, 2003) would be completed.

d) Student's individual participation not clear. Often the whole class participates in the activities as a group, and individual students don't have well defined role. It is important that all students actively participate in the collaboration, whether through individual roles within the class, or by splitting them into small groups that include students from different schools.

An argument could be made that having such well-defined activities and schedule limits the creativity of teachers and students, and that teachers and students should be able to define their own projects. We agree, and the LiveMappers.net environment allows teachers to design new projects with their students, and to make these projects available to other teachers. However, our experience with teachers, particularly those that have not participated in collaborative projects before, is that a well described project allows them to (a) decide whether they want to participate in the project, and (b) understand what they are getting to, and (c) know what to expect if they participate in the project. As they become more experienced they can then move into designing their own projects.

2.2.4   Lack of a supporting software platform

There are many sites with lists of interesting projects and their descriptions. But they seldom involved a software platform for the teachers and students of the various schools to collaborate. We often find that the teachers "agree" to use combination of platforms for their project, e.g. Messenger or Skype for video-conferences, email for communication, Yahoo for group communication, different sites for Blogs and/or Wikis, and a public CmapServer for concept mapping. It becomes difficult to handle a large number of students with so many different sites involving different userids, passwords, and interfaces. The project becomes unmanageable. Sometimes the teacher's umbrella organization provides a collaboration environment, e.g. Moodle-based, which makes the project more manageable. Social networking environments provide the communication tools and publishing tools, but they were not designed to implement collaborative projects. Furthermore, none of these tools were designed to facilitate concept mapping-based collaboration. A learning environment is needed that allows a group of teachers with their students to have their own space to execute their collaborative project, provides supporting tools such as concept mapping, blogs, and discussions, and where both individual and group spaces can be defined for the different activities with corresponding permissions. LiveMappers.net is such an environment.

2.2.5   Scalability

All the issues described above magnify when multiplied by the thousands of teachers that use concept mapping and that potentially would participate in concept map-based collaborative projects if they had the opportunity. The problem then becomes one of scalability. How do thousands of teachers find an interesting project and other teachers with whom they can collaborate? It would be preferable if the learning environment that supports concept map-based collaborative projects scales to large numbers of teachers and projects.
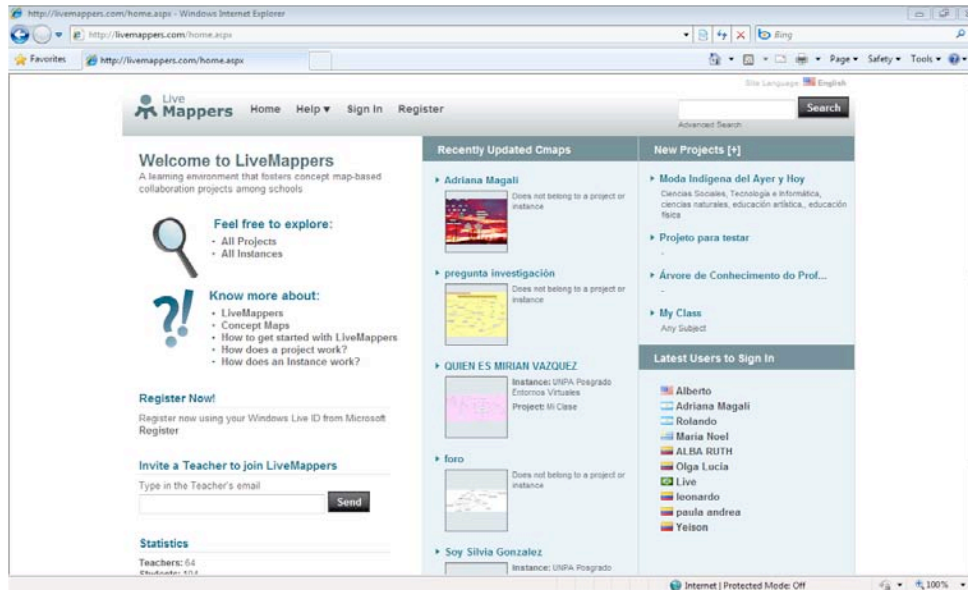
Figure 1. The main page of the LiveMappers.net website showing recently updated Cmaps, New Projects and Latest Users to Sign In.

3   LiveMappers.net

LiveMappers is a learning environment that fosters concept map-based collaborative projects among K-12 schools and attempts to address the challenges described above. In LiveMappers teachers can find a collaborative project that suits their needs, interests, and schedule. They can register for the project, and through the LiveMappers site, their students can collaborate with students from other classrooms, who can be in other countries, other regions or within the same school. Additionally, teachers with their students can propose and create their own projects and execute them within LiveMappers. The site has been designed with the objective that students use concept maps as the artifact over which they collaborate, using CmapTools as the software tool to construct and share their concept maps. Figure 1 shows the Welcome page for the Livemappers.net site.

3.1   Project and Instance

LiveMappers consists of descriptions for a set of Projects which include, for each Project, its Overview, Purpose, Description, Requirements, etc. and a suggested Schedule for activities the students need to carry out during the execution of the Project. This information allows teachers to decide which Projects suit their needs and interests, based on the grade, the subjects involved, and the time frame for the Project. Figure 2 shows an example of a Project called "Home Remedies". In "Home Remedies" students interview their grandparents and elderly relatives and friends of the family for home remedies used to treat particular diseases, illnesses and discomforts. The students act as "Knowledge Engineers", creating concept maps from the interviews. Since students are assigned to groups, where each group includes a couple of students from each participating school, the students for each group will then integrate the concept maps for each disease, leading to a group's knowledge model (a knowledge model is a collection of linked concept maps and associated resources about a particular domain). Eventually a knowledge model is created for all the home remedies from the different groups, and the Forum is used for discussions among students.

Figure 3 shows part of the proposed Schedule for Home Remedies. The Project's Schedule is a "suggested" schedule, since at the time the Project is executed it will be changed to specific dates and adapted according to the participating teachers' requirements. The Schedule for a Project consists of 4 phases: (1) Registration, (2) Preparation, (3) Execution, and (4) Finalization. The entries in the Project's Schedule only contain the duration for events and activities. To further describe the parts of the Schedule we need to first introduce the concept of the *Instance* of a Project.
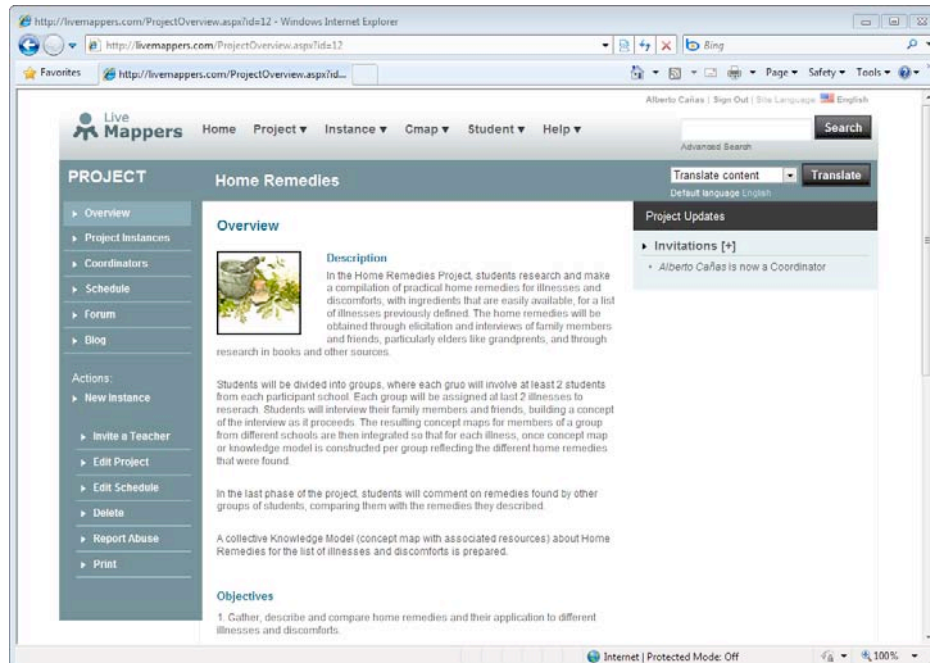
Figure 2. A Project description in LiveMappers includes Overview, Purpose, a link to a document with details, a Schedule, Blog and Forum. Each Project can have multiple executions, called Instances. The Schedule is shown in Figure 3.

The execution of each Project within LiveMappers is called an *Instance* of the Project. For any Project, there can be as many Instances as needed, whether one, a dozen or thousands. Each Instance will have its own Schedule. So, for example, and Instance for Home Remedies could be created that begins on July 1, another can be created that begins August 1, and a third one that begins September 1. The teacher would look at the different Instances and decide which one would be more appropriate and register for that Instance (not for the Project). When creating an Instance for a Project, whoever creates the Instance can make whatever changes are required to serve the purpose, not being limited to changing the starting date. For example, an Instance for Home Remedies could have the project description changed so the students are required to do research on Home Remedies during the Renaissance instead of interviewing their grandparents. The Project's description doesn't need to change, only that of this particular Instance (or a separate Project could be created about "Home Remedies throughout History" which describes in more details the ideas behind this variation of the Project).

Figure 3 shows the Schedule for the Home Remedies Project. When an Instance is created, the dates are adjusted to reflect calendar dates based on the starting date and the relative duration of each event in the Schedule. During the Registration Phase, the Instance is open for teachers to register. In Figure 3 the Registration is set to last 30 days, but if a group of teachers decide to run the Project with just themselves as participants, they can create an Instance, make the Registration Phase last 1 day, Register, and close the Registration by moving to the Preparation Phase. During the Preparation Phase, teachers make sure students are registered in LiveMappers, CmapTools is available and installed, groups are formed and students assigned to the groups. The Execution Phase consists of activities together with their deadlines and deliverables. During the Preparation Phase, teachers can adjust these according to their needs, changing dates (e.g. based on holidays, exams, etc.) and adding or removing Events. The last Phase is Finalization, where the Instance closes down and cannot be modified any further.

3.2   Project's and Instance's Blog and Forum

Each Project and each Instance of a Project has its own Blog and Forum. These are created automatically as new Projects or Instances are created. Teachers and students can use the Instance's Forum to discuss ideas as the Instance progresses. The Blog can be used, for example, as a historical narrative for the progression of the Instance.
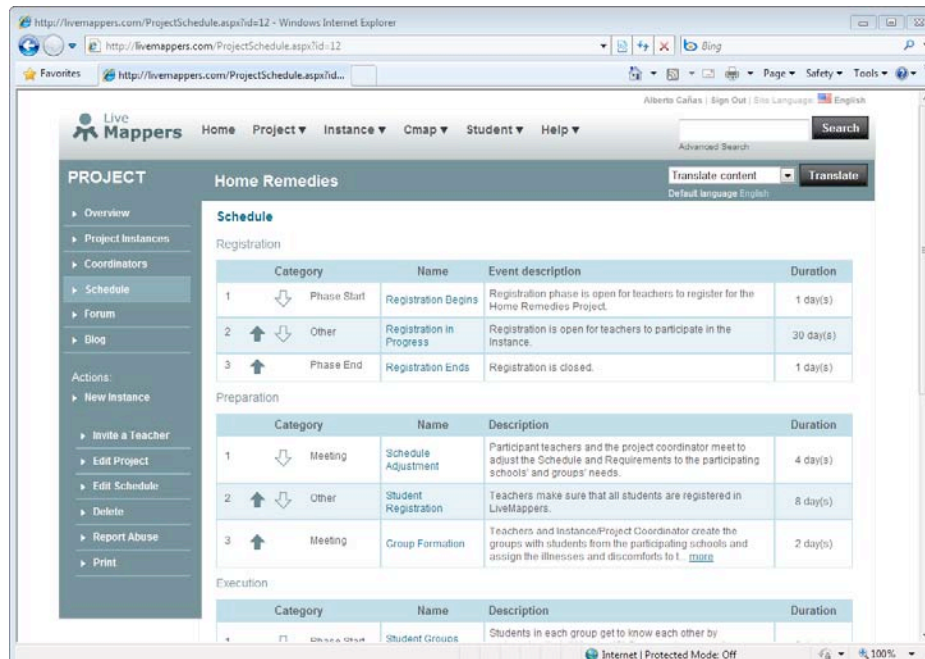
Figure 3. Part of the Schedule for the Home Remedies Project, showing the first three phases of the Project with some of the Events.

3.3 Teacher and Student's Space: Integration with a CmapServer

Each student and teacher registered in LiveMappers has their personal home page where they are presented with a summary of what is happening in Instances they are part of (e.g., a student can be in more than one Instance, e.g. from different classes, and a teacher can have several classes, each registered on a different Instance), links to the Instances, and a profile page as shown in Figure 4a. Teachers' pages have links to their students' pages, and students have links to their teacher's page. Teachers and students get assigned their own "space" to store their concept maps. This space is actually a folder in a CmapServer associated with the LiveMappers site with the appropriate permissions, as displayed in Figure 4b.

Each Instance also has its own space for concept maps (which is also a folder in the CmapServer). Within this space, each student registered in the Instance has his/her personal space (a folder), where only the student (and the teachers) has permissions to edit Cmaps and resources. A link to this folder is displayed in the student's Cmap area as shown in Figure 4b. Thus, from their concept mapping area students can get to the Instance's area, and there they can select their own folder. LiveMappers automatically creates the folder structure with appropriate permissions for the different Instances the student is registered in. The Teacher also has links to the Instances folders and therefore to the student's concept maps. If an Instance involves students participating in groups (as explained for Home Remedies above), LiveMappers creates a shared folder within the Instances' folder, for which all students that are members of the group have permissions. Permissions for shared folders are handled automatically.

3.4 Integration with CmapTools

The page that presents the concept maps and folders to the student (or teacher), as shown in Figure 4b, provides tools to manipulate these Cmaps and resources. Selecting the "Edit Cmap" entry in the pull down menu for a Cmap's thumbnail will automatically launch CmapTools and open the Cmap for editing.[1] Once the Cmap is saved, a "Reload" button on the page will reload the new thumbnail. In the same way, a "New Cmap" button allows the user to launch CmapTools with a blank canvas, and when the Cmap is saved it is stored in the appropriate folder.

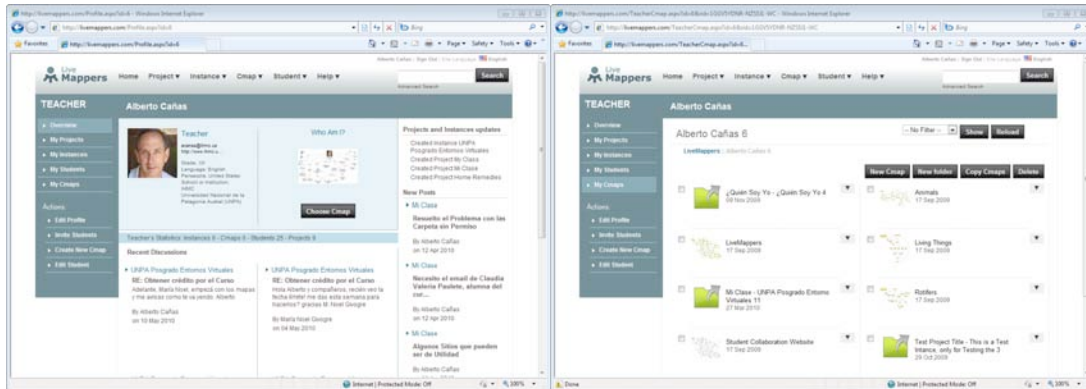[1] Version 5.04 or newer of CmapTools or CmapLite is required.

Figure 4. (a) The Teacher's Page, which includes a "Who Am I?" Cmap, and (b) View of Cmaps and links to Instances.

With the ability to create new Cmaps and edit existing ones using CmapTools directly from LiveMappers, there is little need to go into the CmapTools Views. However, as students become more adept at using CmapTools and want to manipulate their Cmaps directly in the Views, they can open a Cmap and select the menu entry "Edit -> Find in Views" to display the Views folder where the Cmap is stored.

3.5   Implementation

LiveMappers integrates a Website with a CmapServer to store, share and publish concept maps. It is built upon Microsoft development technology, including the Live ID service. We used a layered architecture, as shown in Figure 5. On the data layer area a database implemented using SQL Server 2008, and an abstraction implemented with ADO.net Entity Framework, which facilitates the representation and access of data. The domain layer includes a transaction component, responsible to access data and deliver it to the Web site, based on the transaction script design pattern because of its simplicity (Fowler, 2002), which helped to delegate tasks. This component makes use of LINQ to Entities, a Microsoft technology which facilitates the process of querying data. The domain layer also contains the CmapServer component, responsible for consuming the CmapServer API and retrieving Cmaps from the LiveMappers CmapServer. The application layer and Web site component, implemented using ASP.net, ASP.net Ajax Control Toolkit, JQuery and also responsible to interact with Live ID Service for authentication.

The CmapServer API is the component used by the application to interact with the CmapServer. In its current form, the API rests atop a SOAP-based Web Services architecture that advertises the CmapServer services via WSDL (Cañas, et al., 2006). Exporting a WSDL description of the services makes this design particularly useful in a development environment that is capable of consuming the WSDL description and exposing the service to the programmer as if the CmapServer itself were simply an object that exposes several methods (the services).

The functionality provided by SOAP based CmapServer API is a large subset of the same functionality provided by the proprietary API that is used by the CmapTools client. With the API, the LiveMappers client can create a folder for each user that will act as a container for storing that user's resources (concept maps, images, documents, etc.).

4   Availability

LiveMappers was developed as a collaborative effort between the Institute for Human and Machine Cognition (IHMC) and the Laboratório de Tecnologia da Informação Aplicada (LTIA) of the Universidade Estadual Paulista Júlio de Mesquita Filho (UNESP) under the sponsorship of Microsoft Corporation. LiveMappers is being tested with a small number of teachers and students in order to adjust functionality and fix bugs. It is available for teachers interested in collaborating with its development. Agudelo Velásquez (2010) reports on her experience with LiveMappers with high school students at her school in Colombia. It should become operational in the second half of 2010. The interface is currently in English, Spanish and Portuguese, and an automatic translation option is available to translate displayed text. It can be accessed at www.livemappers.net.
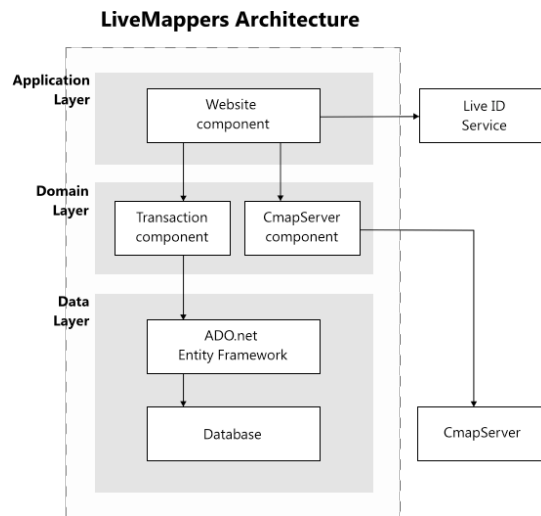
Figure 5. The implementation architecture of LiveMappers.net.

5 References

Agudelo Velásquez, O. L. (2010). El Map Conceptual, Una Estrategia Viva. In J. Sánchez, A. J. Cañas & J. D. Novak (Eds.), *Proc. of the 4th International Conference on Concept Mapping*. Viñas del Mar, Chile: Universidad de Chile.

Cañas, A. J., Hill, G., Bunch, L., Carff, R., Eskridge, T., & Pérez, C. (2006). KEA: A Knowledge Exchange Architecture Based on Web Services, Concept Maps and CmapTools. In A. J. Cañas & J. D. Novak (Eds.), *Concept Maps: Theory, Methodology, Technology. Proceedings of the Second International Conference on Concept Mapping* (Vol. 1, pp. 304-310). San Jose, Costa Rica: Universidad de Costa Rica.

Cañas, A. J., Hill, G., Carff, R., Suri, N., Lott, J., Eskridge, T., et al. (2004). CmapTools: A Knowledge Modeling and Sharing Environment. In A. J. Cañas, J. D. Novak & F. M. González (Eds.), *Concept Maps: Theory, Methodology, Technology. Proceedings of the First International Conference on Concept Mapping* (Vol. I, pp. 125-133). Pamplona, Spain: Universidad Pública de Navarra.

Cañas, A. J., Hill, G., & Lott, J. (2003). *Support for Constructing Knowledge Models in CmapTools* (Technical Report No. IHMC CmapTools 2003-02). Pensacola, FL: Institute for Human and Machine Cognition.

Cañas, A. J., & Novak, J. D. (2005). *A Concept Map-Centered Learning Environment.* Paper presented at the Symposium at the 11th Biennial Conference of the European Association for Research in Learning and Instruction (EARLI), Cyprus.

Coffey, H. (2010). Project-based Learning. *K-12 Teaching and Learning* Retrieved August 19, 2010, from http://www.learnnc.org/lp/pages/4753#noteref5

Correia, P. R. M., Infante-Malachias, M. E., & Godoy, C. E. C. (2008). From Theory to Practice: The Foundations for Training Students to Make Collaborative Concept Maps. In A. J. Cañas, P. Reiska, M. Ahlberg & J. D. Novak (Eds.), *Concept Mapping: Connecting Educators*. Tallinn, Estonia: Tallinn University.

Jerald, C. D. (2009). *Defining a 21st Century Education*: The Center for Public Education.

Novak, J. D., & Cañas, A. J. (2004). Building on Constructivist Ideas and CmapTools to Create a New Model for Education. In A. J. Cañas, J. D. Novak & F. M. González (Eds.), *Concept Maps: Theory, Methodology, Technology. Proceedings of the 1st International Conference on Concept Mapping*. Pamplona, Spain: Universidad Pública de Navarra.

Tifi, A., & Lombardi, A. (2006). WWMaps, A Community on Education Through Collaborative Concept Mapping. In A. J. Cañas & J. D. Novak (Eds.), *Concept Maps: Theory, Methodology, Technology. Proc. of the Second Int. Conference on Concept Mapping* (Vol. 1). San José, Costa Rica: Universidad de Costa Rica.

Torres, P. L., & Marriott, R. d. C. V. (Eds.). (2010). *Handbook of Research on Collaborative Learning using Concept Mapping*. PA: Information Science Reference.

Vygotsky, L. (1978). *Mind in Society: the Development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press.