Design and Implementation of Academic Networking in an Integrated Personal Learning Environment and Electronic Portfolio Assessment Management System

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ABSTRACT
The integration of Hardwire, a cloud-based personal learning environment, with Projectrix, a cloud-based Electronic Portfolio Assessment Management System, addresses the need for tools needed for informal learning. Both systems embrace a learner-centric environment where learners are allowed to personalize, control and manage their own learning, and at the same time, have a learner-centric assessment process of their projects. Academic networking makes use of social networking tools to teach students interaction, collaboration and engagement. This paper proposes Hardwire and Projectrix 2.0, an improvement of the existing systems, focusing on a design that supports academic networking within a Personal Learning Environment that is integrated with an Electronic Portfolio Assessment Management System. Specifically, the improvement utilizes the internal social network of peers to share or bookmark learning resources, show common interests, communicate through comments and messages, invite peers to evaluate work products, and share and collaborate on the creation and use of rubrics.

Keywords
Elearning, Personal learning environment, informal learning, Eportfolio, performance-based assessment, academic networking

1. INTRODUCTION
Conner describes [4] that at the very least, learning can be divided into two dimensions. The first is between formal learning, which includes "the hierarchically structured school system" and "organized school-like programs created in business for technical and professional training," and informal learning, which "describes a lifelong process whereby individuals acquire attitudes, values, skills and knowledge from daily experience and the educational influences and resources in his or her environment." The second is between intentional learning, where a learner "aims to learn something and goes about achieving that objective" and non-intentional or accidental learning, wherein a learner "learns something that he or she had not intended or expected".

The increase in use of technology in learning has produced different applications and platforms that support the different ways of learning used today. First, for the formal, intentional learning, there are Virtual Learning Environments and Learning Management Systems for classrooms and professional trainings, respectively. Secondly, for accidental learning, the moment of learning can happen anywhere, and therefore does not need a dedicated platform. Lastly, for informal, intentional learning, there are Personal Learning Environments. Personal Learning Environments (PLE) are defined as "systems that help learners take control of and manage their own learning. This includes providing support for learners to set their own learning goals manage their learning; managing both content and process, and communicate with others in the process of learning and thereby achieve learning goals." [13]

One of the tools a learner can utilize in a PLE is assessment. Assessment, specifically an educational assessment, is defined as the process of documenting the knowledge, skills, attitudes and beliefs based on their projects or work products. Traditional assessment, as described by Elliot [9], pointed out its several characteristics that paved way to modern modes of assessment. These forms of assessment allow peer evaluation, learner generated content, and a broader audience for participation. Plus, modern assessments are not paper-based, classroom-based, formalized in organization and administration, and too controlled in contents and creation.

Academic networking is defined [10] as the use of social networking for academic benefit. Social networking is commonly used for communication and sharing of content; this can be extended for learning purposes. Applying social networking capabilities to a PLE will provide learners a way to communicate and collaborate with each other.

In line with these points, this paper presents the design and implementation of an integrated Personal Learning Environment and Electronic Portfolio Assessment Management System, with the addition of support for academic networking. The system builds upon existing systems: Hardwire, a cloud-based Personal Learning Environment, Projectrix, a cloud-based Electronic Portfolio Assessment Management System. The system particularly utilizes the internal social network of peers in (a) sharing and bookmarking learning resources, (b) discovering content through peers of common interest, (c) getting support from learners pursuing the same learning objective, (d) collaborating with peers in the creation and editing of assessment rubrics, and (e) gathering assessors to assess work products.

2. CONCEPT
2.1 Personal Learning Environment
A Personal Learning Environment has many definitions, which are compiled by Buchem [2]. This paper uses van Harmelen's definition [13]: "Personal Learning Environments are systems that help learners take control of and manage their own learning. This includes providing support for learners to set their own learning goals manage their learning; managing both content and process communicate with others in the process of learning and thereby achieve learning goals."

2.1.1 *Focus on Creation and Communication*

Some PLEs and other online learning platforms are like social bookmarking sites: they focus on content acquisition and consumption. These are still vital to learning, but the researchers believe that the PLE should focus more on the creation of work products, and communication between peers.

As stated by Asuncion, et al. [1], the PLE "should also have collaboration features that enables a learner to form sets of connections with other learners based on learning objectives." This opens a way for learners to discuss, collaborate and start collective learning action.

2.1.2 *Different Levels of Learning Support*

To adopt the various ways and methods a learner can use to learn, a PLE should be able to support the different levels of learning support, as described by Koper and Specht [7].

At the bottom level, there are knowledge resources, which are containers for actual learning resources like books, articles, software and even informal messages and communities.

On top of knowledge resources are learning activities, which compile knowledge resources and add pedagogical aids such as study tasks, feedback and assessment.

Competence development programs act as a guide for learners in utilizing the learning activities. These programs include positioning, navigation, performance assessment, and learner support.

Lastly, networks for life-long competence development are the collections of development programs organized by institutions and individuals.

2.1.3 *Learner Support Service*

As a part of the competence development programs stated in the previous point and in Koper and Specht [7], learner support is another functionality a PLE can provide. When a learner needs human help on learning a learning activity, the learner support service finds related peers and tutors, and provides a way to communicate with them on matters related to that learning activity.

2.1.4 *Support for Academic Networking*

Social networking, when used for academic and learning purposes, is called academic networking [10], another tool which can be used for a PLE. Applying this to a PLE will allow learners to communicate with other learners with a common interest and learning objective, and to invite peers to collaborate in the various aspects of learning.

Academic networking can be implemented through either creating an internal social network or developing on an existing social network's web services for use of the PLE.

2.2 Electronic Portfolio Assessment Management System

2.2.1 *Project Portfolio*

Projectrix allows learners to manage their learning products via links. This lets the learners have their projects assessed by themselves, their peers, or their mentors and advisers. Assessors are notified and invited to assess work products via email or through their Twitter accounts.

2.2.2 *Peer and Self Assessment*

Self assessment allows a learner to judge a learner's own work [9]. This also gives the learner a sense of ownership to the learning experience and thus increase motivation. Peer assessment on the other hand helps learners to develop insight to their own performance by assessing the work of others.

In a learning environment, assessment is no longer limited to a teacher, thus allowing a broader access for gauging a learner's work.

2.2.3 *Rubrics and Collaboration*

All assessments are assessed using rubrics that were created collaboratively. Each rubric has a name, description, rubric id and a set of tags associated with it. Once a rubric has been published via Projectrix, users may now look up and use a rubric for assessing a project.

These rubrics are created through the Google Spreadsheets API, which has document sharing options, thus allowing the author to include other people to collaborate in defining and customizing the rubrics.

In the new version of Projectrix, users who have Facebook accounts can place comments about the rubric thus aiding in its definition. Facebook users may also "like" the rubric via the the Like Button Social Plugin.

3. HARDWIRE AND PROJECTRIX

3.1 Hardwire

Hardwire, the result of the research of Asuncion, et al., is a cloud-based PLE that "has functions for managing content, learning resources, a network of learners and a portfolio." [1]

The proponents of this research have developed Hardwire 2.0, which extends Hardwire by improving its database design and adding features to support content discovery, learner support and academic networking.

3.1.1 *Database Design*

The database contains three models: Learner, Module and Project, whose relationships are described in Figure 1.

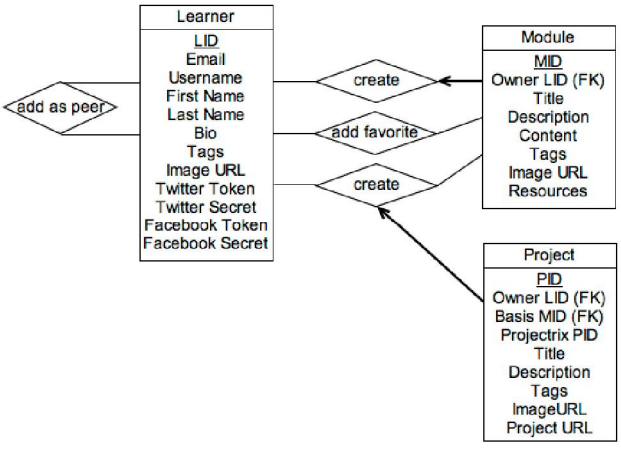

Figure 1. Entity-Relationship Diagram of Hardwire

3.1.2 *Workflow*

The changes to Hardwire's workflow include ways to discover modules through peers or search, and ways to get support from other learners. The workflow is shown in Figure 2.

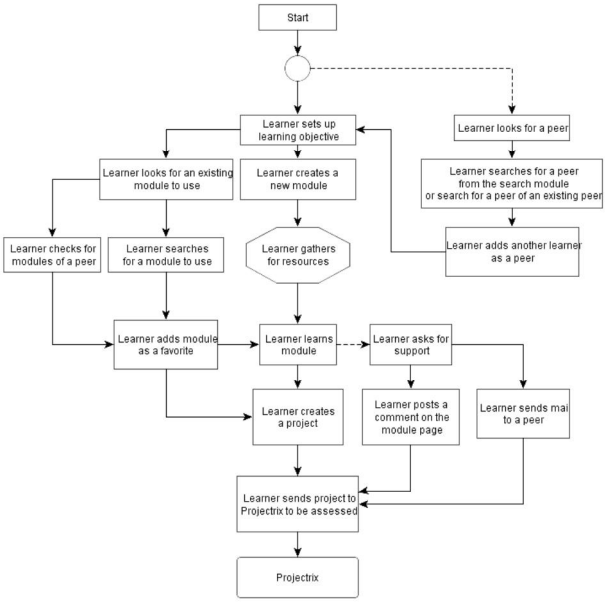

Figure 2. Workflow of Hardwire

3.1.3 *System Architecture*

Hardwire uses a Model-View-Controller architecture, which effectively divides the tasks into data access, content management, and user interface display. This architecture is displayed in Figure 3.

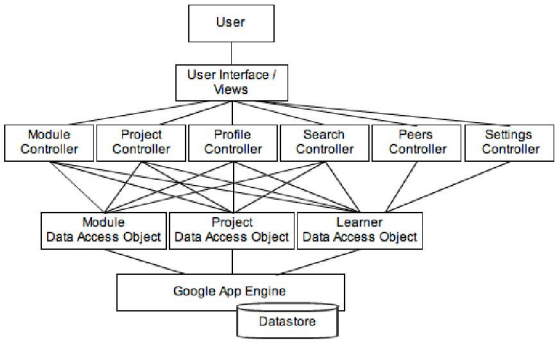

Figure 3. System Architecture of Hardwire

3.2 Projectrix

Projectrix, an application originally designed and implemented by Delgado, et. al., "provides a venue for learners to upload and manage their work products via links," and has features that "allow learners to have their projects assessed by themselves, mentors and advisers."

Projectrix 2.0, an improvement to the original, broadens the capabilities of Projectrix by integrating the reach of existing social networking sites and other online applications to its assessment and rubric definition features.

3.2.1 *Collaborative Assessment with Projectrix*

As discussed earlier, PLE's should provide a way for learners to showcase or have their learning projects or work products assessed. Projectrix, also an e-learning application is an e-portfolio management system that provides means for collaborative assessment. Learning projects can be created from Projectrix which can be assessed by both the user and his peers.

Projectrix, now on its second version, is no longer limited to inviting friends with GMail accounts to assess a learner's project. The learner may now invite friends from his/her twitter account via the Twitter API.

Once a learning project has been finalized on Hardwire, the learner has the option to have the project assessed via Projectrix. Projectrix provides an interface for Hardwire to access it's web service for project assessment.

3.2.2 *Database Design*

The database contains six models: User, Assessment, Rubric, Criterion, Rating and Project, whose relationships are described in Figure 4.

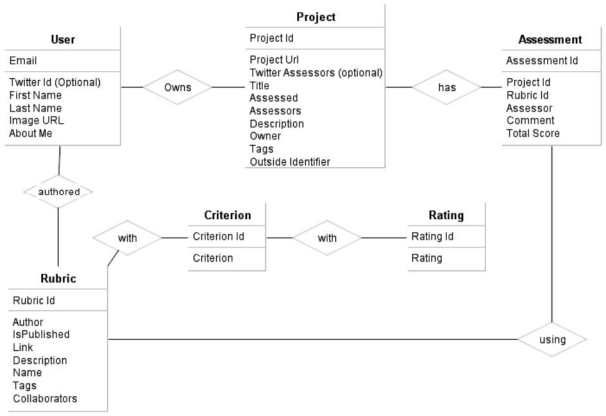

Figure 4. Entity-Relationship Diagram of Projectrix

3.2.3 *Workflow*

The workflow of Projectrix now accomodates access from Twitter, as shown in Figure 5.

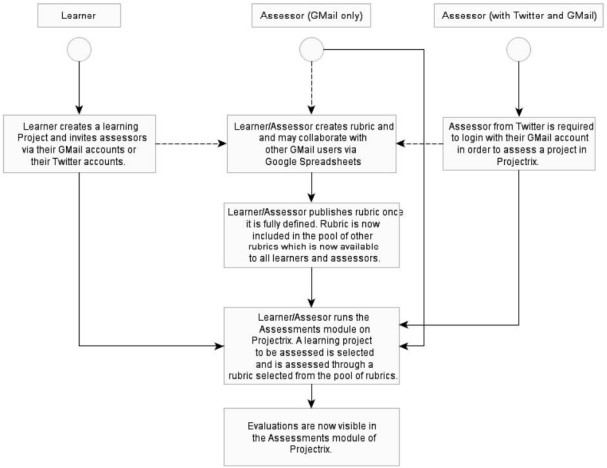

Figure 5. Workflow of Projectrix

3.2.4 System Architecture

The system architecture of Projectrix also supports operations for the Twitter functionality.

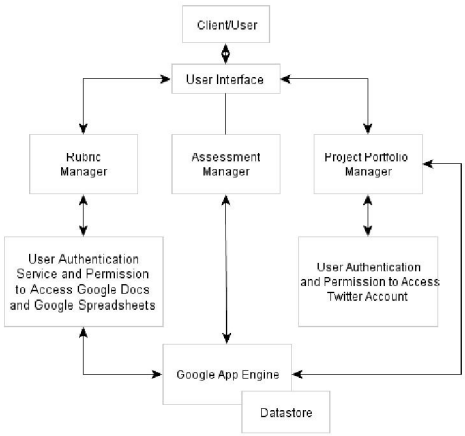

Figure 6. System Architecture of Projectrix

3.3 Integration

Hardwire and Projectrix has already been integrated through a web service. The proponents of this paper propose a new workflow for the connections between the two systems, as seen in Figures 7 and 8.

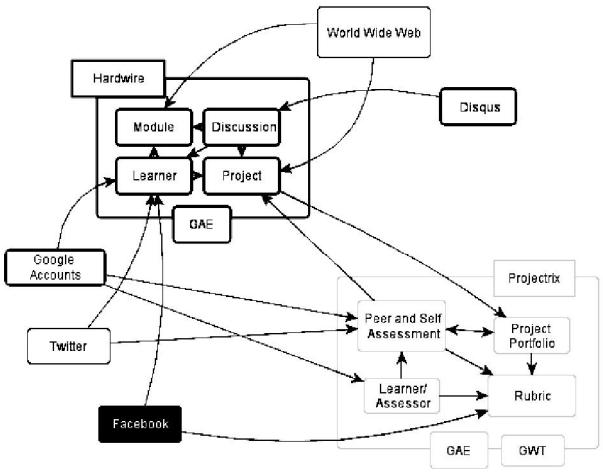

Figure 7. Data Flow Diagram of Hardwire and Projectrix

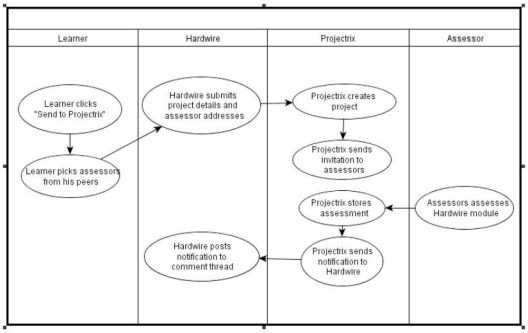

Figure 8. Workflow of Hardwire and Projectrix

4. TECHNICAL ISSUES

4.1 Implementation

Hardwire and Projectrix are implemented as web applications independent of each other. Hardwire is a Personal Learning Environment with features especially designed for personal learning while Projectrix is an electronic portfolio management system with tools for collaborative rubric definition and assessment. Hardwire and Projectrix are currently deployed at [6] and [8], respectively.

The current versions of both Hardwire and Projectrix still utilize the same highly scalable cloud computing platform, Google App Engine [14] as used in the original implementation [1]. Projectrix still uses Google Web Toolkit to design its user interface.

4.2 Hardwire

4.2.1 Tag Search and Directories

Hardwire 2.0 has extended Hardwire's search function to include learners and projects. Also, these searches are combined in one page, to give the learner an overview of the various content on a specified tag. In addition, Hardwire now has directories that allow learners to freely explore all content posted to Hardwire.

4.2.2 Academic Networking through Peers

The original Hardwire already has the concept of peers, in that it is a one way connection like Twitter's Follow.

Hardwire 2.0 extended the existing peer system by utilizing social networking aspects, such as common peers, tags and modules. Also, in module pages, peers who use the module will also be shown there.

4.2.3 Peer Messaging through Electronic Mail

In addition to the capabilities described in the previous section, learners can also send messages to each other through electronic mail. Specifically, when a learner adds another as peer, the former shares messaging capabilities to the latter.

Also, this implementation increases security against email spam, by hiding email addresses and building a messaging interface, so that the addresses are hidden even to peers.

4.2.4 Learner Support through Disqus Comment Threads

All learner, module and project pages now contain comment threads, in which learners may ask for learning support, or just post comments. These comment threads are powered by Disqus, a commenting system that can be used as a plugin on websites. It's features are listed in [5].

4.2.5 Learner Information through Twitter4J, and Java Facebook API

To get learner information, Hardwire accesses the Twitter API through Twitter4J, an unofficial Java library for the Twitter API, and Facebook through its Java Facebook API.

Upon authorization by the learner, Hardwire 2.0 gathers information like the learner's Bio, Profile Image, First Name and Last Name from his/her existing social network accounts.

4.3 Projectrix

4.3.1 Assessors Invitation through Twitter4J

In Projectrix 2.0, learners may invite their friends in Twitter. Learners must search for the Twitter user-name of their friend and add them to the list of assessors. The friend will receive an invitation with a hyperlink to Projectrix's assessment module via a direct message on Twitter. Before the invited Twitter user can assess a project, the user must log in to Projectrix first via their Google account. In the event that the assessor has no Google account, the assessor may opt to sign up for one.

4.3.2 Recommendations through Facebook Social Plugins

Projectrix takes advantage of the Like Button and Comments plugins to let learners and their friends who have Facebook to comment and "like" rubrics the learners authored. For assessors, this might help them decide on which rubrics they should use to assess a learning project based on the number of "likes" and the comments.

4.3.3 Instant Messaging through Meebo Bar

The Meebo bar, a "customizable sharing platform that connects your visitors to their friends on any communication and social network" [12], is integrated to Projectrix 2.0. This will allow users of Projectrix to easily communicate with other assessors and learners and share and post Projectrix activities directly to their social networking accounts such as Facebook and Twitter.

4.4 Integration through Web Services

The web services of Hardwire and Projectrix now have two functions: Create Project (Figure 9) and Send Assessment (Figure 10).

Resource Name
Project
URL
http://projectrix-development.appspot.com/ws/createProject
Parameters
key secret title desc url owner assessors tags
Response
OK – code 200 plus outside identifier of the project BAD REQUEST – code 401 ACCESS DENIED – code 404
Response Type
XML

Figure 9. Projectrix API Specifications for Create Project

Resource Name
Assessment
URL
http://hardwireple.appspot.com/ws/createProject
Parameters
key secret owner url owner assessor rubric id score comment

Figure 10. Hardwire API Specifications for Send Assessment

5. RESULTS

Hardwire and Projectrix are currently deployed at [6] and [8], respectively. They are running on the Spring Framework on top of the Google App Engine and Datastore. They both use Google Accounts for the login system (Figure 11).

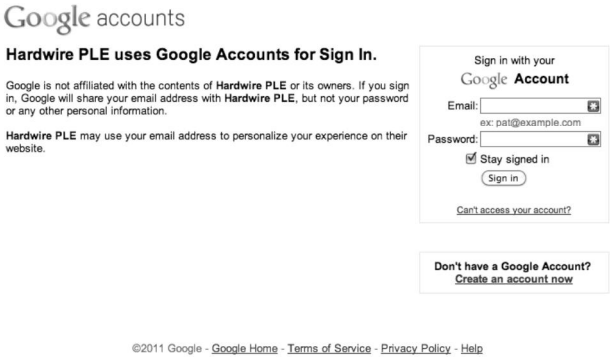

Figure 11. Hardwire Login Page

The search utility of Hardwire doubles as a list for all existing content, as seen in Figure 12.

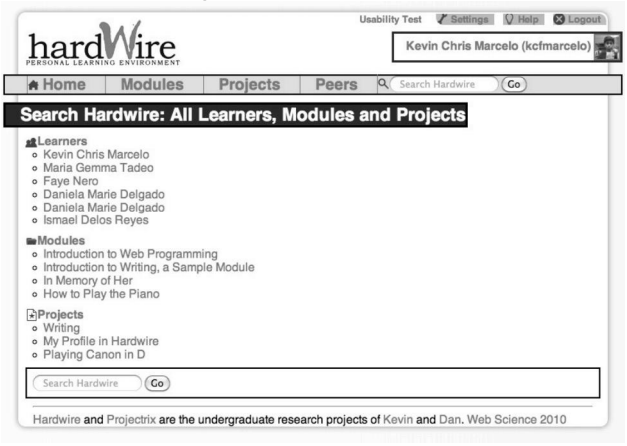

Figure 12. Hardwire Search

Figure 13 is an example of a profile page of another learner, featuring common peers and interests with the current learner.

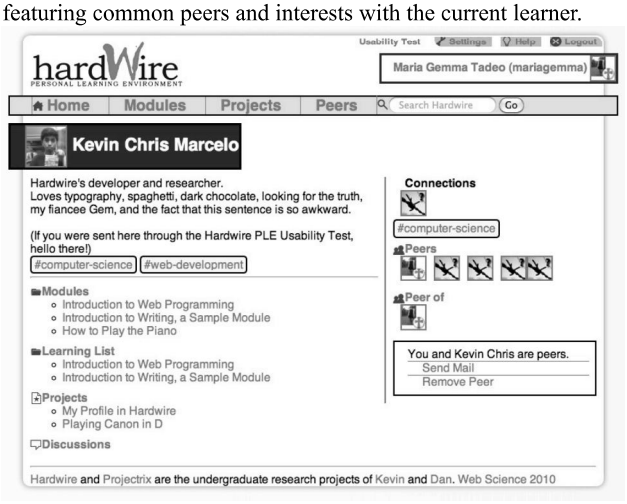

Figure 13. Hardwire Profile Page

The two ways of communication, i.e. electronic mail and discussion thread, are shown in Figures 14 and 15, respectively.

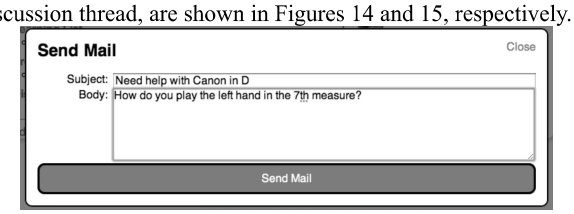

Figure 14. Send Mail Form

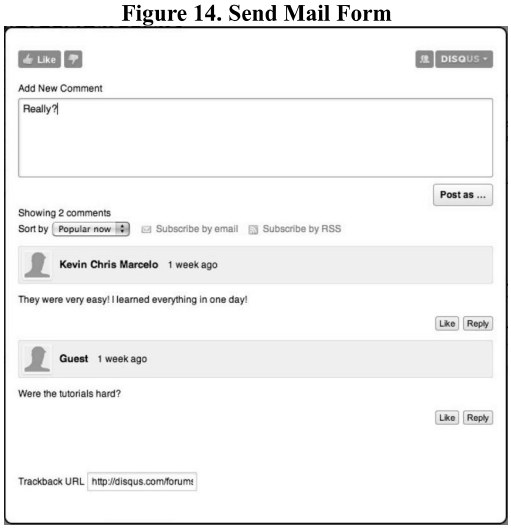

Figure 15. Discussion Thread powered by Disqus

In Projectrix, inviting assessors can be done through electronic mail or Twitter direct messaging (Figure 16). This

figure also shows the Meebo Bar, as is found in all pages in Projectrix.

Figure 16. Add New Project Form

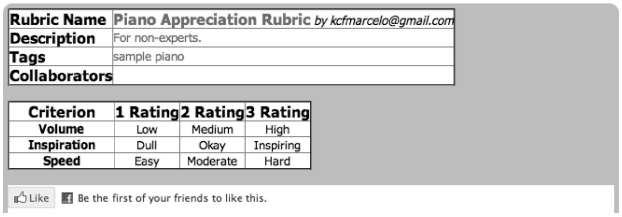

Figure 17. Rubric Page

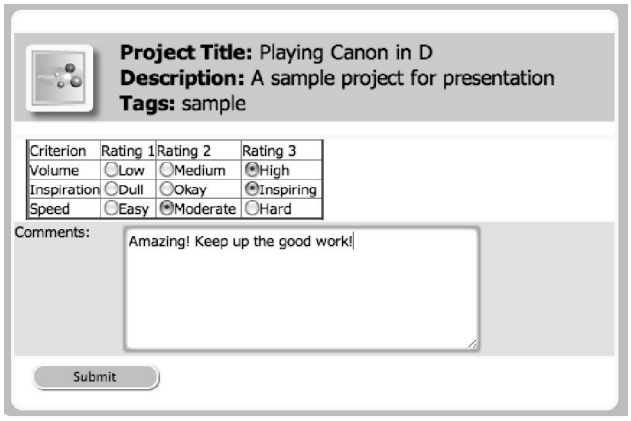

Figure 18. Project Assessment Form

Figure 17 is an example of a rubric which was already finalized in Google Spreadsheets. This rubric can be used in assessment, as shown in Figure 18.

6. RECOMMENDATIONS

An ideal Personal Learning Environment is open and integrated to all systems relevant to a person's learning. Hardwire is currently connected to Twitter, Facebook and Disqus, while Projectrix is connected to Twitter, Facebook and Google Spreadsheets. The researchers recommend more integrations with social networks, communication tools and blogging services.

Secondly, there are two ongoing research efforts for Hardwire and Projectrix: one is on folksonomy and recommendation engines for both systems, and the other is on the systems' semantic web implementation.

6.1 Hardwire

First, to keep up with the other Web 2.0 tools for content discovery, Hardwire could utilize content caching and display capabilities, e.g, video embedding, content previews. Secondly, efforts can be done to make Hardwire accessible on mobile devices. Lastly, Hardwire could also be connected to existing learning institutions to gather resources.

6.2 Projectrix

The web service for assessments is limited to Hardwire on the current version of Projectrix. Projectrix could open its web service to other web applications who may want to take advantage of it's collaborative assessment tool in newer versions.

Projectrix is only currently using rubrics as a way of assessing a learner's work product. Other forms of assessments which may be more appropriate for certain learning projects could be offered in newer versions.

7. REFERENCES

[1] Asuncion, J. Moscatel, M. Feria, R. Design and Implementation of Cloud Based Personal Learning Environment. in *The PLE Conference*, (Barcelona, Spain, 2010). Retrieved January 17, 2011 from The PLE Conference: http://pleconference.citilab.eu

[2] Buchem, I. *Definitions of Personal Learning Environment (PLE)*. Retrieved January 17, 2011 from Slideshare:

http://www.slideshare.net/ibuchem/definitions-of-personal-learning-environment-ple-4029277

[3] Castañeda, L. Soto, J. Patchworking Web 2.0 for learning: Introducing ICT as a professional tool building Personal learning Environments. in *The PLE Conference*, (Barcelona, Spain, 2010). Retrieved January 17, 2011 from The PLE Conference: http://pleconference.citilab.eu

[4] Conner, M. Introducing Informal Learning. *Marcia Conner Home*. Retrieved January 17, 2011 from Marcia Conner: http://marciaconner.com/intros/informal.html

[5] Features Tour. in *Disqus*. Retrieved January 17, 2011 from Disqus: http://disqus.com/features/

[6] *Hardwire*. Retrieved January 17, 2011: http://hardwireple.appspot.com/

[7] Koper, R. Specht, M. TENCompetence: Life-Long Competence Development and Learning. in Sicilia, M. *Competencies in Organizational E-Learning: Concepts and Tools*. IGI Global, Pennsylvania, 2007, 234-252.

[8] *Projectrix*. Retrieved January 17, 2011: http://projectrix-development.appspot.com/

[9] Smale, C. Peer and Self Assesment. *Teaching Expertise*. Retrieved January 17, 2011 from Teaching Expertise: http://www.teachingexpertise.com/articles/peer-and-self-assessment-2867

[10] Smith, F. How to Use Social-Networking Technology for Learning. *Edutopia Magazine*, 3(2).

[11] Social Plugins. in *Facebook Developers*. Retrieved January 17, 2011 from Facebook Developers: http://developers.facebook.com/plugins/

[12] The Meebo Bar. *Meebo*. Retrieved January 17, 2011 from Meebo: http://www.meebo.com/websites/

[13] van Harmelen, M. Personal Learning Environments. Retrieved January 17, 2011 from Personal Learning Environments: http://octette.cs.man.ac.uk/jitt/index.php/Personal_Learning_Environments

[14] What is Google App Engine? Google Code. Retrieved January 17, 2011 from Google Code: http://code.google.com/intl/fil/appengine/docs/whatisgoogleappengine.html