Components of a Research 2.0 Infrastructure

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Abstract. In this paper, we investigate the components of a Research 2.0 infrastructure. We propose building blocks and their concrete implementation to leverage Research 2.0 practice and technologies in our field, including a publication feed format for exchanging publication data, a RESTful API to retrieve publication and Web 2.0 data, and a publisher suit for refining and aggregating data. We illustrate the use of this infrastructure with Research 2.0 application examples ranging from a Mash-Up environment, a mobile and multitouch application, thereby demonstrating the strength of this infrastructure.

Keywords: research 2.0; infrastructure; mash-ups; #Res2TEL

1 Research 2.0

In technology-enhanced learning (TEL), the use of Web 2.0 technologies is now actively researched under banners such as "Learning 2.0" [1], "Personal Learning Environments" [2] or "Open Learning Environments" [3] and the like. In our Research 2.0 work, we aim to leverage the same opportunities for research on TEL. Research 2.0 can be defined as the application of new practices that focus on opening up the research process to broaden participation and collaboration with the help of new technologies that are able to foster continuous engagement and further development.

The basic idea is that, as researchers in technology-enhanced learning, we already know how to make use of for example blogs, wikis and forums to enhance collaborative work, but a full Research 2.0 framework might provide us with a much more powerful structure to make our research more effective.

The proposed components of a research infrastructure build upon the ideas of Research 2.0. By now, the focus is on individual practice and especially on the information management of publication and social media data. Based on this foundation, future extension will strengthen collaborative and community practice for a full "Research 2.0" framework.

The paper is organized as follows. We first outline the tree main components of the research information infrastructure. It follows an outline of a publication format, of services for publication and Web 2.0 data, and a publisher suit. The interplay between these components is shown with three applications, which are build on top of the infrastructure. Finally, we conclude and give a forecast about the next development steps.

2 Components of a TEL Researcher Information Infrastructure

The architecture of the infrastructure foresees three cornerstones [4]. (1) On the server side, services provide the backing data for the tools and widgets. The data are retrievable through a RESTful API. (2) On the client-side, widgets are combined into a coherent user experience with the help of a mash-up environment. Mobile and multitouch applications use their own environment. (3) Widgets are administered in a directory, thereby subjecting the management of the portfolio to conscious maintenance and development. The fundament of the infrastructure tying these three pillars together is a set of interoperability formats.

Based on these cornerstones of Research 2.0 architectures we implemented data services, tools and widgets, using interoperability formats. We begin with the description of a publication exchange format. This defines a minimum set of guidelines easing the usage across different systems and partner infrastructures. It follows two data services approaches, one for research data including publication data and Web 2.0 data, and a publisher suit. These services are accessible for the use in tools and widgets. We outline three of them, which especially show the strength of the Research 2.0 mash-up architecture for the use in different application fields, including desktop, multitouch and mobile applications. We begin with the interoperability format.

Publication feeds: In order to facilitate the exchange of bibliographic data across the TEL community we use the concept of publication feeds. They are used for a lightweight exchange of publication metadata in a format commonly readable by existing Web 2.0 infrastructure. Hence, they can easily be combined, aggregated, visualized and re-released. This allows for inclusion of external parties who can expose their publication data trough publication feeds as well. An institution only needs to export its publication metadata once to automatically update all the

subscribers to this feed (e.g. the STELLAR[1] Open Archive[2]). Publication feeds are RSS 1.0 feeds enhanced with elements from the SWRC and DC ontologies. The feeds are based on the BuRST format [5]. The basis for the publication feed are RSS 1.0, RDF, DC 1.1, SWRC 0.3, and BuRST 0.1. Modifications were applied where the format was outdated or underspecified.

ResearchFM service: The ResearchFM API was proposed as a RESTful API to provide publication and social data of authors in a unified way. Publication data shed light on of communication and collaboration of a research community, e.g. through analysis of co-authorship, co-citations and conference themes. With social media content, there is an unfathomable amount of data being generated almost constantly on the Web from research communities aside from the "official" publications. Heinze et al. [6] point out a number of Web 2.0 tools that are actively used during the daily work of researchers. However, in many community and group work situations the awareness of others is essential for effective and efficient work. This can be especially true in conference settings, since they provide the time and space for exploring new themes, finding like-minded researchers, or finding out what is being discussed online about one's own work. Reinhardt et al. [7] propose the model of Artefact-Actor-Networks (AANs) to store, analyse and visualise the actions, connections and structure of individuals within research communities on both social and artefact level. Therefore, they monitor the community's activities on social media sites based on given tags or given online handles and analyse the content of the gained artefacts. Every artefact is stored together with its metadata, semantic annotations and connections to other artefacts in a semantic database. Furthermore, the relations to actors referring to an artefact (e.g. creating, linking, retweeting, forwarding, discussing about, favouring, tagging) are stored and allow analysing the nexus of a community starting from any artefact or actor in the Artefact-Actor-Network. Furthermore, it allows the identification of semantically similar artefacts or actors from their respective content, extending the possibilities of co-citation measures or co-authorship relations.

As all the collected data is very similar on the one hand, and the tools and widgets use this data in a similar way on the other hand, it became apparent that a lot of benefit could come from a common API in terms of interconnectivity and reusability.

Services for publication data: A suite of publisher services was released to aid institutions and individuals in producing, aggregating and refining publication feeds in producing, aggregating and refining publication feed. The services include a BibTeX converter as well as a feed merger and a feed filtering service: these services can be mashed together, e.g. by using DERI pipes[3]. Additional to the data from the STELLAR Open Archive further TEL specific publication data has been gathered, namely the publication data of two conferences EC-TEL and ED-MEDIA, with others to follow. This will help to feed more data into the Archive, and form an interesting foundation for tools and widgets to build upon. To have easy access to this data, all tools and widgets will be able to use the unified ResearchFM service.

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[1] http://stellarnet.eu
[2] http://oa.stellarnet.eu/
[3] http://pipes.deri.org

Build upon the data services and interoperability format three applications are used to demonstrate the wide usage of the Research 2.0 infrastructure.

STELLAR Widget Universe: Builds upon the mash-up idea. It uses Elgg[4], an open source networking and publishing software, as showcasing platform for bringing together widgets and services and the legacy systems of the STELLAR partners. The widgets are delivered through the Wookie widget engine[5]. A plugin for Elgg enables to embed the widgets into Elgg (plugins for Wordpress, Moodle, LAMS exist as well). Researchers can arrange a widget per drag-and-drop on their dashboard. A list shows the gallery of all available widgets from the STELLAR directory. After the selection, the widget is automatically instantiated and can be used by the researcher. All widgets are packaged according to the widget 1.0 specification[6] and can thus not only be run within the reference implementation called Universe, but similarly within STELLAR's stakeholder platform TELeurope[7].

ScienceTable: While the widget universe is browser based, the ScienceTable is a multitouch tabletop application for the collaborative exploration of publication data. This tool allows for an interactive exploration of co-authorship relations. Its layout is completely dynamic, based on a spring graph algorithm. The ScienceTable can be interesting for a researcher exploring his own collaborations or exploring the clusters of co-operating authors in the field. In order to start navigation, search for a specific author is supported. Exploration happens through zoom, pan, drag and tap gestures on a large multi-touch tabletop. Extensions towards citation data are planned for the near future.

The **More!** application [8]: This application is build for mobile devices. Its purpose is to let researchers find information about for example a speaker at a conference and to subscribe to feeds from social tools that keep the attendee informed about ongoing work from the speaker. The application exposes the following information:
- Speaker: full name, photo, e-mail, affiliation and publication list
- Current presentation: slides and paper
- Social tools: Twitter, SlideShare, blog, Delicious, LinkedIn, and Facebook

The following figure gives an overview of the above outlined components of the Research 2.0 information infrastructure. The publication data are collected through the publication feed format. These data and social media data are retrievable through the ResearchFM API, which serves as the backing data for the applications, like the STELLAR universe, the ScienceTable, the More! application and many more.

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[4] http://elgg.org

[5] http://incubator.apache.org/wookie/

[6] http://www.w3.org/TR/widgets/
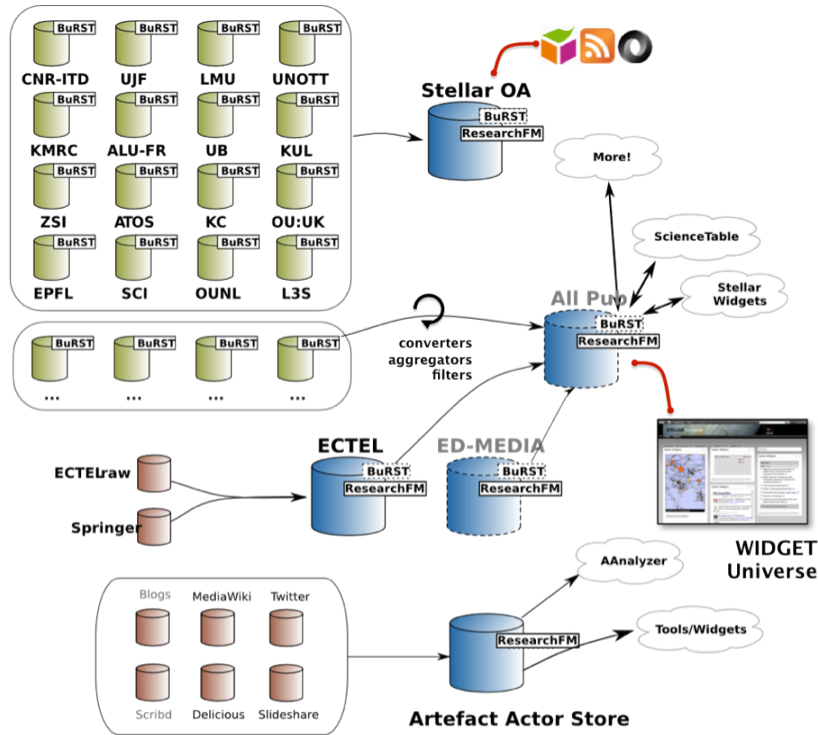
[7] http://www.teleurope.eu/

Fig. 1. The Components of the TEL Research 2.0 Information Infrastructure

3 Conclusions and Future Work

We proposed a mash-up infrastructure allowing for continuous innovation, by recombining and repurposing existing technology, and showed concrete implementations. With this, the first steps towards a Research 2.0 framework have been made. The outlined Research 2.0 architecture can help to support the practices of researchers providing them with tools to discover and develop their research field.

The Research 2.0 infrastructure lays the foundation for researchers to experience new practices and provides a rich set of data (publication and social media data) to explore further possibilities. Overall, broadening participation means broadening communication and therefore Research 2.0 must aim at supporting research communities in information processing creating more awareness amongst the members of a research community.

While the components of the infrastructure by now focus on the practice of information provision and distribution, for a full Research 2.0 framework further practices, like collaborative and community practice need to be taken into account. They will serve as a further testbed helping to determine extension and modification

needs. However, with the use of Mash-Up environments we see suitable support for the later two, allowing users to engage in collaboratively in a personal research Mash-Up environment.

Although the concepts outlined here focus on the domain of technology-enhanced learning, they might very well apply to several other domains.

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REFERENCES

1. Ala-Mutka, K., Bacigalupo, M., Kluzer, S., Pascu, C., Punie, Y., Redecker, C.: Learning 2.0: The Impact of Web 2.0 Innovation on Education and Training in Europe, http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=2139.
2. Wilson, S., Liber, O., Johnson, M., Beauvoir, P., Sharples, P., Milligan, C.: Personal Learning Environments: Challenging the dominant design of educational systems. Journal of e-Learning and Knowledge Society. 2, (2007).
3. Hannafin, M., Land, S., Oliver, K.: Open learning environments: Foundations, methods, and models. Instructional-design theories and models: A new paradigm of instructional theory. 2, 115–140 (1999).
4. Wild, F., Ullmann, T.D., Scott, P.: The STELLAR Science 2.0 Mash-Up Infrastructure. Presented at the 10th IEEE International Conference on Advanced Learning Technologies, Sousse, Tunisia (2010).
5. Mika, P.: Bibliography Management using RSS Technology (BuRST), http://www.cs.vu.nl/~pmika/research/burst/BuRST.html.
6. Heinze, N., Bauer, P., Hofmann, U., Ehle, J.: Kollaboration und Kooperation in verteilten Forschungsnetzwerken durch Web-basierte Medien – Web 2.0 Tool sin der Wissenschaft. GMW2010. (2010).
7. Reinhardt, W., Moi, M., Varlemann, T.: Artefact-Actor-Networks as tie between social networks and artefact networks. In Proceedings of CollaborateCom 2009, November 2009.
8. Parra, G. Duval, E.: More! A Social Discovery Tool for Researchers. ED-MEDIA 2010-World Conference on Educational Multimedia, Hypermedia & Telecommunications. Accepted. (2010).