The Everlasting Dawn of Educational Brokers – A Search for Key Design Principles

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Abstract. In the last couple of years we have evidenced several initiatives promoting the vision of open educational systems. Educational brokers are supposed to take advantage of this 'infrastructure of standards and open specifications' and provide exchange services for users and systems. However, a quick assessment of the adoption of educational brokers leads to the conclusion that educational brokers have still not managed to integrate themselves successfully into the educational landscape. Based on an action research methodology we derive and discuss three design principles that – once implemented – shall lead to an effective brokerage infrastructure.
Based on the action research undertaken in two separate research projects we conclude that an effective educational broker needs to: (1) provide a balanced metadata model for learning resource descriptions, (2) take advantage of interoperable 'home systems' that provide services from the user's most frequently used access point, (3) report on who is re-using what in case 'open content' is brokered.

1 From Standards to Educational Brokers

In the last couple of years we have evidenced several initiatives promoting the vision of open educational systems. Standardized data formats for describing learning objects (e.g. IEEE LOM, IMS Metadata, IMS Content Packaging) and open, component-based frameworks for learning resources (e.g. AICC, SCORM, OKI) shall ultimately lead to an improved interchangeability of learning resources.

Educational brokers are supposed to take advantage of this "infrastructure of standards and open specifications" and provide exchange services for users and systems. Educational brokers – from a technical point of view also referred to as educational mediators [11] – enable their users to reuse and compile distributed units

of knowledge. Other terms used for educational brokers are electronic markets for learning [4], knowledge pools [2], or learning media [3].

In this paper we offer the following definition of educational brokers: Educational brokers are network-based information systems in the sense of educational mediators, which integrate learning objects from dispersed sources in order to make them available to a wider audience. Educational brokers can be perceived as enhanced digital libraries [1], which include computer-mediated communications, community process support and/or marketplace functionality. Educational brokers focus on different kinds of educational artefacts ranging from small learning assets (e.g. a picture of an elephant), to full-fledged online-courses (e.g. A course about the wild life in Africa). In order to integrate and distribute these educational artefacts, educational brokers provide interfaces to learning management systems, local repositories of educational material, course catalogue management systems, assessment tools, etc [7].

2 Educational Brokers: Not Ready For Prime Time?

The idea of "share and reuse of learning objects", commonly referred to as learning object brokerage, is an appealing one. Why shouldn't we reuse existing material instead of paying the costly price of developing it on our own while we enhance the quality of teaching at the same time?

Both, from an institutional and an individual perspective, in becoming an active member of an exchange community one can foster national or international alliances. As an author or publishing house, you can also easily increase the sales of your latest textbook by giving away teaching material for free. Stakeholders and management of education institutions, academic consortia and society as a whole, are all interested in a successful realization of this idea, because it would make the single institution, but especially the education industry as such, more productive.

However, a quick assessment of the adoption of educational brokers leads to the conclusion that educational brokers have still not managed to integrate themselves successfully into the educational landscape. For example, while a particular region in Austria focused on the development of an open brokerage platform that ultimately collected (mostly links) to about 3.000 learning objects in Austria and Germany, another Austrian region on the other hand developed more than 20.000 learning objects on their own in a closed platform, without having any external brokering mechanism[1]. Cross-organisational educational brokers such as Ariadne and EducaNext suffer from stagnation in the growth of learning objects made available.

The number of failed projects and initiatives in this context call for a substantial research in the subject area in order to develop design principles that shall lead to the successful implementation of brokerage systems. In this paper we address that research question carrying out interviews and workshops with various stakeholders of

[1] The system was closed to the outside world, but within the region teachers were able to reuse from and provide to a central object repository.

educational brokers. Based on an action research methodology we derive and discuss three design principles that – once implemented – shall lead to an effective brokerage infrastructure.

3 Methodology

Given our objective of developing and testing design principles that contribute to the adoption of educational brokers, we selected 'action research' as our mode of inquiry. Action research has been described as "a post-positivist social scientific research method, ideally suited to the study of technology in its human context"[2].

Even though there are other methods for studying technology in its "natural" context of everyday use, action research distinguishes itself in that it is interventionist and dedicated to the development of knowledge useful to both research and practice [5]. As an interventionist method, action research allows the researcher to test a working hypothesis about the phenomenon of interest by implementing and assessing change in a real-world setting.

In our particular setting we had a parallel approach to develop design principles of educational brokers. One research activity focused on the higher education world. We collected contact information from organisational developers, computer service providers, and faculty members all interested in the development and exchange of educational content. As a next step, we invited to two workshops. At the first workshop we set the scene for developing a nation-wide educational broker and collected interest. Based on the demonstration of various existing solutions in combination with a theoretical analysis using a design space approach [8], we asked for a voluntary participation in a follow up workshop.

Due to the high number of interested participants we organized a second meeting, where concrete design alternatives were discussed. The design alternatives were presented via screen mock-ups (prototypes without a real functionality behind) and a potential model for describing learning resources based on existing metadata models was discussed.

The workshops of Research Activity 1 took place at 20th and 21st of December 2005 and 16th and 17th of March 2006, respectively. Overall 21 e-learning experts attended the workshops, representing faculty members, computer service centres, and e-learning service centres.

Research Activity 2 took place in the school sector. Here we aimed at the integration of various content providers and asked them open questions with respect to their requirements for integration. The questions were developed at an experts meeting and focused mainly on issues related to digital rights management. An operational brokerage platform served as 'living case'.

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[2] Baskerville and Wood-Harper 1996 in R. Lindgren, O. Henfridsson, and U. Schultze, "Design Principles for Competence Management Systems: A Synthesis of an Action Research Study," MIS Quarterly, vol. 28, pp. 435-472, 2004.

Interviews were held with representatives of one commercial content provider, and four potential (at the time of the interview) providers of 'open content'. The interviews were deepened when the integration work started with some of the providers.

4 Results

4.1 Design Principle #1: Balanced Metadata Model for Learning Resource Descriptions

In Research Activity 1 the IEEE LOM Standard for Learning Objects Metadata (LOM) was our starting point. The metadata model was discussed at the example of the LOM application profile as implemented in the educational broker EducaNext and further developed in the "Elena – Smart Space for Learning" research project.

In Research Activity 2 an Austrian application profile of LOM was used to trigger the discussion with various stakeholders about the applicability of the model. The rework was also inspired by the Learning Resource Exchange (LRE) LOM application profile developed by European Schoolnet in the context of the CALIBRATE project.

The Austrian application profile was already implemented for more than two years at two connected repositories when we discussed adaptations. At the meeting the participants complained that the effort for announcing a learning resource was too high with the current metadata set. The metadata model was implemented at a commercial vendor and used by publishing houses for offering electronic learning material for schools.

In the context of the first research activity we agreed that the search query that a potential user submits to an educational broker shall determine the requirements for the metadata model. We discussed various useful restrictions to a query ranging from language restrictions, over learning resource type restrictions to discipline classifications that are broadly applied in the domain. The group agreed that these query scenarios in combination with a limited set of metadata elements that provide additional guidance to the user shall ultimately determine the metadata model rather than what as understood as 'full compliance with the IEEE LOM standard'.

Although addressing two quite separated sub-domains of education, both activities led to almost identical results. In order to balance the metadata model between highly expressive descriptions and low provision effort we ended up with a low number of mandatory elements and vocabulary. The metadata model differentiated automatically provided data elements such as identifier and format from manually entered data for title, subject or description. The designers were very careful when it came to choosing mandatory status with a manually provided element.

In the spirit of the Web 2.0 we suggested a user-controlled vocabulary instead of enforcing a vocabulary. However, in some cases the participants felt that a widely accepted centrally developed and maintained vocabulary would do a better job.

Finally, Research Activity 1 found a consensus with a very simple set of 14 elements (6 required, 8 recommended), see Table 1. Research Activity 2 was synchronised with Research Activity 1, but extended the model with elements by the taking the requirements of school content into account [9].

However, please note that a lasting consensus was reached on the design principle, while the metadata models themselves might, but do not have to change, with every system entering the educational brokerage network.

Table 1. Mandatory and Recommended Metadata Model Elements for Higher Education [10]

Mandatory Elements	*Recommended Elements*
Identifier (ID)	Learning Resource Type
Title	Description
Language	Keyword
Contributor	Creation Date
Location	Issue Date
Rights	Format
	Instructional Method
	Context

4.2 Design Principle #2: Users Want Their 'Home System' Connected to the Educational Broker

In the workshops of Research Activity 1 various architectures of a brokerage system were discussed. The workshop chair demoed central, world-wide accessible platforms, as well as interface components that connect local content management systems to central brokers. At the second workshop this discussion was deepened by using screen mock-ups.

As a first conclusion, the group felt that the brokerage environment should not become an extra tool, potential users need to register and learn about. Instead the broker shall – almost seamlessly – integrate with what was referred to as the 'home system'. The final version of the workshop protocol states "Instructors should be provided with the possibility to use their own system (e.g. LMS) and just by one mouse click they should be able to publish their content". Beyond provision, the 'home system' should also facilitate federated search and import of learning objects.

Such architecture was considered to be the 'best possible world' scenario. However, in order not to discriminate those users that are not privileged with a connected "home system" a central service shall be provided – again for both – provision and search for learning objects.

Interestingly, decentralization became less important when it came to institutionally provided learning objects of higher granularity. The working group considered a central site for announcing and disseminating project-like learning objects as an attractive solution. A portal that is highly used within its target community constitutes an attractive dissemination media for those activities where dissemination is required. In such a scenario, where dissemination (versus: sharing and collaboration) is the key issue, a central portal is an acceptable solution for attracting users.

4.3 Design Principle #3: People Don't Care Where It Goes, But Would Like To Know Who Is Using It

In an earlier paper the assumption was made that "Creators of learning objects, like any holder of corporate knowledge, live in an extra- and intra-organizational network of hierarchies and communities. These communities and hierarchies play an important role when it comes to the exchange of knowledge. Learning object brokers have to find ways of representing these communities and hierarchies electronically."[3]

Based on this assumption we tried to test the requirement whether users need to have some kind of control when offering a learning object. In the context of Research Activity 2 we therefore posed the question whether a light-weight Digital Rights Management (DRM) was required even in the context of open educational resources.

The results were surprising to some extend: While many of our interviewees appreciated the idea of open content licenses that allow you to describe the intended usage of their learning objects, we could not find a single interview partner that required an electronic enforcement of these open content licenses. Neither institutional providers nor individual providers seemed to trust such an infrastructure.

Beyond that, both groups were also quite open in terms of access control required. In the spirit of open collaboration they all mentioned that they do not see a need in supporting restricted access to open educational resources.

Our interpretation of these findings is based on the assumption that users have already made up their minds at the moment they openly offer their learning objects. At this stage they do not seem to care any more about access restriction, but are more concerned about a broad dissemination of their learning object description. Long lists of user groups seem to be too anonymous for them in order to make a decision about a group's access to their learning objects. Of course, situation changes once the learning object is collaboratively developed in a predefined group.

When it comes to the usage of their learning resources, users are, however, very much interested in who is using it and what for. Here usage statistics seem to be an important element, serving various purposes such as:

a) reporting on the effectiveness of the brokerage infrastructure

[3] B. Simon, "Learning Object Brokerage: How to Make it Happen," in Proceedings of ED-MEDIA 2003, D. Lassner and C. McNaught, Eds. Honolulu, USA: AACE, 2003, pp. 681-688.

b) potential investigation of the correct application of the open content license attached to a learning resource

c) providing a first contact point for future collaborative development.

5 Discussion and Conclusion

With respect to the 'balanced metadata model' Massart came to a similar conclusion [6]. The CELEBRATE project he reported from, suffered from the high effort required by, both, functionally connecting a system to the educational broker, and providing learning resource descriptions in the right format. We also share his finding with respect to the implementation of a full-fledged DRM for commercial content: In the context of Research Activity 2 commercial content providers were not ready to open-up their repository using state-of-the-art DRM mechanisms, but rather focused on attracting visitors to their own access-controlled portal using the broker as a kind of advertising platform.

The findings of this research can be concluded in the recommendation that engineers of educational brokers need to investigate and design appropriate business models first, before a technological solution is rolled out. In order to design a successful broker, users' interests need to be served while effort and costs of using the broker need to be low. In our paper we present a value-adding reporting feature that informs providers about collaboration opportunities based on content re-use and emphasize the importance of a 'balanced metadata model'. In order to explore the deep web of closed learning management systems we recommend the integration of interface components that link an LMS with an educational broker for the purpose of provision, search, and import of learning objects.

At the time of writing we are in the process of setting up an educational brokerage infrastructure according to these design principles to further validate our findings, but also to bring educational brokers to a long awaited success.

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