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# Managing Online Resources For Teaching And Learning

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## Abstract

Apart from providing access to a huge collection of information resources the Web promotes a new paradigm for teaching and learning. In response to this opportunity a number of major projects are taking place to develop educational metadata standards to describe digital resources which promote interoperability of resource discovery.

Pedagogical frameworks such as 'resource based learning', scaffold learners and resources to achieve desired educational goals. The majority of online resources, however, are not created as educational tools or classroom materials. The term 'non-educationally-focused' (NEF) resource is introduced in this paper to refer to a resource originally created for purposes other than educational consumption. Yet these NEF resources can have great educational value in the right context. This context is generally provided not by the creator or initial indexer of the resource, but by a third party, a teacher, student or librarian perhaps.

This paper describes the technical work of the EdNA Higher Education Team in this area since mid 1999. The distinction between educational resources and NEF resources provides a model for educational metadata development. A mechanism for "education enabling" NEF resources is proposed and is compatible with current educational metadata standardisation efforts. It is argued that Subject Gateways are potential providers of enabling resources and enabling metadata for domain specific NEF resources.

## Introduction

Technological advancement in the last few decades has created new social orders. The advancement in transportation and communication has transformed the economy into a global phenomenon, the mass uptake of telecommunications and rapid improvement of the performance to cost ratio of computing technology has significantly transformed our society from an industrial society into the information era.

Charles M. Reigeluth (Educational Technology, May-June 1996 pp13-20) argues that as society transforms from an industrial society into an information society, the organisation, and hence the people working within the organisation must adapt to the new demands of the changing environment. The key markers that distinguish industrial-age and information-age organisations are tabled below.

Industrial Age	Information Age
Standardization	Customization
Bureaucratic organisation	Team-based organization
Centralized control	Autonomy with accountability
Adversarial relationships	Cooperative relationships
Autocratic decision making	Shared decision making
Compliance	Initiative
Conformity	Diversity
One-way communication	Networking
Compartmentalization	Holism
Parts-oriented	Process-oriented
Planned obsolescence	Total quality
CEO as "king"	Customer as "king"

There are dramatic changes in *who* is learning too. Undergraduates are commencing their study at an older age, many with full-time or part-time jobs. This is also related to *when* students learn. For instance, Twigg [1994] suggested that in the US, 75% of the work force will need retraining by year 2000 as old jobs disappear and new one emerges due to the global economy. Students need flexible learning arrangements. The traditional fulltime learning model will fail to serve the needs of such students. On the *where* students learn, these working adult students would need flexibility and would like to learn from home as well as the workplace. Twigg suggested that new tools need to be available *while* students learn. Finally, as we know more about *how* people learn, more changes in the pedagogical functions of higher education institutions will be needed.

An education system must take into account these changing needs of learners. Specifically, it must:

- accommodate students' needs in respect of pace, time, place and duration;
- provide for a range of ability and different learning preferences of students;
- provide greater autonomy and accountability, so that learning responsibilities reside with the learners but continuous assessment of their performance enables just-in-time help when problems are detected; and
- recognise learning as a holistic process, where digital technologies are integrated into a well-designed curriculum that includes the role of social interaction in the complete learning process.

While the Web may be considered as the driving agent of such changes, it also provides opportunities to promote a new paradigm for teaching and learning to meet the new demands. A lot has been written about the "any time and any where" learning opportunities facilitated by the Web. It is argued here that the Web is also like a huge (digital) library, is a communication medium, even a virtual community. As a huge and distributed library, it contains information of any kind imaginable which is published, maintained and supported by people with widely different backgrounds.

A number of major projects are taking place to develop educational metadata standards to describe digital resources and subsequently promote efficient management and interoperability of resource discovery. Such efforts have been largely focused on describing resources which are inherently *educational* resources. However, there are many other resources created originally for purposes other than education which are subsequently used or potentially useful for educational purposes.

We argue that current metadata initiatives should also consider the educational aspects of resources which may not have been created originally for purposes other than education. Although focused on digital resources, the following argument is also applicable to non-digital resources including pictures, samples, movies, historical events, books and magazines.

## Current Metadata Implementations

A great deal of effort has already gone into describing resources specifically intended for educational use. At the inaugural meeting of the DC-Education Working Group in October 1999, the first domain-specific Working Group to be constituted within the Dublin Core Metadata Initiative (DCMI), five categories based on the common semantic elements of eleven major educational metadata projects, were identified. These included (and are listed here for completeness):

- *Users*: Metadata elements that focus on the general idea of the "audience" for the resource being described, further distinguished as those "who mediate access to the resource" from those "for whose benefit from how it may be used".
- *Duration*: Metadata elements/qualifiers that capture the typical "use" time of an educational/training resource.
- *Learning Processes & Characteristics*: Contains a number of different attributes that focus on pedagogy including "student groupings, teaching methods, mechanisms of assessment, learning prerequisites, interactivity type and level, material type from a didactic viewpoint, type of use in a scholastic milieu, 'difficulty', 'semantic density,' etc.
- *Standards*: Mapping to meet specific education/training content/process standards
- *Quality*: Relates to an assessment of the quality of the object for educational/training purposes. Sutton identified two sorts of such assessments: (1) unstructured assessments (e.g., third-party reviews/annotations), and (2) structured assessments based on established evaluative criteria. [Sutton, S. 1999]

As further noted by Sutton, there are two broad types of education/training users for Web-based resources: Intermediary (teachers) and beneficiary (learners). This would lead to the notion of two types of educational resources:

- those created primarily for teachers' consumption, such as lesson plans, curriculum materials and guides, and
- those created for the learner's consumption, such as activity sheets, reading material, and virtual interactive environments.

## Non-Educationally-Focused Resources

However, educators select and use many items that are not originally designed as educational resources. A feature film such as "Twelve Angry Men", initially intended as general entertainment, might have great educational benefit when included as part of a multimedia unit on group dynamics. The item has gained an extra dimension. It follows, then, that there is a difference between "educational resources" and "educational potential of a resource".

We use the term "non-educationally-focused" (NEF) resource to refer to a resource which was originally created for purposes other than educational consumption. However, this name should not imply the appropriateness or otherwise of the use of such material in educational or training situations.

A review of the major educational metadata standards efforts reveals that most attention on capturing educational metadata is placed upon defining metadata elements for educationally-purposed resources only. Thus, for example, the IEEE LOM element (Education.IntendedUserRole) or DC-Education's proposed DCEd.Audience category target resources where a teacher or learner is clearly defined. However, there are no obvious elements apart from the general metadata elements themselves to support or direct a learner to the use of NEF resources in an educational context.

Because the intended purpose of NEF resources, by definition, is not educational use, it is highly unlikely that any form of educational metadata will have been applied to these resources. This paper is concerned with the education-enabling potential of NEF resources and what mechanisms might be useful in order to make them optimally available for educational use.

## Values of NEF resources in Pedagogical Designs

The effective use of the Web as an educational resource would require widespread recognition that there is "educational value" that can be attributed to NEF resources. NEF resources might include general descriptive articles, news or applications of techniques, etc.

Unless the learning objective is "to be able to research information", a courseware designer would normally provide the relevant resources to the learning object. To fully capitalise on the Web as an educational resource content experts need to be able to efficiently locate high quality, current resources using either comprehensive or targeted coverage. Traditionally, a lecturer might be able to do so in the area in which s/he is the content expert. However, the task of keeping up to date on such resources is becoming more and more specialised.

"Resource-based learning" typically refers to the use of a wide variety of resources in support of learning. Pedagogical designs are scaffolding around resources to achieve learning outcomes. However, much resource-based learning incorporates only educational resources traditionally collected, collated or summarised by professional librarians. It is argued here that NEF resources may or should be

included as well. "World Politics in Transition", a "role play simulation", [Linser *et al*, 1999] is one of many examples of the use of NEF resources to support learning. The students made extensive use of resources from the web to develop their role profiles, live and current news to formulate their strategies during the role play simulation.

Typical resources, which are commonly NEF resources but have significant educational value, are

- "real-time" information (unlikely to be created for sole educational use). They can be linked by including static URLs of the most current pages of dynamic web resource sites, e.g., in the resource page of "World Politics in Transition" Role Play Simulation, there are links to News sites such as BBC and CNN,
- Aggregation, customization and/or other value-added services such as result pages from appropriate subject gateways, search engines and data sources (for example, the First Fleet Online database hosted at the University of Wollongong has been a useful resource for many schools in teaching of the early white settlers in Australia).

Using the resource page of the "World Politics in Transition" as an example, subject gateways (or general-purpose search sites) may be an effective means of locating static resources and collating a list of relevant news services. However, for current analysis of the evolving political situation relevant to the simulation, currently there is no effective way of searching and obtaining a comprehensive, current and focussed list of discussion articles on the issue appropriate to the level of the students. The development of subject gateways, primarily serving political science, would provide material for educational purposes with almost no additional cost if the following service model is adopted.

## Using NEF resources

NEF resources are typically used without modification. The "Twelve Angry Men" example may be used as a motivator or an opening in a learning experience in its part or entirety. In a way, it is easy to use NEF resources. The challenge is to provide mechanisms which maximise opportunities for discovery of these resources for both learners and educators.

Let us consider a visit to a museum which is commonly regarded to be a good learning opportunity. Many museums pride themselves in displaying the original artifacts - NEF resources! The way the exhibits are presented, the accompanying descriptions and sometimes the activity sheets all help to create the learning experience. The information about the organisation of exhibits is potentially a "teaching resource"; the accompanying descriptions and activity sheets, "learning resources". Such teaching and learning resources have "education-enabled" the NEF resource.

The availability of Web-based digital resources is related to handling of IP issues and it is assumed in this discussion that the NEF resources are freely available for educational use. The difficulties in using NEF resources are:

- Discovering the appropriate NEF resource, and
- Creating linkages to educational resources that education-enable NEF resources.

## Education-enabling of NEF resources

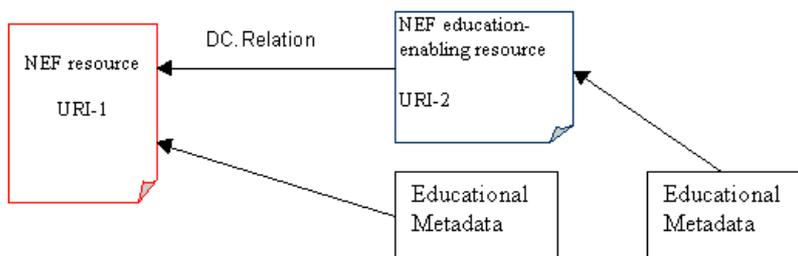
Education-enabling of NEF resources involves providing some sort of functionality whereby "intermediaries" are able to link value-added usage information to the resource and make this available to "beneficiaries". This could involve the linking of ancillary educational resources (e.g., lesson plans) or the provision of educational metadata to augment the NEF resource.

[Ip et al \(1999\)](#) proposed a data model to understanding the information architecture of resource discovery. Briefly, this model defines resources as *Type 1* data. To support efficient search and information management, *Type 2* data are created by the information manipulating agent. In the case of search engine, an index of the resource is created whenever a resource is discovered. When a request of a search is received, search engine will search the index (not *Type 1* data directly) for a match and returns the location of *Type 1* data. Hence, our familiar experience of "404 error" in search result pages. The data model notes that index is only one of the possible *Type 2* data. Metadata is also *Type 2* data.

Using the terminology of the data model, *something* can be *Type 1* data which comment, annotate or describe specific exemplar use of the NEF resource. *Something* may also be activities based on the NEF resource. It is - defined here as a *Type 1* enabling resource.

Or *something* can be detached metadata linked to the NEF resource, called *Type 2* enabling metadata.

However, in the case of a *Type 1* enabling resource, it is an educational resource and hence can have educational metadata associated with it to assist the discovery of the "description of a potential use of a NEF resource".



The "organisation of exhibits", the "descriptions" and "activity sheets" in our museum example are *Type1* enabling resources. On the other hand, we may have metadata (using educational metadata) to describe what a grade level a NEF resource may be used. Enabling resources or enabling metadata are created by an "intermediary" and may potentially have multiple of enabling resources and enabling metadata pointing to the same NEF resource. A *Type 1* enabling resource, by definition, is useless unless used with the NEF resource.

This puts a special constraint on the education metadata on type 1 enabling resource - the link to the NEF resource is of prime importance.

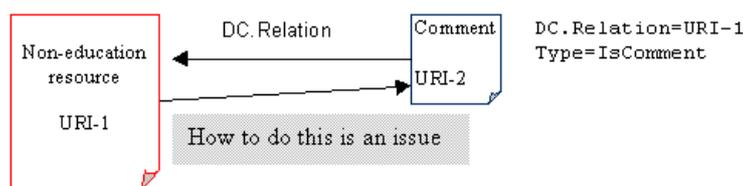
For all practical purposes, enabling metadata cannot and should not be embedded within the NEF resource. Because the intended purpose of NEF resources, by definition, is not educational use, it is highly unlikely that any form of educational metadata will have been applied to these resources and embedded. Due to IP issues and the document control, it is unlikely that arbitrary people can gain access to the resource to add embedded metadata. Hence, enabling metadata cannot be embedded within the NEF resources. It is unlikely that there is ONLY one potential educational use of NEF resource. There will, theoretically, be more than one enabling resource or enabling metadata of the same NEF resource each of which reflects a perceived use of the NEF resource meeting the need of the creator of the enabling resource or enabling metadata. By locating these enabling resources or enabling metadata closer to the use community, the better is the chance of discovery of such possible use. Hence, enabling metadata should not be embedded within the NEF resource either.

In the case of the simple act of linking an NEF resource for a course, there seems to be no obvious enabling device. However, while the resource page (which may contain a list of links to educational resources and NEF resources) may serve other educational purposes, for the purposes of this discussion, NEF resources become available to learners as a *Type 1 enabling resource* (albeit inseparable from a typical educational resource). This is a logical distinction and does not imply any endorsement on an implementation level.

## Mechanism of Subject Gateways to support Resource-supported Learning

Effective educational use of NEF resources would typically rely on a third party to create the enabling resource or enabling metadata. The most appropriate third party for such creation of enabling resources/metadata would be a community interested in the domain of NEF resources. Such as third party might be administrators of Subject Gateways which have emerged to serve special needs of different subject disciplines. One of the functions most subject gateways aim to provide is "educating the community" of their specific discipline area. Thus, managing an effective repository of enabling resources and enabling metadata may be best hosted by relevant Subject Gateways. Subject Gateways have the domain expertise to understanding the value of different NEF resources.

The technical problem of implementing this is in being able to provide a persistent link to the NEF resource. Such links would be ideally implemented as bi-directional so that accessing the enabling resource will enable the reader to locate the NEF resource, but equally accessing the NEF resource will enable links back to the enabling resources.



A Hyper-G [Maurer,1996] Web server may be used for building such bi-directional links. For typical dynamic Web server implementation, a possible solution is the development of a Link Table. A Link Table can be a table in the search database of a Subject Gateway. When an enabling resource is harvested (or otherwise added to a database) its linkage to the NEF resource is noted. A link table stores all the links between NEF resources and their enabling resources to allow a following of enabling resources from NEF resource.

Key	Possible values
URI of NEF resource	URI's of enabling resources

Some issues arise from this.

1. Subject Gateways generally don't host *Type 1* resources..
2. How would the enabling resources be checked for Quality? The expertise of the Subject Gateways can act as an important gatekeeper to ensure quality of both the NEF resource and enabling resources.
3. How would users be encouraged to provide enabling resources and how would this process take place?
4. A mechanism needs to be developed for constant updating of the Link Table and monitoring of URL changes to resources.

## Comparison of Type 1 and Type 2 Enabling Resources

*Type 2 enabling* metadata is a simple mechanism for Subject Gateways to implement. By attaching appropriate educational metadata to an NEF resource and making such metadata searchable, the NEF resource can be incorporated into appropriate learning and research contexts. Such a mechanism, however, is not yet implemented. Nor do most of the current educational metadata schemas provide adequate elements to describe exemplar use.

On the other hand, a student worksheet which might be tightly related to an NEF resource (and would be much less useful if used without the NEF resource), is also a resource in itself. In this case standard metadata schemas which describe authorship may be effectively applied. This *Type 1 enabling* approach in many contexts is probably a more durable mechanism.

## Conclusion

While the Web has been recognised as a great medium for publishing content and potentially useful for learning, there is still a long way

before effective and widespread use of the resource in education becomes optimised. The national and international efforts in creating metadata standards are a step in the right direction. However, it is necessary to recognise the subtle difference between an "educational resource" and the "educational potential of a resource". We have articulated a possible enabling mechanism for the latter.

Value can also be added to resources for teaching and learning in the form of user comments, evaluations and enabling resources for educational use. Our approach is in line with the general trend of aggregation of value rather than re-creation of resource and duplication of effort.

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Maurer, Hermann, (1996) HyperWave, The Next Generation Web Solution.

Sutton, S. (1999) Email to DC-education mailing list, Nov 21, 1999

## Hypertext References

HREF1  
<http://www.dls.au.com/metadata/DataModel.html>

HREF2  
<http://www.roleplaysim.org/papers/polsim.htm>

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