

# Handling Multiple Metadata Streams Regarding Digital Learning Material

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**Abstract.** This paper presents the outcome of a study performed in the Netherlands on handling multiple metadata streams regarding digital learning material. The paper describes the present metadata architecture in the Netherlands, the present suppliers and users of metadata and digital learning materials. It furthermore describes the roles of suppliers and users that were defined. Based on the needs of the present and new roles, and based on the present architecture the necessary changes to the metadata architecture are described to make it more future-proof and to ensure it can handle multiple metadata streams.

**Keywords:** Metadata, architecture, learning materials, interoperability, reusability, edurep, eck, educational content chain

## 1 Introduction

In the last couple of years, the use of metadata to be able to search and find appropriate learning materials has increased drastically. With this increase, more organizations are interested in producing digital learning materials. To be able to find appropriate learning materials, metadata records need to be provided. In the past, most digital learning materials were created by publishers, who also provided metadata records for their materials. Now that not only publishers are creating digital learning materials, but also schools, individuals and many more, the metadata records for one piece of learning material are not provided by one group anymore. These new groups of people and organizations providing metadata create new streams of metadata records. Metadata streams are metadata records flowing from the creator of the record, to the central database where the records are used to find learning materials. These new streams were not foreseen when developing the present metadata architecture<sup>1</sup>. Instead of handling only one metadata stream, the educational content chain now has to handle many streams, all with different characteristics, and often providing additional metadata information about the same piece of learning material. This leads to difficul-

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<sup>1</sup> A definition of how the systems handling metadata interoperate.

ties in the educational content chain<sup>2</sup>, as the present architecture is based on the principle of only one metadata record for each piece of learning material.

Based on these developments in the educational sector, TNO [1] and VKA [2] were asked by Kennisnet [3] to perform a study on this subject, and to provide Kennisnet with recommendations on changes to the present educational content chain making it able to handle multiple metadata streams and making the educational content chain more future-oriented.

Kennisnet is the foremost public knowledge centre regarding information and communication technologies (ICT) and education in the Netherlands. TNO is an applied scientific research company that applies scientific knowledge with the aim of strengthening the innovative power of industry and government. Verdonck, Klooster & Associates (VKA) is an independent consultancy company with extensive experience at the intersection of strategy, implementation and ICT in the public sector.

## 2 Present Educational Content Chain

Constant developments in society, and the need of the Netherlands to extend their competitive knowledge industry, lead to a need for changes in the Dutch educational sector. A major development in the educational sector is the need to educate people during their entire life; education does not stop anymore after obtaining a degree. The digital era provides huge possibilities to support lifelong learning, and furthermore the present generation of students has high expectations about the digital possibilities in education.

These developments lead to more flexible education, and therefore ask for new educational material: digital material. To ensure a good user experience, and to ensure interoperability and reusability of digital material there is a need for agreements. Kennisnet therefore developed an educational content chain to make agreements about the use of digital learning materials and to ensure interoperability, reusability and usability [4]. The educational content chain in the Netherlands consists of five major steps:

1. Developing (creating digital learning material)
2. Making available (placing material on the web and providing metadata)
3. Finding (searching in the central database)
4. Arranging (creating new material based on existing materials)
5. Using (using the material during courses)

These steps are often represented as a circle as the use of digital materials often leads to the development of new, or renewed, digital material.

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<sup>2</sup> The educational content chain consists of all users and suppliers that create, distribute, make available or use digital learning materials. This can for instance be publishers, schools, teachers, students, etc.

### 3 Present Content Chain Issues

The present content chain has implicitly been developed with only one main stream of provisioning (*authoritative [5]*) metadata information: the stream that from the suppliers of the learning material to the central database where all metadata is collected and which the users can use question to find learning material. As long as this assumption is valid, for each piece of learning material only one metadata record is provided and users searching the database will only find each piece of learning material once. Examples of these *single (authoritative [5]) metadata-stream* central search platforms are Edurep [6] in the Netherlands, the LRE [7] and the Spider project [8].

Recent developments though, show more and more sources providing complete metadata records, or supplying additional metadata to the original record. These new records lead to more than one metadata record in the central database for most of the learning materials. The availability of multiple metadata records for one piece of learning material in the present content chain makes it difficult for users to locate useable learning materials as the search results show one piece of learning material multiple times (once for each metadata record).

Furthermore these multiple records also have another effect: users cannot search in the richest metadata, resulting in not finding useable learning materials. Table 1 shows two metadata records for the same piece of learning material. If a user searches for 'Geography' as course, he will find the material. If he searches for 'Layer of the earth' he will also find the material. When a user searches for the combination of both keywords the present content chain will not return the material as the combination of the key words are not available in one metadata record.

**Table 1.** Multiple metadata records from different suppliers for one piece of learning material.

| Supplier | Course    | Key word           |
|----------|-----------|--------------------|
| A        | Geography | -                  |
| B        | -         | Layer of the earth |

Based on the information available, the study [9] concluded that the two main issues of the present content chain are:

1. The present chain is incapable of handling multiple metadata streams
2. The present chain cannot link multiple metadata records that describe one piece of learning material

### 4 Roles of Users and Suppliers

The study showed that it is difficult to the characterize parties (people or organizations supplying learning materials and metadata). There is no such thing as a general publisher or a general user. Each party has different requirements and performs different roles, as has been argued in [10]. In this study six roles are defined [9]:

1. Suppliers: the expert creator/publisher of the learning material.
2. Prosumers: a consumer that also produces learning material.

3. Scouts: scouts locate learning material on the internet.
4. Enrichers: enrichers provide additional metadata for a specific target group.
5. Reviewers: reviewers review learning material for a specific target group
6. Users: a user that supplies metadata and/or reviews learning material for a specific target group

The needs of the roles are: suppliers, prosumers, and scouts want to provide metadata to make the learning material findable. Enrichers, reviewers and users want to provide additional metadata to make the material more findable for specific target groups.

## 5 Desired Educational Content Chain

Based on the defined roles and their needs, a new architecture for the educational content chain was defined. In this architecture every role can provide the information they define or have present. Figure 2 presents the old and new architecture. The new architecture includes everything that is in the figure; the old architecture has the same structure, but only consists of the roles and records that are marked in a grey. On the left side of the figure the different roles are represented. The different roles are divided into three groups to give the users of the search engine the possibility to make a distinction while searching. Because of the distinction in three groups, users have the possibility to search only in metadata records provided by the source of the learning material. Each group has its own contact point at the central search platform (Edurep [6] in the Netherlands) to make the distinction described possible. On the right side of the figure the users that search for materials are represented.

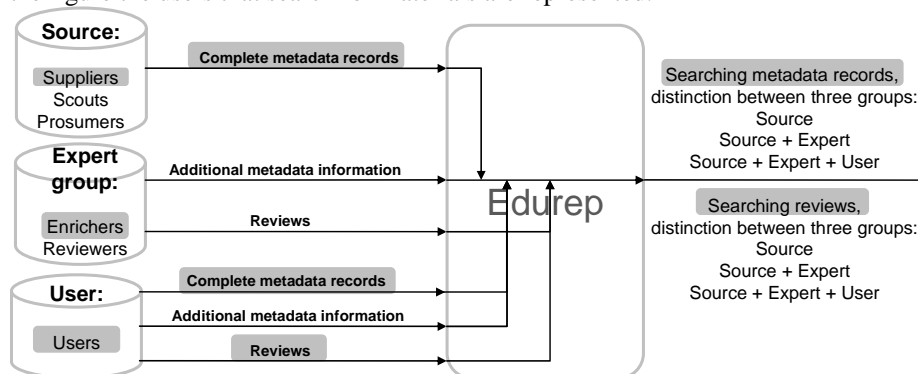


Fig. 1. Old and new architecture of the Dutch educational content chain

## 6 Recommendations

To be able to create the new architecture as described in section 4, it is necessary to make some changes to the present educational content chain. The most important rec-

ommendation that was defined is: “Ensure that each piece of learning material has a unique identifier, and ensure that the user can search in the richest metadata information (a combination of all available metadata information) available” [9].

By ensuring that each piece of learning material has a unique identifier, it is possible to reference different metadata records that apply to the same piece of learning material. If these references can be made by the central database, it is possible to search in the richest metadata possible. It is furthermore possible to combine multiple pieces of metadata to create the best set of metadata for one piece of learning material. To ensure unique identifiers for each piece of learning material, agreements have to be made on how to generate unique identifiers. The suggestion made in the study is to use a formal URN (Uniform Resource Name) [11] as the unique identifier for the learning material. Kennisnet could apply for a formal URN to be used in the Netherlands, and could supply each provider of learning materials with its own unique number. The combination of the URN, the unique code for the provider and a unique number to be defined by the provider of the piece of learning material ensures that each piece of learning material has a unique identifier.

Furthermore, two other recommendations have been defined based on the study: “Ensure that the educational content chain is managed” & “Provide a service to add additional metadata”. The first recommendation is important since the management of the content chain is currently not explicitly defined. The second recommendation is important to ensure that all roles defined have the possibility to provide metadata. Most roles already have some kind of tooling available, but f.e. for enhancers and reviewers, no tooling is available.

## References

1. TNO, <http://www.tno.nl>
2. VKA, <http://www.vka.nl>
3. Kennisnet, <http://www.kennisnet.nl>
4. Kennisnet Educational Content Chain, <http://contentketen.kennisnet.nl>
5. Recker, M. & Wiley, D.A.: A non-authoritative educational metadata ontology for filtering and recommending learning objects. In: *Journal of Interactive Learning Environments*, pp. 255-271, Taylor & Francis, London (2001)
6. Edurep, <http://edurep.kennisnet.nl>
7. Massart, D.: Towards a pan-european learning resource exchange infrastructure. *Lecture Notes in Computer Science 5831/2009*, pp. 121-132, Springer-Verlag, Berlin (2009)
8. Paulsson, F.: Connecting Learning Object Repositories: Strategies, Technologies and Issues. In: *2009 Fourth International Conference on Internet and Web Applications and Services*, pp. 583-589, IEEE Press, New York (2009)
9. Roes, J., Verbeij, N., van Vuuren, J.: *Adviesrapportage metadatastromen*. Kennisnet, Zoetermeer (2010)
10. Manouselis, N., Sampson, D.: Learning Resources Brokerage Systems: An Agent-Based Virtual Market Model. In: *Third IEEE International Conference on Advanced Learning Technologies*, pp. 424, IEEE Press, New York (2003)
11. IANA URN namespaces, <http://www.iana.org/assignments/urn-namespaces/>