Description of Accessible Learning Resources by Using Metadata

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Abstract: This paper presents IMS Access for All v3.0 specification, which main objective is to simplify the definition of the accessibility metadata for learning objects and the preferences and needs of the users of these objects, thereby achieving an inclusive learning process. The AfAPad tool has been created for helping the accessible content creators to complete the set of specification's accessibility metadata and to create the XML files that represent them. This tool also helps users to create their XML files with the preferences and needs metadata. This tool has been developed by the authors at the University of Alcala (Spain) in the field of project ESVIAL. This paper exposes the practical steps to be followed by a content creator to perform an accessible training activity, explaining the specifications and standards that can be used and the necessary tools.

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1 INTRODUCTION

The first public reference to the accessibility concept emerged in 1974 in the Expert Group Meeting on Barrier-Free Design in New York (Arjona, 2012), where disabilities that restrict the free movement of people were highlighted. Since then evolution in this field has been slow and uneven across countries, having spent 40 years without reaching the expected inclusion, in general, and in education, in particular.

Online learning has many advantages over traditional learning, being the most important the possibility of access by those people who, due to their different type of access to information, are deprived of it.

The information held in an online educative course is divided or organized into smaller units, so that it can be easily published for a better understanding. Each of these parts is a learning object (LO).

LOs have some metadata associated, so that they can be reusable through Internet searches. The literal meaning of metadata is "data over data" and its function is to describe a LO's characteristic. LOs, besides regular metadata, must have associated accessibility metadata that describe their accessibility characteristics and that make them accessible to all people. These metadata are the fields used for searching LOs.

This paper presents the technical process necessary to enable content authors the creation of accessible LOs based on IMS Access For All v3.0 specification (IMS, 2012) throw the inclusion of accessibility metadata into LOs. The authors have developed the AfAPad tool which helps in these tasks.

2 LEARNING OBJECTS

LOs are the minimum unit in which educational content is organized. To enable LOs searches and that they can be reused by different people and in different training activities, they must be described by including their metadata, which are a set of fields that provide information about the LO such as, for example, its identifier, the language in which it is written or its scope.

There are some specifications and standards commonly used, such as Dublin Core (DC, 2013) or LOM (LOM, 2002), which indicate what metadata or metainformation should be inserted in LOs for a correct description of these.

One way to facilitate the search and therefore their reuse is to store them in repositories, which are places where learning objects' storing and searching operations are provided. Searches are performed based on their metadata, hence the importance of clearly and correctly describing the resources, which provides more precise searches.

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When users need to perform a training activity they use these repositories to find the learning objects that better adapt to that training, thus drawing up a new course from the learning objects found in the repository or repositories to they can access.

Metadata should be inserted in a XML (eXtensible Markup Language) file (W3C, 2008), composed of each of the fields (each field corresponds to a metadata) described following one of the standards published for this purpose such as, for example, LOM (Learning Object Metadata) (LOM, 2002). This work is provided by metadata editors such as, for example, LomPad, known for being one of the most used (Licef, 2004).

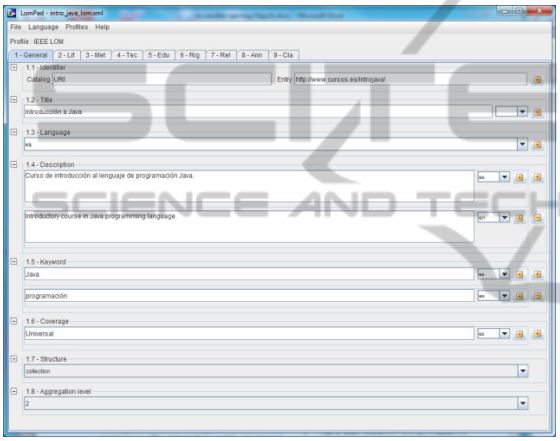

Figure 1: LomPad Editor.

As shown in Figure 1, the LomPad editor allows completing the LOM specification fields. Once all data have been inserted, a XML file containing all information is generated.

The process for sharing content and distributing it among different information systems is to pack it in a compressed file composed of the content and metadata that describe it. In this scope there are two specifications widely used, such as SCORM (Sharable Content Object Reference Model) (SCORM, 2009) and IMS Common Cartridge (IMS, 2009). Just as there are editors to help content authors to describe the metadata, there are also editors that help to pack this content along with metadata. One of the most known editors is Reload Editor (Reload, 2013).

3 IMS ACCESS FOR ALL (AfA) V3.0

IMS AfA v3.0 specification is created with the aim of simplifying the ISO/IEC 24751 standard (ISO/IEC 24751-1-2-3, 2008) due to the difficulties encountered when putting it into practice. Both standard and specification in version 3.0 cover the entire process from reading the user needs to the search mechanism needed to find the LO that meets those needs or preferences.

It has two data models to describe:

- Personal Needs and Preferences (PNP): Description model of the users' needs and preferences to access and interact with the digital resources.
- Digital Resource Description (DRD): Description model of the accessibility metadata for the digital training resources.

AfA PNP aims to provide a way forward for the personal needs of the students (or those due to disability environments) are satisfied. It presents a method for expressing the user's PNPs and lets their reading in an automated manner, all with respect to the digital learning. AfA PNP can be used independently, for example, to import or export the user's PNP to other educational systems, or in combination with AfA DRD to deliver digital resources that meet the needs and/or preferences of a user.

3.1 Digital Resource Description (DRD)

AfA DRD defines the accessibility metadata of a resource that will be used for searching and using the most adequate learning resource to each user according to his/her PNPs.

For LOs searches can be carried out, two types of LOs must exist: original and adapted. An original resource corresponds to an initial resource, while an adapted resource presents the same educational information than the initial or original resource. For example, a PDF format file as the original resource and an audio-description of its content as an adapted

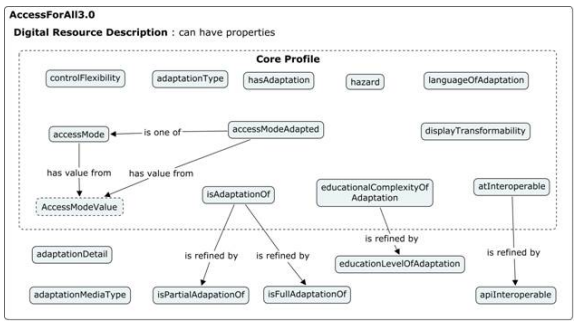

Figure 2: Digital Resource Description (DRD) properties.

resource. The first one presents textual access while the adaptation presents auditory access to the same educational content.

Original resources may have any number of adaptations, which may be total or partial, i.e., or they are adaptations of the whole educational content or they are just a part of this.

Figure 2 shows the accessibility properties or metadata of a resource and how they relate to each other, as IMS AfA v3.0 specification presents them. As seen in the figure, in order to simplify as much as possible the data model, the metadata have been organized in two clearly distinguished levels:

1 Those belonging to a basic core (core profile), containing the most important metadata, necessary for a proper description of the resource.
2 Those belonging to the full specification, which extent and complement the basic core information.

3.2 Personal Needs and Preferences (PNP)

The specification shows a common information model to define and describe the student's or user's PNPs with a different sensory perception mode or who is in a disability context.

The recommended method to generate the student's PNPs is the presentation of a form with various options (like aforementioned or preferred sensory mode). The PNPs will be generated from students' responses to these questions.

The declaration of PNPs is associated to one person. In turn one person can generate several sets of PNPs for being used in the environment he/she is at each moment (for example, in the dark or in a noisy area). Like any software application, user's

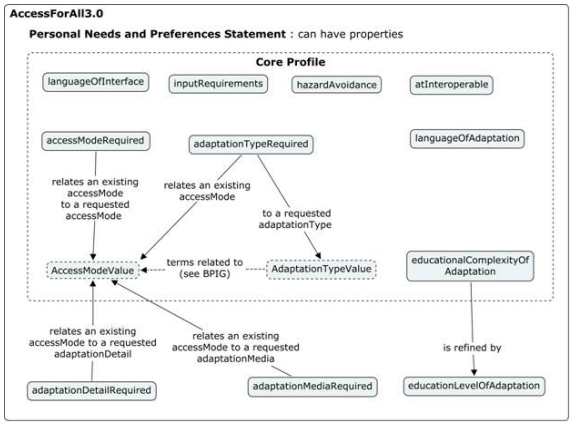

Figure 3: Personal Needs and Preferences (PNP) properties.

PNPs should be easily modified by editing the user profile and allowing its extension, replacement or removal.

Figure 3 shows the user's accessibility properties and how they relate to each other. In the same manner as AfA DRD specification, there are properties belonging to the basic profile (Core Profile) and those belonging to the full specification.

4 AfAPad TOOL

This section presents AfAPad tool, which has been developed from the need to create accessible LOs that allow an equal education without social discrimination and in order to cover the existing technological gap in the field of accessibility. This tool has been developed by the authors at the University of Alcala (Spain) in the field of project ESVIAL (ESVIAL, 2013), funded by the ALFA III program of the European Union. The objective of the project is to improve the accessibility of virtual higher education, through the creation and implementation of methodologies to establish a working model for compliance with accessibility requirements and standards in the context of virtual training, especially through web.

AfAPad allows the content authors and the learning platform users to insert accessibility metadata of LOs (DRDs) and students PNPs, respectively, generating both XML format files. This tool allows to complete the properties of DRDs and PNPs graphically and to generate the corresponding XML file following the IMS AfA v3.0 specification.

The tool shows all properties of DRDs and PNPs. The properties belonging to the Core Profile are highlighted in blue, and the other properties that cover the full specification are highlighted in black. The properties of IMS AfA may have two types of cardinality, [0..N] or [0..1], and being defined for a set of default values or having a free value. If a property has a cardinality [0..N] and a set of default values, the user has the possibility of choosing the values from a dropdown list. Once the values are selected, they will appear in a text field, separated by commas and in the same order they were selected. If the property has a cardinality [0..N] and a free value, the user can write different values in a text field separating each value with commas. Finally, if the cardinality is [0..1] a dropdown list is shown, which displays the metadata space values, where only one value can be chosen.

AfAPad tool has been developed as a desktop application in Java Swing and therefore it is portable

across platforms. The following section details its utilization.

4.1 Application Scenario

In this section a scenario of use of IMS AfA v3.0 specification is described, in addition to other e-learning specifications and standards previously explained, describing all stages for getting an accessible learning object.

Firstly, a content author plans to carry out a learning resource that contains a video tutorial (original resource) of an educational course. Two alternative content (adapted resources) are created to provide access to this course to the students with disabilities: on the one hand, an audio description (audio file that describes the images containing meaningful information) and on the other hand, an expanded text (text file containing an explanation about all the information presented by the video).

The content author uses LomPad or Reload to describe the LOM metadata of the video tutorial, thus describing the educational material so that it can be located and reused in different training activities.

Then it is necessary to include the accessibility metadata of the original resource, thus the type of sensorial perception is described, which is needed to understand the training content. As this is a video,

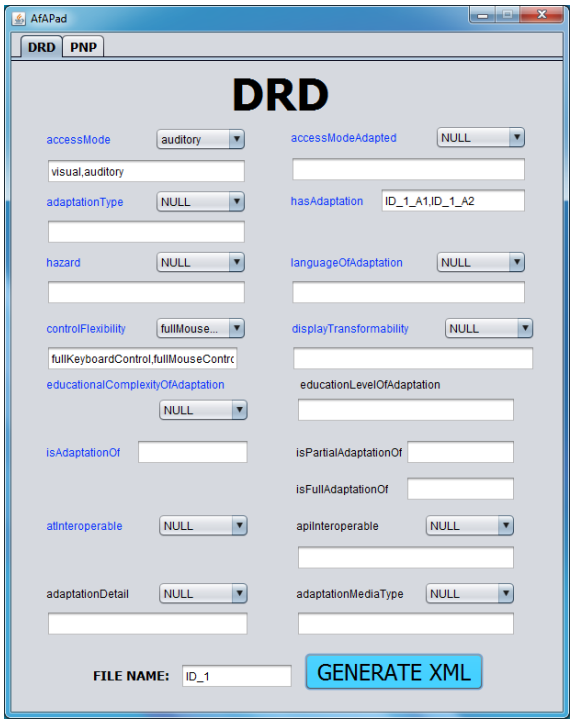

Figure 4: Original resource's DRD properties.

```
<?xml version="1.0" encoding="UTF-8"?>
- <accessForAllResource
xsi:schemaLocation="http://www.imsglobal.org/xsd/accessibility/afadrdv3p0/imsafav3p0drd_v1p0
imsafav3p0drd_v1p0.xsd" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns="http://www.imsglobal.org/xsd/accessibility/afadrdv3p0/imsafav3p0drd_v1p0">
    <accessMode>afaterms-visual</accessMode>
    <accessMode>afaterms-auditory</accessMode>
    <hasAdaptation>ID_1_A1</hasAdaptation>
    <hasAdaptation>ID_1_A2</hasAdaptation>
    <controlFlexibility>afaterms-fullKeyboardControl</controlFlexibility>
    <controlFlexibility>afaterms-fullMouseControl</controlFlexibility>
</accessForAllResource>
```

Figure 5: Original resource's DRD XML (afadrdv3p0_ID_1.xml).

both the visual and the auditory senses are needed. For inserting the accessibility metadata by following IMS AfA specification the author uses AfAPad tool as shown in Figure 4 and whose ultimate goal is to generate the XML file shown in Figure 5.

In the XML file generated, which is shown in Figure 5, it is described that the original resource has two access modes: visual and auditory, it has two adaptations: ID_1_A1 and ID_1_A2, and it can be controlled using the keyboard and mouse.

The following step will be creating the description for one of the adapted learning object, which contains the audio description. Using AfAPad the accessibility metadata are filled as shown in Figure 6 and generated the XML file shown in Figure 7.

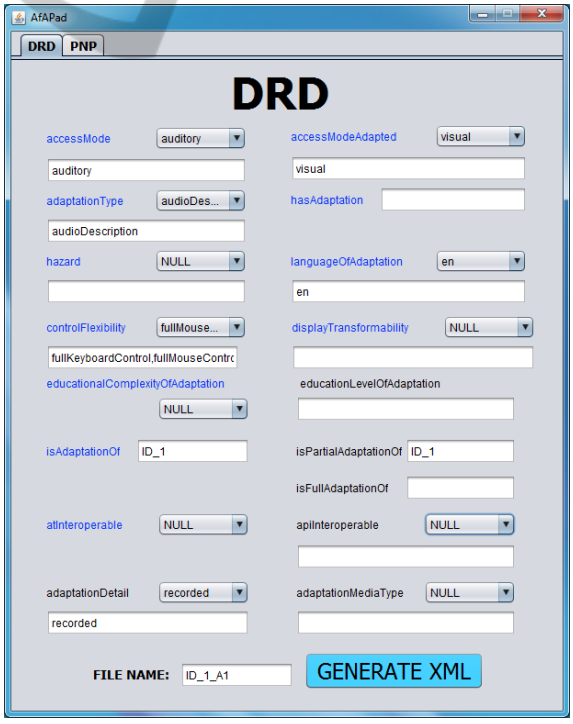

Figure 6: Adapted resource's A1 DRD properties.

In the XML file generated, which is shown in Figure 7, it is described that the adapted resource has an

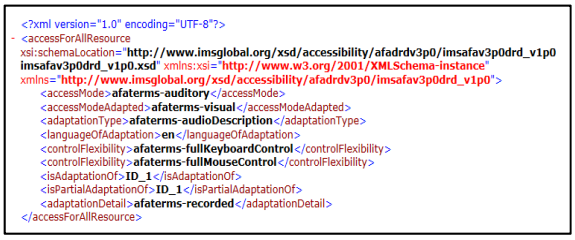

Figure 7: Adapted resource's A1 DRD XML (afadrdv3p0_ID_1_A1.xml).

auditory access mode and it adapts a visual one. More details about the type of adaptation are given through property "adaptationType" and it is specified that it is an audio description. It has full control by keyboard and mouse. It is an adaptation of the original resource ID_1 and it is a partial adaptation. Finally, it states that the audio is recorded using a human voice.

The same actions will be performed for the description of the expanded text's metadata and they are shown in Figure 8 and Figure 9.

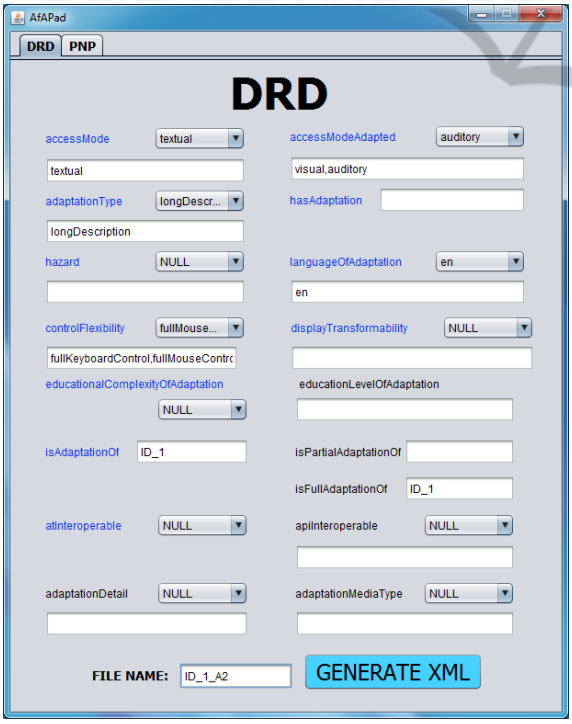

Figure 8: Adapted resource's A2 DRD properties.

In the XML file generated, which is shown in Figure 9, it is described that the adapted resource has a textual access mode and it adapts both, the visual and the auditory modes of the original resource. By means of property "adaptationType" more details about the type of adaptation are given and it

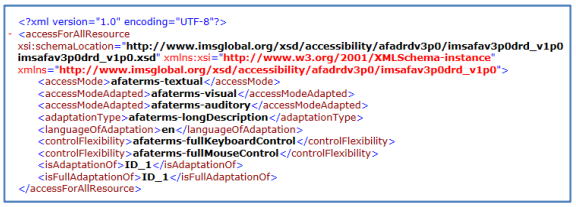

Figure 9: Adapted resource's A2 DRD XML (afadrdv3p0_ID_1_A2.xml).

specifies that it is a long description. It has full control by keyboard and mouse. It is an adaptation of the original resource ID_1 and it is a full adaptation.

Once the resources are created and the metadata are defined in their corresponding XML files, a package containing all information and following SCORM specification will be created. As shown in Figure 10, the SCORM package will be composed of three resources (the original and the two adaptations) and their metadata files. The original resource will have associated two metadata files, one with its LOM metadata and another one with the IMS AfA metadata. Adapted resources only need the IMS AfA metadata.

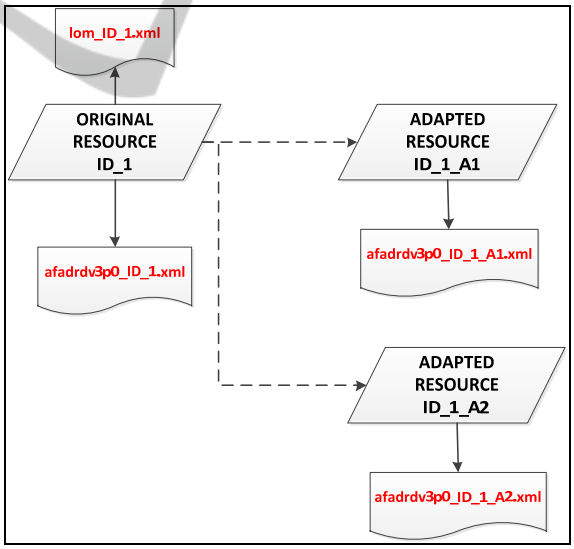

Figure 10: SCORM content.

Furthermore, AfAPad tool allows generating XML files containing the users' PNPs. For example, if a blind person wants to describe his/her preferences, he/she has to fill the metadata as shown in Figure 11 and generate the XML file shown in Figure 12.

In the XML file generated and shown in Figure 12 it is described that, for visual content, the user prefers adapted resources that have a textual or auditory access mode. By means of property

Figure 11: User PNP properties.

Figure 12: User PNP XML (afapnpv3p0_USR1.xml).

"adaptationTypeRequired", more details about the type of desired adaptation for visual content are given, and it is specified that they should contain audio and long descriptions. Finally, it is stated that for visual content enhanced content is preferred, for example, a video with a detailed audio description.

A learning system (educational platform, learning object repository, etc.) that is able to understand the PNP defined above and whose user is interested in learning the educational resource of the video tutorial which represents the original resource, should show the adaptations that are associated with it.

5 CONCLUSIONS

IMS AfA v3.0 specification presents to the content authors and developers the technical way to follow for achieving an accessible online teaching.

According to ISO/IEC 24751-2-3 standard and IMS AfA v3.0 specification, the basic steps in developing an accessible online course are: creating accessible LOs, both original and adapted, by means of inserting the accessibility metadata; reading the users' PNPs; and searching and presentation of LOs meeting those PNPs.

For a LO can be used in an educational platform it is necessary to pack all files shaping the LO with the files containing its metadata, including the accessibility ones, and following the standards established.

There is a great lack of technical applications and human resources to provide assistance in developing accessible resources.

The AfAPad tool developed by the authors avoids the standstill of the process of creating accessible LOs in the absence of similar tools to perform this task.

The usefulness of AfAPad tool will make more sense in future work, already scheduled, consistent in adapting learning platforms that are able to interpret and read the file generated by the tool and conclude the whole process of searching accessible LOs.

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