

## Considering Student Personal Needs and Preferences and Accessible Learning Objects to Adapt Moodle Learning Platform

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### Abstract

This paper provides information about the standards that govern accessibility of learning objects, presents an example of an accessible learning object and shows the procedure to operate the Moodle learning platform which has been adapted by the authors to the preferences and needs of the students. The way to operate the Moodle adapted platform takes place in three phases. In the first phase, the platform asks the students and stores in their profile their sensory preferences to access the information. In the second stage the content authors or teachers are provided with the possibility to upload adapted learning objects to the platform. In the third stage, it searches for adapted learning objects that best suit the needs and preferences of the students, showing them how to view and use.

**Keywords:** E-learning, Accessibility, Metadata, Learning Object, Personal Needs and Preferences, Digital Resource Description.

### 1. Introduction

Accessibility is an unresolved subject in our society. Seale and Cooper [13] show the limited success of accessibility of some specific tools and mention the possibility of a mix approach in the use of specific accessibility tools and general pedagogical tools. Cooper [3], points out the need to consider the personal needs of the student, conducted by the Open University in order to provide access to information to students who possess some type of disability in higher education. Other authors such as Karampiperis and Sampson [12] also stress the need. Today there is still no clear solution.

An Accessible Learning Object (ALO) is one that consists of an original Learning Object (LO) and other adapted LOs presenting the same intellectual content but a different sensory form of access (sight, hearing or touch) to content, where each LO must have associated the accessibility metadata specified in the standards.

In section 2 we describe the developed projects related with accessibility in education. Section 3 shows both the standard in which it is based, and the example of ALO that we have chosen. Section 4 describes the three phases which must take place in order the students are able to access the information. Finally in section 5 we present the conclusions.

## 2. Related Works

Three projects are presented in this section, in which, in one way or another, it has worked on accessible learning: TILE (The Inclusive Learning Exchange) [14], EU4ALL (European Unified Approach for Accessible Lifelong Learning) [6] and Xerte [15].

TILE is a repository of accessible learning objects that provides authoring tools and allows the users to define their needs and preferences. The project was developed in 2004 to be implemented in a network of learning communities in different sectors in Canada.

In a comparative way with our application, the TILE project allows searching for ALOs in a specific repository and download, while the plug-in that we present is embedded in a learning platform where ALOs are part of an online training course in a particular area and where you can perform different activities with ALOs in order to get a high learning level and quality assessment.

The EU4ALL project was developed by 13 countries within the Sixth Framework Programme of the European Union. It lasted four years ending in 2011. Its objective was to improve the efficiency and effectiveness of learning strategies in the field of universities and institutions for people with disabilities. The project is based on accessibility standards such as ISO / IEC 24751-1-2-3 "Individualized adaptability and accessibility in e-learning in education and training" [9]. In the same way as in the previous project, the Personal Needs and Preferences (PNP) of users were taken into account for access to information. Boticario et al. [2] and Cooper & Heath [4] provide wide information of the followed process.

In order to start our work from the achievements of this project, we have been in touch with some of the people responsible for LOs and software architecture areas of the EU4ALL project. To solve possible problems of "bottlenecks" in the flow information that can be caused by complex software architecture, a simple structure has been designed. The IMS Global Access For All (AFA) 3.0 of 2012 [8] specification has been followed to facilitate the construction of ALOs and save the current obstacle posed by the lack of ALOs generation by content authors. The IMS Global AFA 3.0 specification makes the creating learning objects easier since it summarizes the ISO / IEC 24751 standard, which presents a difficult start-up for both content authors and programmers due to the complexity of data models presented.

Xerte is a free tool created by the University of Nottingham to develop accessible interactive LOs based on Flash and Internet Explorer and following the SCORM standard. The tool has been created in collaboration with JISC TechDis [11] a UK advisory service on technologies for the inclusion of working in the field of teaching and learning in higher education in the UK.

The plug-in, that we present, allows the teacher and the content authors to upload in the learning platform an original LO and the adapted LOs for use. Furthermore it allows them to upload a compressed file containing a previously created ALO (a file with the original LO, the adapted LOs and XML files with the metadata for each LO). Therefore within the plug-in functionality there is the uploading and use of those ALOs developed with Xerte tool.

Because of the above problems, so far we know of no adaptable learning platform, which is capable of uploading ALOs. To get this utility for the Moodle learning platform, a plug-in software (starting from zero) has been developed within the framework of ESVI-AL (Virtual Inclusive Higher Education in Latin America) [5] project, which allows the student ALOs use. The application is based on both the simplicity of design and the AFA IMS v3.0 specification. It consists of a basic application that runs efficiently and has been conceived and designed to facilitate their growth easily by including new accessibility metadata, that accommodate new types of functional diversity.

### 3. Accessible Learning Objects for Students

#### 3.1. Standard on which is Based

There are numerous standards that seek to guide and direct accessibility in education [7], but there are two [8, 9] that emphasize the role model for adapting an educational platform, which will be shown in this section.

The ISO / IEC standard 24751, regulates how to develop an Accessible Learning Object (ALO). The procedure presented by the standard, to achieve an ALO consists of three phases.

In the first phase the student, at the time of signing up for the learning platform, introduces his or her sensory access preferences to the ALOs. These preferences may be due both to personal characteristics (information access through sight, hearing, etc.) or the characteristics of the environment (dimly lit or a noisy room). The actors in this phase are both the student, who select his or her preferences, and the learning platform which has been reprogrammed through the plug-in, so as to provide the student with the creation of a profile based on his or her preferences.

The second phase should be carried out by the authors of LOs, who, to make an ALO they should develop, in addition to the original LO, several adapted LOs to the original LO. The adapted LOs should contain all or part of the intellectual content, but different format to the original LO [1], to enable the access to information to people not using all the senses. For example the previously mentioned video as an original resource, can accept captions and audio-description as adapted LOs. The captions are an alternative to the hearing part of the video and they are aimed at people who use the sight and may not use the ear as access mode. The audio-description is an alternative to the visual part of the video and they are aimed at people whose access to information is performed through the ear. Furthermore, the authors of ALOs must enter, for each LO, the accessibility metadata established by the standard for this purpose. We highlight two important examples of accessibility metadata: the access mode of a resource (both original or adapted), which can take values as visual, auditory, textual, tactile, etc. and the type of adaptation of an adapted resource, which can take values as captions, audiodescription, alternativetext, signlanguage, transcript, etc. The actors in this second phase are the authors of ALOs, introducing resources and its metadata, and the learning platform which has been reprogrammed so as to allow the authors to enter all the referred data.

The third phase takes place after completion the previous two, when the student clicks on a LO. This phase is carried out only by the plug-in of the learning platform and involves the search and display of adapted learning resources, which best adapt the preferences the user has set in their profile.

Two data models have been defined by the ISO / IEC 24751 standard one for defining PNP students and another for Digital Resource Description (DRD), which includes all accessibility metadata of resources that will guide the most appropriate adapted LO search to the student profile. Due to the complexity of such data models and the difficulties encountered in previous projects for their implementation a draft of specifications, called IMS Global Access For All (AFA) 3.0, has been presented by IMS Global Learning Consortium. The draft of specifications includes the structure and organization of the process and summarizes data models proposed in the Standard ISO / IEC 24751.

#### 3.2. An Example: Learning to Program with Pointers

The ALO that we show is composed by a video as original LO, which teaches how to allocate dynamic memory in C Language using pointers. Sign language is shown as an adaptation.

##### Original Learning Object

As an example, a video is presented demonstrating the debugging process of a coded program in C Language using the integrated development environment Microsoft Visual C ++. The portion of code displayed corresponds to one of the functions of the program, which is in

charge of dynamic memory allocation to add a new item in a dynamic array of structures. The image in Figure 1 shows a time of the debugging sequence, that it allows to display the value of local variables of the function, in order to detect an executing error of the program. The video as a teaching resource has been created in an easy and intuitive way with the free tool Jing [10]. To receive all of the information displayed by the LO, visual and auditory access is required. The students without any or none of the two types of access will be deprived of information.

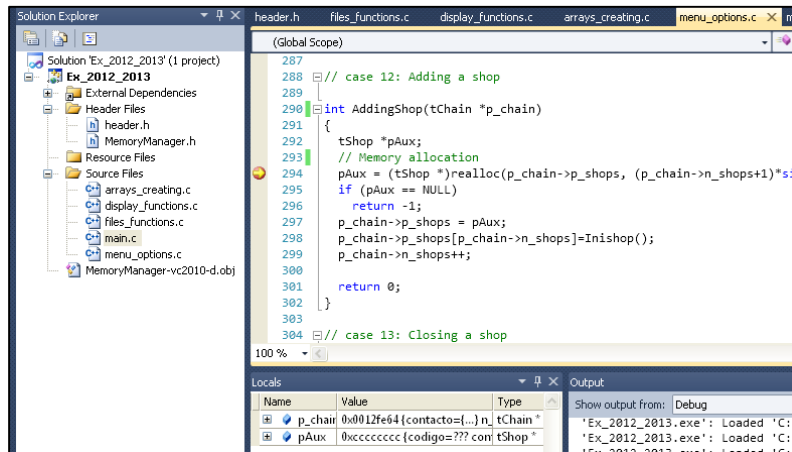


Fig. 1. Video as original learning object.

### Adapted Learning Objects

In order to provide access to the resource to every student, adapted LOs to the original LO, are required. To adapt the audio content of the video, this may include alternatives such as captions, long description, alternative text or sign language. The visual content of the video can be adapted by audio description. Furthermore, for the latter case, if the student has technical aids such as a screen reader, he or she can use adapted LOs whose access mode is textual, such as long description or alternative text, as they are read by the screen reader and automatically converted to audio.

Figure 2 shows the original LO to which it was added the adapted LO sign language.

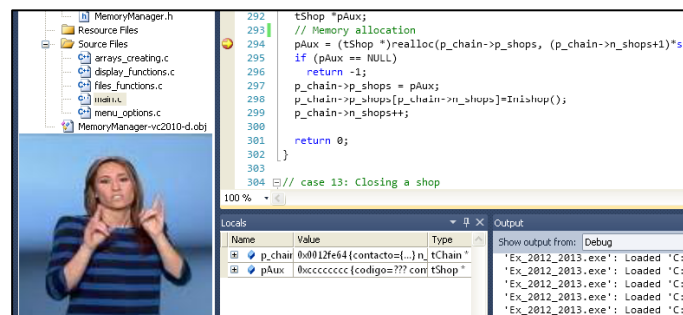


Fig. 2. Sig Language as adapted learning object.

## 4. Applying the Example to the Moodle Platform

To select an appropriate online learning platform an analysis of existing learning platforms to provide information about which one is most effective and has greater projection is required. In this regard, the work done in the ESVI-AL project during the process of elaboration of a methodological guide for the implementation of accessible virtual curricular developments [5] has been adopted. A comparative study of the different platforms in the market has been carried out in chapter 9 of the guide, taking into account a wide range of factors. The study

concludes by selecting the Moodle platform such as presenting a greater number of advantages. Considering the results of this study, a plug-in for the Moodle platform has been programmed by us, which performs all the tasks outlined above. Because of the lack of adaptable learning resources and applications in the field of accessibility, the plug-in, initially has focused on the efficient development and implementation of a basic application that serves as an impetus for new enlargement proposals, and new accessibility metadata covering a wider diversity of access to information.

The plug-in, programmed in PHP, relies on a database, programmed in MySQL, that stores both student PNPs and ALOs (which include the original and adapted resources and its DRDs). It is possible to communicate the database from the learning platform Moodle and also by Web from any LOs.

The next sections describe the three necessary stages to operate the adapted platform.

#### 4.1. Phase 1: Configuring the Students PNPs

Figure 3 shows the Phase 1 which includes the introduction of the student PNPs at the time of first access to the platform. In the example the student has selected as sensory access modes, the textual and visual modes and as preferred or required adaptation types, at least selected, as shown in the picture, high contrast, long description, sign language and transcript; everything which corresponds to the profile of a person with hearing problems. In addition, the selection of English and Spanish languages indicates that LOs will be selected only in these languages. Finally, the student indicated a risk of convulsion with elements that produce flash on the screen. Furthermore, the system is capable of importing PNPs from other systems or learning platforms.

Fig. 3. 1 Student PNPs configuration.

#### 4.2. Phase 2: Adding Access For All Resources

To perform phase 2, the plug-in allows upload in the learning platform the original LO and its adapted LOs, offering in the Add Resources menu a new option called AFA Resource (as shown in Figure 4) in order to add to the platform one new type of AFA resource.

Fig. 4. Window to add an AFA resource.

Furthermore it shows the necessary menus to add the essential accessibility metadata to search the adapted LO that meets the requirements of the student PNPs. A button allowing the teacher or contents author to enter the rest of accessibility metadata is also shown.

Once added the original AFA resource and its DRD, it is possible to upload the adapted LOs to the original LO and its DRDs (Figure 5). Those metadata that are not introduced by the author of content, they will be filled automatically by the plug-in following the logic that is appropriate based on the available information.

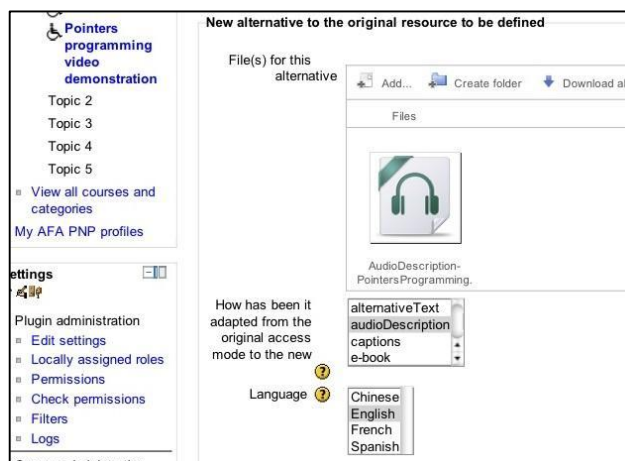


Fig. 5. Introducing metadata to the audio description.

Table 1 shows the accessibility metadata that have been configured for the original video and two of the adapted LOs example shown (sign language and long description).

Table 1. Accessibility metadata for shown ALO.

Metadata	Video	Sign Language	Long description
AccessMode	Visual, Auditory	Visual	Textual
HasAdaptation	ID_1.1, ID_1.2		
ControlFlexibility	FullMouseControl	FullMouseControl	FullMouseControl
DisplayTransformability	Layout	Layout	
Hazard			
AtInteroperable	False	False	False
ApiInteroperable			
IsAdaptationOf		ID_1	ID_1
IsPartialAdaptationOf		ID_1	ID_1
IsFullAdaptationOf			
AdaptationType		SignLanguage	LongDescription
AccessModeAdapted		Suditory	Visual
AdaptationDetail		RealTime	
AdaptationMediaType			PDF
LanguageOfAdaptation			English
EducationalComplexityOfAdaptation			
EducationalLevelOfAdaptation		4	4

After entering the metadata, they are stored in XML files. Figure 6 shows a part of the XML file of accessibility metadata for captions as adapted LO of the video. LOs can be downloaded from the platform in a zip package that includes the XML file with the metadata

resource (original or adapted), and the file containing the LO (pdf, video, etc), so they can be reused in other systems as repositories or other learning platforms.

```
<accessForAllResource xmlns="http://www.imsglobal.org/xsd/accessibili
  <accessMode>afaterms-textual</accessMode>
  <accessModeAdapted>afaterms-auditory</accessModeAdapted>
  <adaptationType>afaterms-captions</adaptationType>
  <hazard>afaterms-flashing</hazard>
  <languageOfAdaptation>es</languageOfAdaptation>
  <controlFlexibility>afaterms-fullMouseControl</controlFlexibi
```

Fig. 6. XML file of accessibility metadata for captions.

### 4.3. Phase 3: Accessing to the Accessible Learning Objects

Phase 3 begins when the student clicks on the original LO, and involves the search by the plug-in, between existing adaptations to the original LO selected, of those adaptations that are appropriate to the student PNPs. Once found, they are displayed on the screen in order to be downloaded by students. In our example the introduced PNPs are textual and the visual access modes preferred. In addition to this, we have introduced three adapted LOs to the video: sign language, audio description and long description. Sign language is shown in figure 7 as the adapted resource found in the search, which meets the PNPs. At the end, the plug-in presents the rest of the adapted LOs that they not meet the student PNPs.

**AFA Resource selected: Pointers prog. video**

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Here is the alternative(s) found based on your active personal needs & preferences

**Pointers prog video - Download**  
 Access mode for these files: auditory  
 Access mode for these files: visual  
 Language: English

**Pointers prog\_SignLanguage - Download**  
 Access mode for these files: visual  
 Access mode of the original resource that is adapted: auditory  
 How has been it adapted from the original access mode to the new: signLanguage  
 Language: English

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Other alternatives to this resource found in the AFA central

Name	Language

Fig.7. Adapted LOs that meet the student PNPs.

## 5. Conclusions

Accessibility is an unsolved problem, which produces marginalization and social exclusion at all levels, especially at the level of education.

To solve the problem, we have developed a plug-in that runs on three phases: introduction of the student PNPs, ALOs creation by the authors of content and instructors, and search for the adapted LOs, which meet the student PNPs.

The simple design of the elaborated plug-in allows an efficient implementation of the adapted learning platform and an easy portability to other platforms for learning and storage of LOs.

The reduction of data models that we have followed, which is presented by the IMS AFA 3.0 specification, it facilitates both the programming of the application and the creation of ALOs by the content's authors and teachers.

The software structure of the plug-in allows for an easy extension at a later stage through the introduction of new accessibility metadata and based on the experience of its use.

Through this application the students with functional diversity will be able to access the learning material. Nevertheless there is a lack of adaptations of learning objects that must be solved by Public Institutions since funding is required for their development.

There is a wide range of degrees in functional diversity, which complicates the design of applications, building adaptations and difficult work since lacking specific data on which to rely.

### Future Works

The plug-in will be installed in a virtual campus under the project ESVI-AL. It will be used in 6 online courses. Each course will house 150 students with physical and sensory disabilities and will last for 30 hours.

The project is scheduled to begin a second phase, that building on the experience of this first phase, it will be expanded the functionality of the adapted platform, including new types of functional diversity.

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