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Research on standards supporting A2UN@: Adaptation and Accessibility for ALL in Higher Education

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Abstract. Currently there are many standards that impinge on accessibility issues regarding users' models, learning scenarios, interaction preferences, devices capabilities, metadata for specifying the delivery of any resource to meet users' needs, and software accessibility and usability. Each standard represents a different viewpoint with its own sets of goals and scope and it is difficult to understand the existing relationships between them. This paper gives an overview on the existing standards addressing accessibility, usability and adaptation issues in e-learning, and discusses their application to cope with the objectives of the A2UN@ project, which focuses on attending the accessibility and adaptation needs for ALL in Higher Education.

Keywords. Adaptation, Accessibility, e-Learning, Standards

Introduction

Higher education should be an accessible service to all to consider the specific needs of each student and to adapt their processes based on the context, environment, devices, competences, skills and individual abilities. Perhaps the above sounds utopian, but the truth is that it has begun to be realized. This statement comes from a state of consciousness of mankind in the problem of exclusion of some people to access, because of their disability, to information, services, products and places, the use of which was intended to be global in nature [1], and it reaffirms, when the efforts of universities, governments, standards bodies, corporations, foundations and non-profit organizations, are able to state that the term "accessibility" should be included in any human-oriented project [2].

Higher Education (HE) in the form of distance education on the Internet (e-learning) is one of the most promising and important solutions for addressing this problem (for instance, in Spain roughly 50% of students with disabilities choose the

distance learning mode [3]). On the other hand, the Information and Communications Technologies (ICT) play today an increasingly important role at HE supporting the e-learning process of students and professionals with specific needs, including those who have so-called disabilities. However, ICT used in e-learning are still not fully accessible for all. For this reason, European initiatives as well as national legislations promote and regulate actions to enable the conditions for everyone to take part in the information society by providing both, "services, procedures, and information in an accessible way for every person", and policies to create a society that is ready to technological changes in the time they occur. This is strongly related to de concept of life-long learning (LLL), that can be defined as the lifelong, lifewide, voluntary, and self-motivated pursuit of knowledge for either personal or professional reasons [4]. Accessibility is extremely relevant for the LLL paradigm, due to the evolution of human capabilities when ageing.

A2UN@ is a research project whose main objective is to analyze the possibility of developing a general ICT framework, which will be based on standards and user modelling, to support the development of the LLL services required to attend the accessibility and adaptation needs for ALL in Higher Education, with special attention to the diversity of requirements of adult and disabled learners.

This paper reflects the first results of an analysis of standards related to accessibility, usability and adaptability of e-learning in the context of the A2UN@ project. The next section provides a brief introduction to the aims and scope of A2UN@, with special attention to strategy of using standards. Section 2 provides a list of standards that are considered relevant to the project. Finally, section 3 discusses about the possibility of creating a standards based generic LLL model.

1. A2UN@: Accessibility and Adaptation for ALL in Higher Education

The project A2UN@ "Accessibility and Adaptation for ALL in Higher Education", is funded by the Spanish Ministry of Science and Innovation. It began on January 2009 and will last for 3 years. The project involves the National University of Distance Education (UNED) and the University of Girona (UdG), the UNED coordinates the project.

Its main goal is to build a general ICT framework to support the development of the LLL services required to attend the accessibility and adaptation needs for ALL in HE. To this end, the project has been structured through a series of work packages, including following areas: (1) standards supporting IT accessibility to learning objects and services, (2) user modelling and dynamic support, (3) adaptive and re-usable learning services and workflows, and (4) device modelling, adaptive user interfaces and negotiation strategies. Thus, the goal of this project is to detect, extend, interrelate, integrate and exploit as much as possible all these areas upon which a general, flexible, open, standard-based framework can be defined to support the development of the LLL paradigm.

The driving need to achieve interoperability at different levels of abstraction is the "wide variety of services, contents and devices in large information systems". This need is another challenge: to develop the required interoperable and layer-based infrastructure to facilitate the definition, development, deployment and evaluation of the services to be provided for supporting accessible and personalized learning in HE.

A2UN@ follows a strategy of active use of standards with the purpose of development his objectives. The open question is, “can international standards, in a dynamic global environment, meet the challenges of modern society, such as the implementation of LLL?”. Our initial hypothesis is affirmative and is based on two premises:

1. *Widespread use:* to ensure the success of a product, service or technology, it should be accepted, implemented and used by a large majority of people which it benefits. We believe that the use of international standards is an appropriate way to gather knowledge about a given topic with a sufficient level of representation of stakeholders.
2. *Starting point*: we intend not to reinvent the wheel. The use of standards is a good starting point for verifying and analyzing the knowledge gathered so far on a specific issue, and from this to try and improve it as much as possible.

Moreover, we believe that knowledge about a subject is dynamic and must be appropriate to the needs of mankind. Therefore, another objective of the project A2UN@ is to work actively in the extension and evolution of standards to reflect new findings [5].

2. Relevant standards for A2UN@

Here we present the first results of the analysis of standards that could support the development of A2UN@. We have structured this description into two sub-sections, the first one provides an overview of the chosen standards and criteria for their selection and the second one presents the analysis itself.

We have used as key sources of information the report on accessibility-related standards by Richard Hodgkinson for the Royal National Institute for de Blind [6], and the standards inventory in ISO/IEC FDTR 29138-2 [7].

2.1. Overview of standards

The choice of the following standards[1] has met the following criteria:

- They address some of the research areas covered by A2UN@.
- They are international guidelines or standards.
- They have a special emphasis on addressing accessibility and usability.

2.1.1. ETSI EG 202 116 V1.2.1 - design for all guidelines for ICT products and services [8]

This document gives guidance to ICT product and service designers on human factors issues; good human factors design practice, and relevant international and national standards. The guidelines are intended to encourage a "Design for All" approach so as to make products and services accessible to as many people as possible, including elderly people and persons with disabilities, without the need for adaptation or

[1] The standards are presented in alphabetical order according to their complete code.

specialized design. This document is applicable to ICT products with a user interface that are connectable to all kinds of fixed and mobile telecommunications networks.

2.1.2. ETSI draft ES 202 746 - User profile preferences and information [9]

This upcoming standard defines a set of user profile preference and information settings for deployment in ICT services and devices for use by ICT users and suppliers. The present document specifies: (a) objects including settings, values, operations and a lexicon of end user terms; (b) a rule definition language for defining functionality such as automatic modification of profiles.

Profile solutions within the scope of the present document are: (1) those provided for the primary benefit of the end-user; (2) those which the end-user has rights to manage the profile contents; (3) those where the end-user has the right to have a dialogue with the information owning stakeholder.

2.1.3. IEEE std. 1484.12.1-2002 - learning object metadata [10]

It is a multipart standard that specifies learning object metadata (LOM). In this standard a metadata instance for a learning object describes relevant characteristics of the object to which it applies. Such characteristics may be grouped in several categories: general, life-cycle, meta-metadata, educational, technical, rights, relation, annotation and classification.

2.1.4. IMS Learner Information Package Accessibility for LIP (IMS AccLIP) [11]

The Accessibility for LIP (Learning Information Package) defines two new sub-schemas for IMS LIP [12]. These two sub-schemas provide a means to specify accessibility preferences and learner accommodations. These preferences go beyond support for people with disabilities to include kinds of accessibility needs such as mobile computing, noisy environments, etc.

2.1.5. IMS AccessForAll Meta-data Specification (IMS AccMD)[13]

The AccessForAll Meta-data specification is intended to make it possible to identify resources that match a user's stated preferences or needs. These preferences or needs would be declared using the IMS Learner Information Package Accessibility for LIP specification. The needs and preferences addressed include alternative presentations of resources, alternative methods of controlling resources, alternative equivalents to the resources themselves and enhancements or supports required by the user. The specification provides a common language for identifying and describing the primary or default resource and equivalent alternatives for that resource.

2.1.6. IMS Guidelines for Developing Accessible Learning Applications (IMS GDALA) [14]

This specification provides a framework for the distributed learning community. This framework set the stage for what solutions exist, what the opportunities and possibilities are for implementing them, and the areas where more development and innovation are still needed in educational technologies to ensure education that is truly accessible to anyone, anytime, anywhere.

2.1.7. ISO 9241-110 - dialogue principles for human-system interaction [15]

This standard sets forth ergonomic design principles formulated in general terms (i.e. presented without reference to situations of use, application, environment or technology) and provides a framework for applying those principles to the analysis, design and evaluation of interactive systems. The principles are: suitability for the task, self-descriptiveness, conformity with user expectations, suitability for learning, controllability, error tolerance and suitability for individualization.

2.1.8. ISO 9241-129 - Guidance on software individualization [16]

This upcoming standard will contain ergonomic requirements and recommendations for software-based individualization of human-computer interactions. There are a variety of different basic individualization mechanisms, each of which can have different positive and negative effects on users. Individualization can result from customization (initiated intentionally by the user) and/or adaptation (initiated by the system). Individualization can result in a variety of changes to the user interface, depending on the particular individualization mechanisms involved. This standard will include guidance on:

1. determining where individualization is appropriate
2. selecting appropriate types of individualization mechanisms
3. using all types of individualization mechanisms
4. using specific types of individualization mechanisms
5. using combinations of different types of individualization mechanisms.

2.1.9. ISO 9241-151 – guidance on web user interfaces [17]

This standard provides recommendations and guidelines for the human-centred design of Web user interfaces to increase their usability. The standard is focused on four aspects of designing Web user interfaces: high-level design decisions and design strategy; content design; navigation and search; content presentation.

2.1.10. ISO 9241-171- guidance on software accessibility [18]

This standard provides requirements and recommendations for the design of accessible software. It is applicable to the accessibility of interactive systems and it addresses a wide range of software (e.g. office, web, learning support and library systems).

It promotes increased usability of systems for a wider range of users. While it does not cover the behaviour or requirements for assistive technologies (including assistive software), it addresses the use of assistive technologies as an integrated component of interactive systems.

2.1.11. ISO 9241-20 - accessibility guidelines for information/communication technology (ICT) equipment and services [19]

This standard provides general recommendations to improve the accessibility of ICT equipment and services. This document is intended to be used as a source for defining technology-specific requirements when designing accessible products. If a specific detailed standard exists on the equipment or service (such as software with ISO 9241-171), then users of this International Standard can also refer to that more specific standard.

2.1.12. ISO TR 22411 - Ergonomic data and guidelines for the application of ISO/IEC Guide 71 to products and services to address the needs of older persons and persons with disabilities [20]

This technical report is a support document applying ISO/IEC Guide 71 in addressing the needs of older persons and persons with disabilities in standards development. It provides ergonomics data and knowledge about human abilities — sensory, physical and cognitive — and allergies, as well as guidance on the accessible design of products, services and environments.

2.1.13. ISO/IEC 24751 - individualized adaptability and accessibility in e-learning, education and training [21]

This standard, divided into three parts (framework and reference model, "Access for all" personal needs and preferences for digital delivery and "Access for all" digital resource description), is based on the work developed by the IMS Global Consortium on AccessForAll Meta-data [22] and contains metadata for describing accessibility features of learning objects and for describing accessibility-related personal needs and preferences.

2.1.14. ISO/IEC 24752 Information technology -- User interfaces -- Universal remote console [23]

This multi-part standard facilitates operation of information and electronic products through remote and alternative interfaces and intelligent agents. It defines a framework of components that combine to enable remote user interfaces and remote control of network-accessible electronic devices and services through a universal remote console (URC). The goal of the URC technology is that every device or service can be accessed and controlled by any control device and user interface that fits the user's needs and preferences, using suitable input and output modalities and interaction mechanisms. In the standard, the devices and services that are to be controlled are referred to as "targets", and to the control devices and their user interfaces as "universal remote consoles".

2.1.15. ISO/IEC 24756 Framework for specifying a Common Access Profile (CAP) of needs and capabilities of users, systems and their environments [24]

This standard defines a framework for specifying a common access profile (CAP) of needs and capabilities of users, computing systems, and their environments, including access supported by assistive technologies. It provides a basis for identifying and dealing with accessibility issues across multiple platforms in a standardized manner. It can be used to evaluate the accessibility of existing systems in particular environments for particular users.

2.1.16. ISO/IEC FDTR 29138 Information technology -- Accessibility considerations for people with disabilities [7]

This upcoming technical report is divided into three parts. Part 1, *User Needs Summary*, identifies a collection of user needs of people with disabilities for standards developers to take into consideration when developing or revising their standards. These user needs are also useful for developers of information technology products and services

and for accessibility advocates to consider. Part 2, *Standards inventory*, identifies a collection of documents (which it refers to as standards even though they encompass more than traditional ISO and ISO/IEC standards) that provide guidance on meeting the needs of people with disabilities. Part 3, *Guidance on User Needs Mapping*, provides guidance on the mapping of the set of user needs with the provisions of a particular standard, technical report, or set of guidelines. It provides both basic guidance that should be used for all user needs mapping and optional guidance that may be added to the basic guidance.

2.1.17. W3C Composite Capability/Preferences Profile (CC/PP) [25][26]

A CC/PP profile is a description of device capabilities and user preferences. This is often referred to as a device's delivery context and can be used to guide the adaptation of content presented to that device. The Resource Description Framework (RDF) [27] is used to create profiles that describe user agent capabilities and preferences.

2.1.18. W3C – Web Accessibility Initiative recommendations [28]

These recommendations include accessibility guidelines for web content [29][30], user agents (browsers) [31] and authoring tools [32]. These are generally agreed to be the international reference concerning web accessibility.

2.2. Analysis of the standards

Once the standards were selected according to the above criteria, we decided to classify them to obtain a clearer picture of their scope. The criteria of classification in this case were two:

1. According to the *user orientation* [5], the standards may be:
    - User centred (U), they offer guidance on accessibility, design for all and general usability, from the viewpoint of the users of the product.
    - Developer centred (D), which are more technically oriented and provide technical solutions that developers can use to build products.
2. Depending on the *areas of modelling* that they address:
    - Content modelling (C)
    - User modelling (U)
    - Device modelling, including hardware and software (D)
    - Adaptation modelling (A)
    - User Interfaces modelling (UI)

The standards classification that addresses the accessibility, usability and adaptation in e-learning, according to the criteria of user orientation and areas of modelling, can be seen in Table 1. The results of this classification are covered by Table 2.

According to the results we can say that:

- There is a clear trend of the analyzed standards to guide their efforts towards the user and developer but rarely to both.
- There is a clear orientation towards addressing the user interface modelling and device modelling by the current usability and accessibility standards.

- The current user centred standards for usability and accessibility have a strong orientation towards addressing the user interfaces modelling and device modelling. It contrasts with their lack of support the user modelling and content modelling. The main reason for this is that they provide requirements from the viewpoint of the users and not technical solutions for the developers
- The current developer centred standards for usability and accessibility have a balanced orientation towards addressing the treated areas of modelling.

Table 1. Standards classification for A2UN@

Standard	User orientation		Addressing Areas of Modelling in A2UN@				
	U	D	C	U	D	A	UI
ETSI EG 202 116 V1.2.1	X				X		X
ETSI draft ES 202 746		X		X		X	
IEEE std. 1484.12.1-2002		X	X				
IMS AccLIP		X		X		X	
IMS AccMD		X	X			X	
IMS GDALA	X				X		
ISO 9241-110	X						X
ISO 9241-129	X			X		X	
ISO 9241-151	X		X				X
ISO 9241-171	X		X		X		X
ISO 9241-20	X				X		X
ISO TR 22411	X						X
ISO/IEC 24751		X	X	X		X	
ISO/IEC 24752		X			X		X
ISO/IEC 24756		X	X	X	X	X	X
ISO/IEC FDTR 29138	X					X	X
W3C CC/PP		X		X	X		
WAI-W3C	X	X	X		X		X

Table 2. Results of classification

Standards for areas of modelling	User centred standards for areas of modelling	Developer centred standards for areas of modelling
UI = 10	**UI = 8**	**U = 5**
D = 8	**D = 5**	**C = 5**
C = 7	C = 3	**A = 5**
A = 7	**A = 2**	**D = 4**
U = 6	**U = 1**	**UI = 3**

3. Conclusions and future work

There is a lack of standards that are oriented towards both users and developers and also addressing all areas of modelling treated. One of the expected results of the A2UN@ project is a standards-based conceptual model of LLL systems that meets that objective. Figure 1 shows an overview of the intended result.

The model should contain the basic elements of any LLL system , the relationships between those elements and, finally, the mappings between these elements and the corresponding requirements and recommendations from the existing standards. This is a difficult task, mainly due to two reasons.

Firstly, there are many conflicting standards that should be applied. For instance, in the Device Modelling area, there are at least 8 different standards applying to that issue, probably with different views.

Secondly, there are standards that apply to several areas. For instance, the user-oriented ISO 9241-20 standard applies to both device and user interface modelling.

In both cases there is a clear need for the model to provide a generic common vocabulary for describing LLL systems and their main components. And this common vocabulary should be designed to ease the development of mappings between the model and existing standards. We expect to have this model developed by the end of the second year of the A2UN@ project.

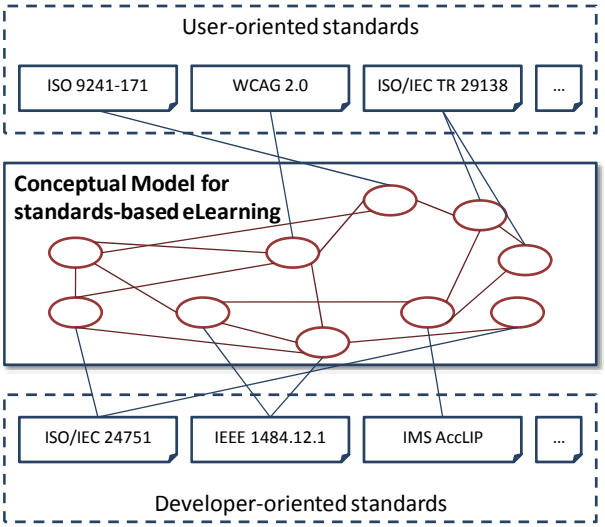

Figure 1. Model for LLL standards

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