A Boosting Approach to eContent Development for Learners with Special Needs

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ABSTRACT

Of late there has been a growing interest and effort toward meeting the requirements of persons with special needs. However, most of the accessibility standards and guidelines that have been proposed have been developed by adopting a domain independent and often 'technical' perspective. Such proposals are therefore often not sufficient to achieve accessibility goals in specific application areas such as eLearning. This paper presents a boosting approach/framework toward the development of more effective and usable accessibility indications for authors of didactic content, which are currently being fed and tested within the Italian context of the VICE project. This approach is intended to take into account the aforementioned issue and to make a step forward with respect to existing accessibility proposals and approaches in the eLearning domain. In particular, we discuss our design method for increasing the quality of eLearning materials for learners with special needs and an authoring tool, *aLearning*, to support eLearning content authors in their development of didactic material matching those needs.

Keywords

eLearning, Special needs, Accessibility, Guidelines, Didactical experts

1. Introduction

eLearning systems typically rely on repositories of online materials that are made available to learners and teachers for access, use or re-use. We have of late witnessed a growing commitment and effort toward providing universal access to online contents for meeting the requirements of persons with special needs, the objective being either to comply with national and international regulations on accessibility (PubbliAccesso, 2004; Section 508, 1973) or to expand the number of potential users that can take advantage of online resources.

However, most of standards and guidelines now available in the accessibility field (Caldwell et al., 2003; W3C, 2004) have been developed by adopting a domain independent perspective, which is sometimes insufficient to achieve accessibility goals in specific application areas, such as in the case of e-learning and the creation of eContent for people with special needs. Previous studies have shown that W3C guidelines are often more suited to ensure 'technical' aspects of accessibility (i.e., that a visual content is readable by a blind person through the support of assistive technologies, such as screen readers) rather than 'conceptual' ones, which are more related to the usability and quality of experience the disabled user is provided with when accessing that specific content (Di Blas et al., 2004).

In this paper we discuss a boosting approach aimed at supporting the usability and effectiveness of accessibility guidelines that eLearning authors could follow to generate appropriate materials for users with special needs (as well as to transform inaccessible contents into accessible one). This approach takes into account the issue mentioned in the foregoing paragraph and contributes to progress from existing accessibility proposals in the eLearning domain, by feeding and testing its ideas within a national project for the production and reuse of didactic material targeted at higher education and industrial contexts (VICE project, *Virtual Communities for Education*, CNR/MIUR Italy, http://www.progettovice.it). In particular, the contribution consists of: i) a design method/framework for increasing the quality of eLearning materials for learners with special needs, ii) an authoring tool, named *aLearning*, to investigate and fulfill usability requirements of eLearning content creators in their development of didactic material for learners with special needs. While acknowledging that the support accorded by the proposed authoring tool is not optimal for learners with special needs, the tool does provide a

guiding and supporting environment through which authors can realize eLearning materials of higher quality for those learners.

The rest of the paper is organized as follows: Section 2 comparatively introduces our approach by relating it to previous work in the field. In Section 3 we describe the design process and the main functionalities of a tool for supporting didactic authors in the creation of accessible eLearning content. In Section 4 we present our current plan and ongoing work for evaluating the tool and methodology developed, both in terms of its usability for authors and effectiveness in reaching accessibility goals. Section 5 contains our concluding remarks.

2. Related work

In recent years many recommendations for the design of accessible eLearning contents have been delivered by international standard organizations, as well as private educational initiatives worldwide (W3C, 2004; ADL, 2005; IMS, 2004; Hodgins & Duval, 2002). Among these we refer in particular to the efforts of NCAM, IMS Global Learning Consortium and California Community Colleges (Freed et al., 2003; IMS, 2002; CCC, 2000), for providing indications on how to create accessible learning material and raising awareness about the most appropriate approach to take when accomplishing this task. Their concern is not only that of achieving content accessibility, but they aim at showing how to address and preserve the didactical properties of eLearning resources when they are to be made accessible to learners with special needs.

However, it has previously been shown that indications in the form of guidelines can be very difficult to incorporate into the everyday design or authoring practice, especially by educators who do not have prior expertise on accessibility (Dix et al., 2003; Gabrielli et al., 2004). To tackle this issue, our recent work has been addressed towards investigating effective methods and tools to make accessibility guidelines more useful and usable to eLearning authors during the creation of accessible content (Mirabella et al., 2004; Gabrielli et al., 2004). This work is based on the assumption that, compliance of a specific web content to guidelines, as it might be assessed by the most commonly used accessibility checkers, e.g., Bobby, LiFT, A-Prompt (Bobby 2006; LiFT, 2006; A-Prompt, 2006), is not sufficient for eLearning material, since these tools mainly perform a syntactic assessment of web pages, but say very little about the adequacy of any equivalent-alternative contents created, to enable effective use of this materials by learners with special needs.

The approach we have adopted is not dissimilar from other relevant proposals found in the literature that support authors in creating directly the right (i.e., accessible) version of didactic material. An example is ATutor Content Editor (ATRC, 2006), part of a Learning Content Management System meant to support educators in a quick creation, reuse, packaging and distribution of web-based instructional materials. What is different in our work is the specific interest and focus on approaching the design of this type of systems from an experimental perspective. Specifically, we aim at developing an experimental prototype enabling a deeper analysis of authors usability requirements during the process of creating accessible content for learners with special needs (including different kinds of disabilities). By conducting a series of evaluation studies on the prototype use we intend to discover, and also propose solutions, to usability issues raised by the deployment of accessibility guidelines in the authoring practice. These findings will inform the current debate on how to effectively approach the design of eLearning contents when a wide range of disabilities (not only sensorial ones) is taken into account.

In a previous work (Mirabella et al., 2004) we have presented a *no-frills* methodology to guide didactical experts during the creation of accessible eLearning content, specifically customized for learners with special needs. This methodology is based on a first categorization of the types of disabilities or impairments for the potential learners. We also characterize the types of content that are critical when it comes to making the learning material accessible. Such an undertaking would be resourceful especially to the creator of the didactical contents (e.g., a lesson), who are usually not well acquainted with the issues or problems of accessibility. We then associate the realized categories of disabilities with the various types of critical content. At the point where a particular disability intersects with a particular critical content, we analyse the range of accessibility barriers and opportunities presented. In the process, we are better positioned to develop indications that could be resourceful especially to the creator of the didactical contents of the learning material. It is worth noting that such indications can guide in specifying alternative content that is characterized by matching the following requirements of being useful, appropriate and effective, where:

- Usefulness is closely related to the concept of necessity of the content. The objective is for an author to eliminate the contents that are not necessary, in order to increase the overall usability of the didactic modules, especially in the case in which alternative content types (or formats) have also been introduced.

- Appropriateness is related to the selection of the right contents while taking into account the characteristics and requirements of a certain type of disability.
- Effectiveness is related to the capacity of the didactic content to enabling the achievement of the learning goals.

In the rest of this section, we first discuss how we categorized the types of disabilities or impairments and the critical content types considered so far, as well as the relations between them. We then exemplify some possible applications of our proposed guidelines and *no-frills* methodology.

2.1 The disabilities, the contents and their critical relations

With critical learning resource types we refer to typical didactical contents (e.g., of an eLearning module) that can affect accessibility. For example a graph (but also a diagram, image or table) is a critical didactical content for people who present cognitive disabilities (such as dyslexia) because of problems with ordering and cluster identification, thus it is not accessible as it is. Several lists of didactical contents are reported by some of the most notable organizations involved in eLearning standardization and specifications.

The IEEE Learning Object Metadata (LOM) (LTSC, 2004) is one of the most comprehensive schemes developed for the description of Learning Objects. In the Educational section of the LOM, there is a list of Learning Resource Types including: exercise, simulation, questionnaire, diagram, figure, graph, index, slide, table, narrative text, exam, experiment, problem statement, self-assessment, and lecture.

We have partially adopted this list, in agreement with the opinion that "LOM allows this (the Learning Resource Types) element to be understood as designating types or formats of content, as well as potential uses of this content. Also, the values recommended by the LOM exclude many important types of content, and also exclude many educational applications of content" (CanCore, 2006). In our proposal we start with an investigation of only the elements from the LOM list that are both critical from an accessibility perspective and that are format independent.

We consider the following elements from the LOM proposal to be format dependent: exercise, simulation, questionnaire, exam, experiment, problem statement and self-assessment. Their format, in fact, can vary according to the different types of contents (images, text, tables, etc.) they may include. Moreover, we consider a slide and a lecture to be non-digital content with respect to the LOM definition. So far, our approach translates visual content to text and therefore, here, we do not list text and index as part of critical content.

Consequently, we focus on four types of critical didactical content from the LOM model: diagram, figure, graph, and table. We also consider another set of critical learning resource types which is derived from a list provided by the CPB/WGBH National Center for Accessible Media (NCAM). In (Freed et al., 2003), CPB/WGBH presents eight guidelines in relation with the same number of learning content types: images, multimedia, forms, tables, text-books, interactivity, graphs and math.

From the CPB/WGBH NCAM we investigate: multimedia and math/scientific expressions. We do not take into account forms because the kind of accessibility issues they present are more related with the format rather than with the semantic meaning of didactical content. We also exclude textbooks, since we assume they are in textual form, and interactivity, since it is not a kind of content. We are aware that multimedia contents present complex technical and pedagogical issues to be addressed for ensuring their accessibility. Initially, we have considered different media as aggregated in a same category (multimedia) to refer to their semantic meaning more than to their particular format. Our aim is to provide clear indications, for example, on how to create effective captions and audio descriptions for video contents typically employed as eLearning materials. More detailed analysis of different components of this category will be considered in our future work in compliance with related efforts in the field e.g., *Rich Media Accessibility* (NCAM, 2006).

The six elements selected above are then mapped and analysed in relation to the following main types of disabilities for potential learners: visual, hearing, motor, cognitive-language impairments. It is worth observing within each of these categories there are many variations and degrees of impairment that require specific strategies to be addressed. Also, there could be learners that exhibit more than one type of disability, like senior citizens having both sensorial and cognitive impairments. However, our current efforts are oriented toward providing didactic experts with a wide spectrum of indications supporting the removal of accessibility barriers from teaching materials for the main categories of disabilities that might be present in our target user population.

As an example, to improve the accessibility of a figure for learners with cognitive disabilities, we indicate how to provide significant alternative content that can properly explain that figure, possibly including a description of the overall meaning and contribute provided by that figure within the teaching material in which it is embedded.

For the needs of learners with motor impairments, we raise awareness and provide support to authors on how to make operations on mathematical and scientific expressions more easily accessible, since this type of learners may have difficulties in using input modalities, such as the mouse, to insert and modify symbols or strings, as well as to keep track of the content already inserted.

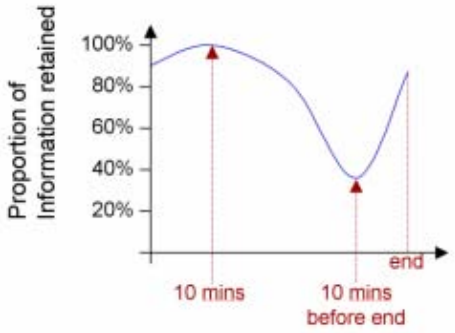
Table 1 which is adapted from (Mirabella et al., 2004) reports schematically the most relevant mappings identified between disabilities and type of content considered so far, which are also of particular relevance to the didactic materials currently dealt with in the VICE project.

Table 1: Relevant mappings between disability types and critical contents

	Type of Disabilities			
Type of Content	Visual	Hearing	Motor	Language/Cognitive
Diagram	•			•
Figure	•			•
Graph	•			•
Table	•			•
Multimedia	•	•	•	•
Math/scientific expression	•	•	•	•

1.3: Graphs
Enable the learner to enlarge the graph on the screen and to print it.
Provide a textual description of graphs or an equivalent audio version (for instance, by representing the curves of variables on the graph through audio tones).

In a textual description of the graph explain the main characteristics of the graph, like the relative position of the variables represented on the axes, their extension/measure, the aspect drawn by the curve.
Provide also a summary of the graph, including its title, the name of variables and range of values for each of them, that could be read by a screen reader. You can also recur to audio representation or text to speech.
To create an audio version of the graph, you might use audio tones to represent the increasing/decreasing trend of the curve or values of a variable. If more variables are to be represented you could say the name of each variable first, then use different tones for each of them.
…
Example



Textual Description of the Graph

- The graph shows the way a person will retain information throughout a typical training session. It shows that memory is good in retaining material at the beginning of the lesson, it tails off during the session to improve significantly towards the end of the lesson.
- The horizontal axis measures the time in minutes usually taken by a lesson. The vertical axis measures the percentage of information retained by the student.
- The curve starts with the lesson when the time value on axis X is zero. For the first 10 minutes after the beginning of the lesson, the percentage of information retained by the student increases from 90% and almost reaches 100%. Between the 10th minute after the beginning of the lesson and the 10th minute before the end of the lesson, the curve decreases rapidly reaching its minimum value of 40%. In the last 10 minutes of the lesson, the percentage of information retained by the student increases from 40% to reach almost 90%.

Figure 1: Example of Guideline for type of Content *Graph* w.r.t. *Visual* Disabilities

2.2 The guidelines and their application through the *no-frills* methodology

Guidelines were developed for each relevant mappings identified between critical contents and types of disabilities, as discussed in the previous section. They included detailed indications on how to create equivalent-alternative versions of inaccessible contents, as well as hands-on examples for authors on how to proceed during the repairing (Gabrielli et al., 2004; Mirabella et al., 2004). Fig. 1 below reports a selection of indications contained in the guideline developed for the type of content *Graph* w.r.t. *Visual* disabilities.

In practice, the guidelines are expected to support authors as they apply the *no-frills* methodology (Mirabella et al., 2004) in both cases in which: a) they are creating new didactic materials to be added to a content repository, b) to reuse already existing materials and transform them into accessible ones for learners with special needs. In particular, the *no-frills* methodology provides an avenue for guiding didactical experts in making the most of their didactical experience when choosing the necessary and alternative didactical content that can fit the requirements of disable learners. A brief description of the different actions an author should take while applying the no-frill methodology is provided below.

1. Initially, the method requires the categorization of the potential learners, in terms of disabilities or impairments for the specific didactical module considered.
2. The next step involves identifying the content types the didactical module is made of. For every type of content, the methodology analyses its impact on each of the categories of the learners in terms of physical accessibility (the learner can practically access the content) and logical accessibility (the learner can effectively access the content). In the first case, the focus is on accessibility as intended in a rather rigid sense, whereas in the second case, the focus is on accessibility related more to didactic effectiveness.
3. The third step involves exploiting opportunities for inserting alternative content that corresponds to the critical content under consideration for some category of learners. In particular, we consider that the didactic content may be considered as:
    a) optional, in which case the content is not essential to the realization of the module's objective;
    b) mandatory, in which case the content is essential or relevant to the realization of the module's objective. In the mandatory case, the didactic expert may also specify whether the level of accessibility is acceptable toward realizing the module's objective. If the accessibility level is not considered acceptable for accomplishing the objective, the didactic expert may decide whether to translate the content or substitute it with some other relevant alternative content better able to contribute to the realization of the same objective.

2.3 Main issues raised in the authoring practice

The guidelines and methodology proposed were initially tested with a small group of eLearning authors during a formative evaluation study that we conducted to assess the principle on which our approach is based (Gabrielli et al., 2004). The evaluation scenario involved five didactic experts who were asked to work individually at inspecting the contents of a Learning Object of the type used in the VICE repository, which consisted of 4 basic modules of material on computer science topics (European Computer Driving License material). These included a series both text and the collection of critical contents of the types mentioned above: figures, diagrams, graphs, tables, multimedia, and math/scientific expressions.

The main task didactical experts were asked to perform was to examine and to identify any content that might have been critical for disable learners (according to the categories reported in Table 1) and to make it accessible to them by following the accessibility guidelines and no-frills approach described above. These were made available in the authoring environment as indications contained within HTML page whose links inspectors could activate whenever required. Throughout the study, suggestions for alternative contents required were reported on paper protocols by the didactic experts, then transformed into digital format and added to the LO by the study moderator, so that subsequent participants had the opportunity of evaluating the appropriateness of the alternative content previously created by other authors. Didactic experts were asked to think aloud during their task performance (lasting approximately 30-45 minutes) and briefly interviewed at the end of the task to collect their impressions about the guidelines and methodology used, as well as about the difficulties raised during their application. As a result we observed that didactic experts found quite difficult and time demanding the translation or substitution of critical content with appropriate alternatives and accessible versions of it, especially when it involved the use of diagrams, graphs, tables and scientific-math expressions. Typically, experts used to develop and apply a limited but consistent set of 'translation' strategies throughout the whole duration of their activity (e.g., inserting textual description for visual contents), whilst elaboration of more original alternatives was rarely found (although indications in the guidelines were specifically prompting them to undertake this

option). Although this finding might be related to experts lack of familiarity with accessibility issues, it also highlighted the need for content creators to be better supported and trained, for instance by interface functionalities, in the acquisition of a specific expertise on accessibility. However, we derived from observations collected in this study that any accessibility support provided during such a task should not constrain authors' activity in a very prescriptive way, but enable flexible and creative use of the indications made available.

To achieve the design of this kind of support, we decided to develop a user-friendly interface for eLearning authors. This serves to present accessibility indications in a more interactive way and to enable authors a more intuitive and easier application of our *no-frills* methodology during the creation of accessible contents.

3. aLearning: Usable Presentation of Accessibility Guidelines

The experimental prototype we have designed is an accessibility interface we named *aLearning*. The main objective of the tool is to enable exploration of more usable presentation of accessibility guidelines in the context of eLearning content creation. The tool (developed in Java) is integrated into an application server which is a key component of the VICE architecture and provides also other functionalities, such as a metadata modeler and editor (Fig. 2). The application server is responsible of ensuring that the eLearning contents retrieved from the VICE repository are packetized into SCORM compliant LOs, to be then uploaded on Learning Management Systems, such as Atutor (ATRC, 2006) for instance, and presented as web-based courses.

The support provided by *aLearning* is also available in the case where authors decide to retrieve materials not originally created for users with special needs. This is not the approach generally recommended by the accessibility literature for generating high quality didactic contents, however it could bring some important advantages in specific eLearning contexts, such as costs and time savings in the production of the required materials. Initial investigations conducted during the user requirements analysis of the VICE project also reported authors increased willingness to work at transforming contents into accessibility ones in return of the possibility of reusing existing materials for the design of university courses.

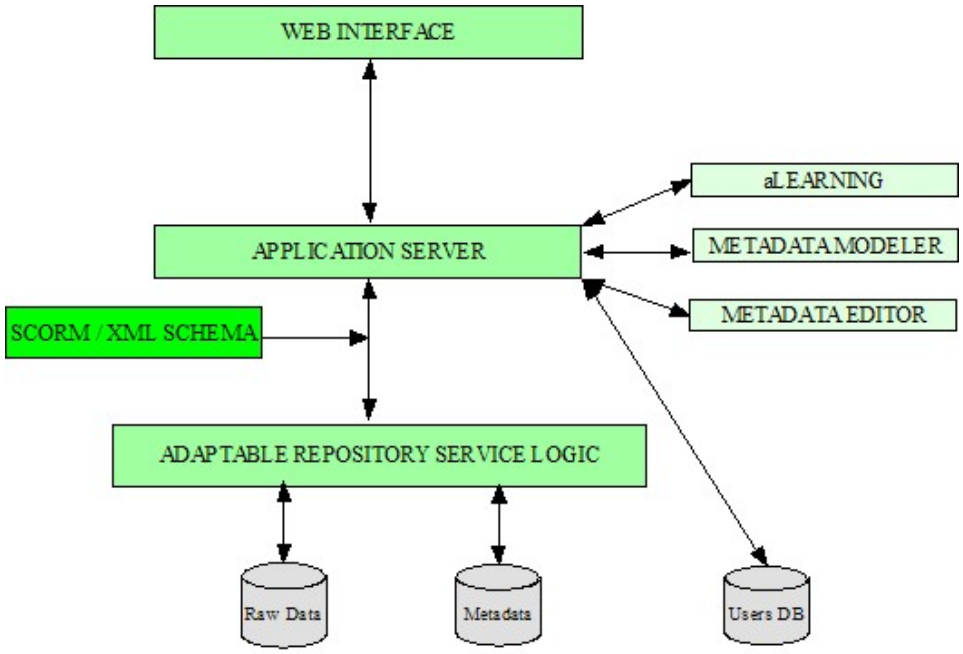


Figure 2: aLearning and the VICE architecture

A user-centred design approach was adopted to make *aLearning* interface intuitive to use even for authors without a specific expertise on accessibility and/or without a technical background. A main characteristic of the

tool is to facilitate the creation of accessible and usable eLearning contents by making automatic or semi-automatic the application of any technical step of our *no-frills* methodology that would not benefit from human intervention or expertise, such as the identification of critical contents within the eLearning material. However, the tool would prompt, inform and capitalize on authors' didactic knowledge and decision making when addressing the non-technical steps of the method (e.g., creating an alternative-equivalent version of the content). The design process went through a task analysis phase and a series of low-mid tech prototyping activities to develop the interface features required, that we briefly describe in the following.

3.1 Overview of *aLearning* Prototype

aLearning interface mainly supports authors by:

- Automatically identifying and marking any critical and inaccessible content within the eLearning material. For example, when a graphic file is detected (e.g., by detecting the file extension) the tool first asks the author to classify it as a diagram, figure, graph etc., then it presents all relevant guidelines to ensure accessibility of that content according to the category assigned by the author. In this way the authoring or repairing process performed on eLearning material is led by the consideration of didactically relevant categories of contents (such as diagrams, figures, graphs, ...), instead of the web related ones (like framesets, scripts, links, ...) typically used by common tools for accessibility checking and repairing (Bobby, 2006; LiFT, 2006; A-Prompt, 2006; NCAM, 2006).
- Enabling the author to select and start repairing a critical content (e.g., a graph) by choosing among three alternative modalities: i) directly clicking on the critical content as it is marked within the didactic module's pages that are displayed, ii) selecting that content from a category list of learning resources reported on a frame window, iii) starting a step-by-step repairing procedure for the whole sequence of inaccessible contents identified. These different modalities are expected to provide authors with more flexibility on how to complete the repairing process (also in terms of its timescale), differently from the file-by-file repairing process typically supported by other tools.
- Explaining to the user why a specific content is inaccessible, prompting the user to classify it as optional or mandatory for the objectives of the course (according to our *no-frills* methodology), supporting different ways of creating alternative versions of the content if it is mandatory, providing links to more detailed information (guidelines and examples) on how to create an appropriate alternative representation of it.

Fig. 3 below presents an example of how an author would be guided to check and repair the critical content *Graph* according to the guideline reported in section 2.

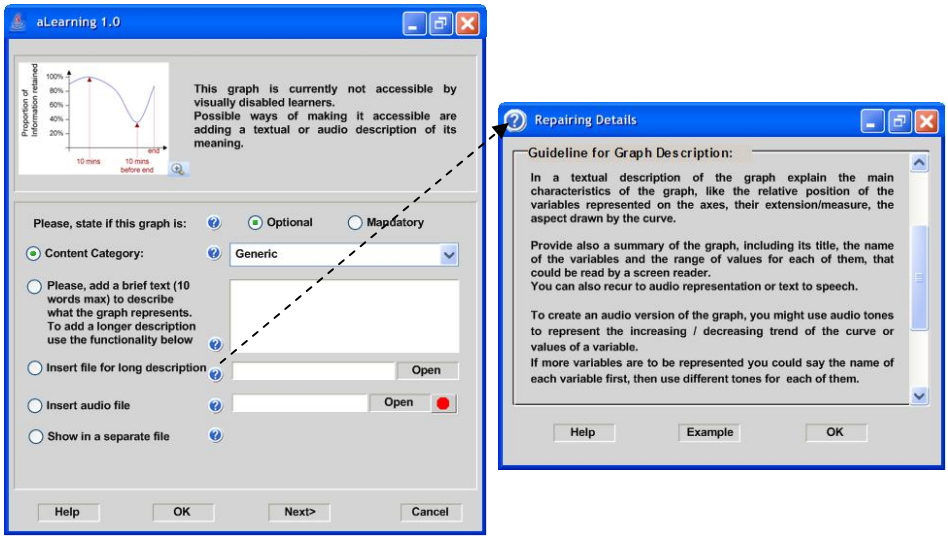


Figure 3: Example of *aLearning* support to authors for repairing the type of content *Graph*

Beyond these basic functionalities of the tool, we are also investigating how *aLearning* interface could support authors in the generation of appropriate metadata for the accessible contents created. By pursuing compliance with existing standards and specifications (IMS AccessForAll, http://www.imsglobal.org/accessibility), as well as by acknowledging current open issues in the field (e.g., adaptability of content), we are analysing the opportunity for a possible extension of LOM categories that would specifically address accessibility properties

of eLearning content and enhance the retrieval of accessible resources from the VICE LOs repository. Moreover, according to our design approach, any interface support for the editing of metadata should include clear and detailed explanations of the metadata fields required, to make it easier for authors without previous expertise on standards technicalities or vocabulary, a straightforward understanding of the metadata information to be included.

Our current efforts are addressed toward refining and improving the usability and learnability of the tool developed so far, to speed up not only any authoring and repairing process performed by the user, but also authors' acquisition of expertise on accessibility by means of navigation through *aLearning* functionalities.

4. Evaluation Plan and Work in Progress

As we mentioned in Section 2, we have already conducted some formative evaluation activities to assess the soundness of our approach and guidelines as a support to the eLearning authoring practice. However, we plan now to conduct a more thorough evaluation on how effective the method and *aLearning* tool developed are in supporting the creation of accessible contents for learners with special needs. This can be achieved by performing comparative studies with other existing accessibility repairing tools and evaluation strategies. Current efforts toward a detailed verification of web content accessibility suggest recur to a combination of techniques and tools, such as:

- the use of more than one automatic check-repairing tool,
- a manual verification of content compliance with accessibility guidelines (usually performed by accessibility experts),
- some testing phases directly involving users with special needs or accessibility experts in using the content created (Lang, 2003; Mankoff et al., 2005; Bertini et al., 2005).

The main motivation for adopting this comprehensive strategy to accessibility verification is that the different methods mentioned above provide useful information as well as possible limitations (e.g., in terms of resources to be invested for the evaluation), thus their combination is often likely to produce better results at a lower cost. Inspired by these considerations we are currently conducting the following activities to validate the quality of the proposed approach to pursue accessibility in the eLearning domain:

- A comparative assessment of *aLearning* features with those provided by other well-known tools for the authoring of accessible eLearning material, e.g., ATutor Content Editor (ATRC, 2006), or accessibility check and repairing, e.g., A-Prompt and LiFT (A-Prompt, 2006; LiFT, 2006), in terms of their usability and support provided to users. In the evaluation studies we observe authors in the activity of transforming eContent (e.g., LOs resources retrieved from the VICE repository) into accessible one, by means of the authoring and check-repairing tools mentioned above. Application of usability criteria (such as effectiveness, efficiency and user satisfaction) steer the assessment process.
- The involvement of a number of accessibility experts in manually checking if a correct application of the eLearning guidelines and *no-frills* methodology has been performed by authors in phase 1. This evaluation is inspired to methodological studies typically carried out in the usability field to assess the validity of inspection techniques, such as Heuristic Evaluation and Cognitive Walkthrough (Cockton et al., 2003). In our case, the aim is mainly to verify which possible improvements to our guidelines are required to ease their understandability and deployment.
- The direct involvement of learners with special needs in accessing the educational materials produced in phase 1 (by using the assistive technologies they are most familiar with) to verify the quality of the eLearning contents generated by authors, with special attention to the equivalent-alternative versions of didactic material they have created.

Observations collected from these evaluation studies will enable us to feed any future refinement of our accessibility approach, as well as to further inform the iterative design of *aLearning*.

5. Conclusion

In this paper, we have highlighted some main limitations of the existing accessibility guidelines for eLearning. The methodological approach we have proposed contributes to improve usability and effectiveness of accessibility indications provided to eLearning authors. This kind of support is particularly important to deliver in contexts such as our VICE project (which is targeted at higher education and professional training environments) where there is also the need to comply with more restrictive accessibility regulations

(PubbliAccesso, 2004) than the ones that have inspired the design of other existing accessibility tools, e.g., ATutor in Canada (ATRC, 2006). Specifically, in this paper we have presented motivations and current efforts towards designing more usable and interactive tools for the presentation of accessibility guidelines as supports to the authoring practice. One of the main objectives of the approach adopted so far has been to encourage the acquisition of expertise on accessibility by creators of eLearning resources, no matter what their professional expertise or previous technical abilities are. Another main focus has been to promote, through a correct application of the methodology presented, that the eLearning contents and experience eventually delivered to learners with special needs reach the same levels of quality and effectiveness of the ones provided to non-disabled learners. Our current work entails a validation of the approach proposed, by which we expect to inform its future refinement as well as its possible extension to a larger set of disabilities and types of contents.

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