

## **E-Learning Contents for People with Disabilities: a Standardized Design Approach**

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### **Abstract**

*E-learning and disabilities are concepts very discussed among international scientific community. Many documents are produced in this area with a big attention to technical instruments, developing methodologies and accordance to the international or local rules and laws. Software and content have to be developed keeping in mind specific learners profiles. Software designed for learners with disabilities can impact positively on programs for all learners. The good blends of technology, content and support have to be achieved. The aim of this paper is a schematization of areas of interests, a definition of macro-areas of critical segments with particular attention to develop a unique methodology for designing e-learning contents for people with disabilities. In this sense we explain some concepts of general design of contents for e-learning and a subset of them used into design according to human disabilities' needing. At the end of this paper we will show any results and experiences due through the application of these methodologies in two areas: university teaching and learning and teaching art and poetry in local schools.*

### **1. Introduction**

As reported by Waits & Lewis [1], the 33% of US institutions that offered distance education courses did not know if their web sites are complaint with accessibility guidelines, 28% followed the guidelines to a moderate extent and 18% followed the guidelines to a minor extent. Furthermore, Schmetzke [2] reveals a high percentage of inaccessible pages for the major US organization for distance learning. These studies prove that most online educational environments are still not accessible to students with disabilities. Having access to, and the ability to use, online learning

contents (e-learning) and information (presented in ways that are accessible to the disabled), could open up new valuable ways for people with physical or cognitive difficulties to learn, work or communicate with others. Internet resources should be for everyone. New technology is interesting from the point of view that much of it is good for simplifying tasks otherwise very demanding. In this sense, the new technologies are a great asset for people coping with disabilities. They create an equal standing for everyone since they are universally usable and allow all kinds of usage forms. With the focus on ICT one can see many concrete advantages for the disabled, irrespective of whether they have a physical or a learning disability of some sort. On the other hand in the last few years, the information technology has had an important role in the business field. Today's workers, immersed in a changing environment, need to rapidly adapt their knowledge. So traditional learning systems have to evolve and readapt in order to meet market requirements and to face up to an extensive, massive and diversified learning demand. E-learning could be an effective solution to this problem. There is a large amount of platforms and portals providing online learning services, it is rather difficult to identify which solution matches best the needs of the organization or institutions. On the Internet there are many reports comparing the features of the different platforms and learning portals. In most cases, the stakeholders decide not to use a commercial solution and develop a system specifically designed to satisfy their needs according to international rules and laws. It is accepted for web the concept of "usability of the situated ones". Rules for the pagination, the use of the colors, the characters for the witnesses, but also the navigability, the link, the same structure of situated and the facilities of access.

Can we say that the same criteria are applicable to the e-learning? Or must we characterize for functions and various requirements for people with disabilities in the planning of the instruments and the interfaces of

the e-learning? Can we try the way of the technical answer and create platforms dedicated and specialist regarding the kind of disability? We can choose the second way but the technological answer not always is right, and in this case we instead would turn out discriminating in how much would come less the principles generates them of the integration concept. On this way we have, instead, to work on general and standard e-learning platform and contents to find useful rules for users with and without disabilities.

## 2. Inner Variables and Requirements

When it is spoken about e-learning not always is clearly the total scene, it is not clearly to the planners, he is not clearly to the responsible of the formation: Everyone it sees “its” world and thinks that that one is the scene of the e-learning. This carries to difficult to manage scenarios if seen by the point of view of the diversity. It is clearly then that in a model of e-learning, including of cooperative environment and diversities one, it is necessary considering fundamental the equilibrium of 3 factors

- Product - that is the contents
- Process - the management of the course, the infrastructures (world in which every “search” the formation fragments)
- People - the support, the interactions (“people are all”).

When e-learning was growing up every one capture his attention on product and contents (course, videos, exercise, tests, etc), and there was no attention in technology. After this phase, a lot of searchers were involved in new technology developments applied to e-learning tools and platforms. When we consider contents, technologies and platforms we are not scaling our scenario on people. If people are with or without disabilities is a focus for our scenario and to consider people’s needing is the only way to reduce the distance (at school as at work) between people with disabilities and people so told “normal”. We have to focus our work on a different significance of “diversity”, an integration between design, people and scenarios, where contents and emotions, perceptions, ideas and excites are present on synergy. Two main aspects to take into account in designing the accessibility of the e-learning environments (technological and methodological issues) are both vital for obtaining a fully accessible online learning environment.

For example, fully accessible tools for learning may be unsatisfactory for visually or hearing disabled users if the learning methodology was designed for sighted or hearing users. Thus, the enabling technologies are very important but not enough. Similarly, a well designed learning contents methodology, if not supported by a set of accessible tools, is not enough to allow the disabled students to learn on the net. The most frequently used network technologies in e-learning are email, web pages, chats and downloading areas.

Today the mail is still the most used service on the Internet. Because email is the main network communication tool it is extremely useful to include it as part of any e-learning environment. Although email presents no significant problems for users with disabilities, some research proposes techniques for improving email accessibility [3].

Likewise, the web is the most used tool for accessing information on the Internet and it is the best solution for distributing educational material for e-learning. Despite WAI guidelines, Universal Design principles, ISO standards and government policies, many web pages are still inaccessible for the disabled. For example, blind users, and users who do not use GUI, for accessing the web cannot get an overview of the structure of a text with one quick glance at the screen. Thus these users can be “lost in hyperspace” very quickly. Producing a document overview is one of the main issues to be considered in an application for surfing the Web which has a vocal interface. Moreover, teachers and students can interact with each other using text chat in order to communicate in a synchronous way. Real-time chat communication is difficult to use for users who can not interact quickly with the computer, for example, who have limited hand function, learning disabilities or simple students who use mobile equipments. Moreover, some chat is inaccessible for visually disabled people. Many variables and constraints are related to laws and directives on general concepts of accessibility and usability. In Italy we have to consider contents of Law n. 4, January 9, 2004 - Provisions to support the access to information technologies for the disabled (also known as "The Stanca Act") and W3C standards on accessibility. These directives are often on contrast when we consider e-learning. In this direction there are also any proposals to upgrade Law n.4 with typical actions related to e-learning and SCORM standard.

An example is “Rough draft of the study on technical requirement of accessibility of the platforms of e-learning and the Learning Object” produced by CNIPA [4]. So we have to refer to perception of our design of e-learning infrastructure by people (with or

without disability). Our design process are so characterized by a recursive loop of PDCA (Plan Do Check Act) used in every quality system. Also quality in every action involved in e-learning design and development maybe considered an inner variable for our system but it is also a resource because indications for every process in design activity are standardized in international literature.

### 3. E-Learning and Disability

The automatic access to the technology does not imply accessibility of the technology. “Accessible” and “accessibilities” have to be distinguished from the “access” since this identifies with the availability of hardware, software and infrastructure.

“Accessibility” indicates, instead, if and as the technology can be used from the final customer with disabilities for any people with disabilities the characteristic is the impossibility for him to adapt himself to environment an object out of it. So every object has to be adaptable to every people and any technologies have to be used with any peripherals. In order to respond to people’s with disabilities needing tools and contents for e-learning have to be designed preserving any characteristics:

- Every tools for e-learning have to cross:
  - a. the first barrier represented from the access to the environment, to the emplacement;
  - b. the successive obstacle to the contents of the e-learning represented from accessibility of the interface;
  - c. the difficulties of digital contents legacies to the platforms and the development systems (enhance the portability and the interoperability of them)
- Every step in to use of e-learning platform has to be repayable on different ways and interfaces (also assistive ones) and the first rule is to reduce number of interaction requested to the user for every step (at least one- step – one interaction).
- According to contemporary laws or rules with different directives (an example is seen in next paragraph) developer has to choose more restrictive ones.
- Environment have to be auto-sense in the way that every people’s feedback is used to reduce mistake in interfaces and contents
- Time to serve has to be reduced to the minimum and at the some time users has perception that no time rules are imposed by

system. In this case in fact people with disabilities have more long time necessary to access contents and to compile forms or tests.

- Song, images and animations have to be reduced to the minimum requested by useful communications of concepts. No more of minimum objects or no useful one have to be deleted in the environment.

We can divide the problems of access in four categories:

- physical /sensorial disabilities: not (or poor) seeing, color-blind, not hearing, customers with motion difficulty in the use of mouse and keyboard;
- cognitive disabilities: difficulty of learning, problems of reading and understanding of the witnesses;
- Technological barriers: slow logon, plug-in absent (java flash etc.);
- Particular situations: the customer is occupied in other asset and can not to use the normal instruments of input and/or output.

For any of these categories there are any rules. In details:

#### ***Physical: (pressure of keys or movements of the hand towards a target)***

In e-learning platform any operations that demand motion, we have to supply a feedback to the customer. Minor is the gravity and greater they are the possibilities to approach platform contents or services, when instead a single possibility is possible on-off is necessary to address to specific programs of scansion adapted to assistive interfaces. Appraisal of the cognitive potentialities of the subject is necessary for people with this type of disturbance and experience of e-learning represents a powerful cultural stimulus within an existential plan wider one.

#### ***Not seeing***

They have problems with the understanding of the images, use generally screen reader with vocal synthesis, need of a page that can be read in sequential way, without knowing of the graphical pagination or to the frame, without “not reading objects” like static images, animations, applet, java scripts, videos, less than they are not accompanies from one adapted alternative description.. So it is necessary to reduce images at minimum and to give always alternative text for them. People with dyslexia, in order to succeed to

read and to write must engage to the maximum their abilities and their energies, are gotten tired very and engaged much time, and very often they commit errors, jumped words and lines.

### ***Cognitive disabilities***

People who have difficulty to interact with the information space can need e-learning contents useful to introduce them in the sequence requested for platform. It is necessary to avoid overloading their Short Term Memory (STM) giving them more familiar elements, in limited number. As example a button has to be designed very big and always in the same position in different web pages. So if a user with cognitive disabilities begins used to push it we have reduced STM and he may focus its attentions on other learning contents or actions.

### ***Technological disabilities***

For this users we have to develop contents and interfaces with horizontal compatibility versus old OS and various environments (Windows, Mac, Unix, Linux, etc) reducing all elements requesting a big bandwidth to be used (images, videos, animations, graphics)

## **4. Scorm and Accessibility**

SCORM is the standards for reuse, tracing and cataloguing of the didactic objects, therefore we can say that SCORM does not regard directly the platforms but the objects of e-learning generally defined Learning Object. Every E-Learning platform has only the task to interact with the object understanding messages between users and system and compatibility of the platform is limited "to understand the language" of the object and, if necessary, to answer it. For being compatible with the standard SCORM every Learning Object it must have characteristic following:

- To be catalogued through metadata so to be indexed and to be searched inside of the LMS (Learning Management System). The fields to be described are many, not all requested. As an example they are demanded: the author, the version, the date of the last modification until arriving to several: others. All these are archived in the section <metadata> in different rows for various objects.
- To be able to converse with the LMS in which it is enclosed, sending data useful to trace learner's activities (for example the time spent

for lesson). The dialogue happens through of the data that pass from to the LMS and the LMS to The language with which it is communicated is the JavaScript

- To be reusable. The object must be transportable on whichever compatible platform without to lose functionality. This principle is at the base of the standard in how much, respecting the directives of construction, the object and the platform do not have to be modified in order to activate the functionalities of tracking and catalogue.

All these elements create any difficulties into application of Law 4 (Stanca's Act) because any points are not in according.

### ***Regarding "Accessibility"***

The standard definition says "*BEES enables the communication of given between content and an RTS typically provided by an LMS via common to set of BEES services using the ECMA Script (more commonly known as Javascript) language. In this section, the term "content" used by the IEEE standard relates to SCO (because in SCORM, SCOs are the content objects that communicate to an LMS using the BEES).*" This specific one is in contrast with how much specifying from requirement 15 of Guidelines containing the technical requirements, the definitions of the different accessibility levels and the technical methodologies for the testing of Web site accessibility - Law 4/2004, Article 11, Paragraph 1, Letters a) and b).Law 4 that filler: *Ensure that pages are usable when scripts, applets, or other programming objects are turned off or not supported. If this is not possible: provide an explanation of the functionality provided; provide a text equivalent as indicated in Requirement 3.*"

### ***Regarding "Usability"***

SCORM introduces a relative problem of usability to navigation for didactic objects. In fact LMS must include external pages and to visualize them like if they were independent elements from the platform in how much contain headings HTML and the organization of navigation, the alternative technically practicable are:

- Using frame with separation of the tree of navigation (specific SCORM relative to the organization) from the pages.
- Using Pop Up that opens the contents in one new independent window from the tree

- Using frame - Omitting technical solution 3 in how much the IFrame is not a Detailed list W3C, many solutions LMS has chosen solution 2, using PopUps (than not it resolves problematic the relative one to the Javascript but it avoids to use the frame) but this creates problems of usability because using them creates disorientation in using contents.

Another solution is to introduce contents and navigation bar in the same page including the didactic object in the frame on centre and the navigation tree in the frame of side. This concurs to obtain advantages in terms of Usability. But both solutions are not responding to requisites of Law 4 in the requirement 2 “Frames are not allowed in the development of new Web sites” and requirement 19 “Clearly identify the target of each link using text that is meaningful even when read out of context or associate alternative texts to the links that in turn explain the target. Provide mechanisms to enable users to skip repetitive navigation links found on more than one page.” As solution of these problems we can consider Rough draft of the study on technical requirement of accessibility of the platforms of e-learning and the Learning Object of CNIPA into Technical Requirement for Platform of E-Learning where we can read the Requirement n. 15 Enunciated: “To guarantee that in the containing pages ECMA-Script script, for which a version was not realizable alternative, the customer is informed of the necessity of it I use of such technology (ECMA-Script). To guarantee moreover that the pages are usable when script, applet, or other objects of programming ECMA-SCRIPT are not disability to you or does not support to you; where that is not possible to supply one textual explanation of the carried out functionality and to guarantee one textual alternative equivalent, in analogous way to indicated how much in requirement n. 3.” In the some way for Requirement 2 Enunciated “Requirement n. 2: It is concurred the use of frame only in platforms e-learning that they use SCORM and exclusively in order to include the contents imports to you and for tracking activity. In these cases the use of HTML 4,01 or XHTML 1,0 with DTD frameset, but with the following warnings is admitted:

- a) avoiding to use, inside of the language to markers with which the page is realized, elements and attributes in order as an example to define of the characteristics of presentation of the page (, characteristics of the characters of the text, colours of the same text and the background, etc), resorting instead to the Sheets of Style CSS

(Cascading Style Sheets) in order obtaining the same graphical effect;

- b) to make so that every frame it has a title meaningful it in order to facilitate of the identification and navigation; if necessary, to describe also the scope of frame and the their relation;
- c) To use on preference not more than three frame for page and however to place for last the frame does not assign you to navigation and use of the content from part of the customer.”

## 6. A Case Study

In an educational context designing the content interaction is extremely important in order to reach a learning goal. Moreover, in online learning the methodology is crucial. Therefore, it is very important to redesign traditional pedagogical approaches by integrating information and communication technologies into courses according to criteria of accessibility and requirements for Usability. Our methodology cross different steps useful to define user’s requirements (if they are with or without disabilities)

The main steps we follow for e-learning accessibility are:

- Focus on target (definition of users’ needing)
- Planning and Budgeting resources and times
- Definition of knowledge needing
- Definition of sections of Laws and rules used in the country where our target lives.
- Definition of accessibility goals for the education content,
- Study of the disabilities of groups target,
- Designing of the content to make sure they comply with the accessibility guidelines,
- Development of platform and contents,
- System testing and monitoring of the e-learning platform usage.
- Analysis of results and feedbacks
- Loop to First step
- Going out by the loop only in according to users’ preferences.

Once the requirements are identified, they must be classified, assessed and ranked. The last step of the requirements capture is the detailed description of the top requirements. The assessment (in the capturing requirements phase) and management (during the whole project lifecycle) of the requirements may be improved if we assign them some attributes such as:

- Added value.
- Alternatives if not implemented.
- Effects if not implemented.
- Priority (critical, important, secondary).
- Risk level if implemented (critical, significant, ordinary).
- Implementation cost (in terms of resources and hours / person).
- State (proposed, approved, included or validated).

In our example we have a general topic useful to personalize scholastic integration of learners with disabilities. Aim is to oppose idea of the management of the group handicap bearers with concepts of integrations and simultaneous development (learning growing). The platform support an integrate environment (on line and on presence) equipped of functionalities that concur with every learner to approach didactic objects, to receive support and personalized attendance during course, to realize the cooperatives learning in small groups with the other participants through e-mail, chat, forum and a common document repository, in order to share experiences and information on the formative activity in course and critical aspects of it. Users with disabilities are in ratio of 10 % (2 on 20 learners) and they use one for everyone accessibility console with pc, Braille plotter, vocal synthesizer, Braille desktop and a sense assistive mouse (voice commander one).

During developing of contents we have supported a heterogeneous staff with a blind technician and a student with motion e cognitive disabilities. In our idea we have developed contents and interfaces unique for people and users with both without disabilities and non discrimination are made also in this direction. During design of contents we have used an approach bottom-up where into lay outing of contents we have considered always more restrictive possibilities and reading requirements of Law 4 we have added also that we may add.

For any module we have supported a trial period with another student (technician and the first student are used only in project and design) compiling a feedback document and for how we have measured Medium Time of Response taking it as reference with a tolerance (superior) of a ratio of 5%. A student association has guaranteed us support with a group of blind users (a student of the same matter treated in learning objects and another student of a different learning area). The accordance of contents developed in first time with users' needing was of 93% (for users

with disabilities) but we have had a reduction of satisfaction for users without disabilities. So we have inserted another two phases into developing where every contents before test are approved and modified by a tester without disability and re-approved by technician with disabilities. So we have introduced a time shift in project of 10% but a similar level of satisfaction for both users (with and without disabilities) of a ratio of 94%. The increment of time reserved to developing contents and interfaces also in according to accessibility was been of 35% but it's so poor if we consider that old development had had a big time to upgrade and more less ratio of satisfaction for blind users (the only type of disabilities in our old tester). We have received a big advantage also by use of documentation provided by ISO 9001:2000 concerning the management of a Project in Quality. Useful diagram and time sheet pre-designed and the requirement to compile module for non-conformance activities have had more transparent every step of our activities and a lot of documentation for project was already compiled during every step.

## 7. Main text

In this paper, we have described a methodology for the design of learning object for E-Learning platform. In particular we have developed learning contents for disabled users. Our approach to problem resolution is based on the use of accessibility and usability guidelines. An experimental evaluation of the proposed method has been performed introducing these contents in some real cases.

## 8. References

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