

A Deaf-Centered e-Learning Environment (DELE): challenges and considerations.

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A Deaf-Centered e-Learning Environment (DELE): challenges and considerations.

This contribution will address accessibility for e-learning environments designed for deaf learners. Starting from a discussion of the meaning of text and web accessibility, we will explain how it is possible to develop a Deaf-centered E-Learning Environment (DELE) focusing on the visual skills of the target users. We will refer to studies conducted within the Italian FIRB-VISEL project (*E-learning, deafness, written language: a bridge of letters and signs towards knowledge society*) in which the Research Units are involved in the development of a distance learning environment for the improvement of literacy skills of prelingual deaf children and young adults. Since their literacy competences may be a constraint to accessibility, the e-learning environment we are working on is based on embodied cognition/semantics, imitation, storytelling, and the construction of educational games. Conceptual metaphors will provide the browsing structure of the entire environment, in which the learning paths will be developed.

KEYWORDS: deaf literacy, e-learning, embodiment, educational games, teenagers, accessibility.

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Introduction

Due to the wide variation not only among factors impacting types of deafness but also the impact of deafness on educational paths, there does not exist a “standard” deaf individual. The fact that each deaf individual is unique makes it impossible to develop a educational system for deaf people as a whole. Despite the fact that literature has shown that deafness is not a cognitive deficit (Caselli et al., 2006; Fabbretti & Tomasuolo, 2006, to name a few), many deaf children and adults experience difficulties in achieving appropriate receptive and expressive skills not only in oral languages but also in written languages.

Schooling still offers no effective systematic response to the education of the deaf. The social cost of this situation is enormous: deaf people often lack access to written communication and in many cases they cannot perform professional tasks involving minimum competences in the written language and cannot access higher levels of education.

Increased availability of new learning environments using advanced multimedia technologies still require appropriate written language skills for access to such opportunities. In the case of e-learning environments it is often difficult for teachers to determine if deaf learners are failing their assigned tasks because of an inability of dealing with the content, or because of linguistically difficult instructions.

In order to design appropriate e-learning environments for deaf learners it is necessary to recognize and take into account both the specific needs and the cognitive and communicative potentials that deaf learners possess in their unimpaired sensory modalities, i.e. vision. For a large number of deaf learners these potentials also include the use of visual-gestural or signed languages as a primary means of communication. The Italian VISEL project (*E-learning, deafness, written language: a bridge of letters and signs towards knowledge society*) is focusing on strategies for promoting written language abilities in deaf learners without relying solely on written text. Its

aim is to design, produce and test novel, flexible and customizable e-learning environments providing accessible content that focuses on the development of the expressive and receptive written language skills in deaf students at the high school and university levels (ages 15 and above). Not only is the platform aimed towards deaf signers, but for deaf non-signers as well. This provides a unique challenge in which alternative

nonverbal strategies for providing accessibility to the text is necessary to bridge concepts for those with weak written language skills.

Web accessibility, texts and deafness

While many studies have confirmed that increased accessibility to education through technology, including the Internet and e-learning, has meant increased student attention and motivation (Maragna, 2003; Shriver, 2000; Marshark, 2003, in the field of deaf studies), accessibility for deaf people remains a largely ignored issue.

Also following the studies conducted by the Web Accessibility Initiative of the World Wide Web Consortium¹, the most common barriers to accessibility for deaf and hard of hearing people using the Internet are:

- Lack of captions or transcripts of audio and video, including web/podcasts;
- Lack of content-related images in pages full of text, which can slow comprehension for people with weaker written language skills;
- Lack of clear and simple language;
- Requirements for voice input on some websites;
- Complete inexistence of websites or search engines utilizing sign language as a markup language.

From the point of view of a deaf person using the Internet, many of the interpersonal communication cues they rely on (such as facial expressions, body movements and direct communication with peers) are lacking.

Navigating the Internet and e-learning platforms require the use of written text containing directions, explanations, and the actual content itself. As mentioned previously, the misunderstanding of written information regarding platform use and activity instructions would be an impediment to proper evaluation and intervention on the student's actual learning process.

The VISEL project is addressing this issue both by taking into serious consideration the interaction between the reader and the text and the (deaf user) and the Web.

Interactional aspects of reading/writing, include habits, lexical and grammatical constructions in both L1 and subsequent languages, and personal motivation towards text.

A number of studies state the importance of information structure (Halliday, 1967; Lambrecht, 1994)

¹ <http://www.w3.org/WAI/intro/wcag.php> last visited 17 February 2011.

or information packaging (Chafe, 1976), in “the tailoring of an utterance by a sender to meet the particular assumed needs of the intended receiver” (Prince, 1981). One consideration regarding information packaging calls for text easification (Bhatia, 1983) in which text is supported by visual media such as flowcharts, images, videos and comics, without modification of the original text (text simplification). In DELE, action on texts will take these principles into consideration, as well as their readability, which will be determined by considering the word frequency using the Basic Italian Vocabulary (De Mauro, 1997) and the application of automated word processing tools such as the Gulpease Index². Using words from the Basic Italian Vocabulary (VIB) renders text more comprehensible to people less trained in reading complex texts. In addition, when a word external to the VIB needs to be used, it is supported by terms coming from the VIB itself. The Gulpease Index calculates the readability of an Italian text based on its structure, ranging from 100 with the highest readability and 0 as unreadable. The readability is empirically related to an index tested on students at different academic levels: e.g. Index 50 is unreadable for a student in primary school, but easily readable for a student in high school.

Embodied Cognition and DELE

Existing e-learning platforms expressly designed for deaf users have learning paths adapted to their needs, including explanation windows in sign language to support content. The VISEL project takes one step further by choosing to eliminate all of the textual impediments that could constitute a barrier for the deaf learner, focusing on written text only when needed, and thus allowing the learner to focus his/her time and energies on the actual learning process. Embodied Cognition (EC) and Conceptual Metaphor (CM) (Lakoff & Johnson, 1980; Johnson, 2007; Lakoff, 1992; Imaz & Benyon, 2007) are helping us in defining what we mean by visually-based way of understanding information. According to the EC theory, real learning can only occur when human beings are engaged in a concrete perception of their environment, which transfers to an unconscious pre-verbal knowledge and subsequently project onto conscious and abstract domains. Such pre-verbal qualitative and emotional knowledge provides the foundation of *all* knowledge, including language, art, science and all abstract disciplines.

Metaphor is one of the best ways to implement “mental bridges” leading us from concrete, unconscious

knowledge to abstract knowledge. From a cognitive view, CM gives the structure that can be applied to concepts in order to understand them. For example, when we analyze a concept as a main object composed of several parts, we can use an industrial metaphor, taking the concept itself as a building that is assembled of several components.

In DELE, we are using CM to improve accessibility in the virtual environment: concepts that are familiar to the deaf users are exploited to represent virtual environments and data.

Design of DELE

There are two main issues to take into account with the design of DELE. First, since deaf users are essentially visual-spatial people, a graphical representation of a physical environment is implemented with the use of bodily-related functions (such as movement in space, entering/exiting places, grasping objects, etc), leading us to our second point: to provide easier interaction with the virtual space.

Since the target population of the VISEL project includes students attending high school, college or university courses, a university campus metaphor is used (Fig. 1).

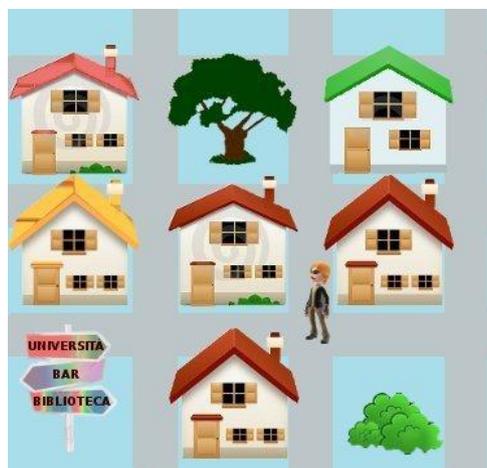


Figure 1: the University Campus metaphor

Within the campus metaphor a natural mapping arises between typical e-learning functions and the campus: informal forums are represented by a community board in the main square; users' personal pages are shown as individual houses, and so forth. The user moves within the campus using an avatar which serves as a virtual body interacting with the virtual environment.

While the campus metaphor serves as the general browsing structure of DELE, the “E-learning

Environment as a Story” metaphor represents the common thread of the entire learning platform. Different environments within the system are represented as different stories, using storytelling as the theoretical basis (McKillop, 2005; McDrury & Alterio, 2002; Bruner, 1991). The learning path itself can be viewed as a story with the user as its main character and the story-structured mapping is straightforward: the user’s arrival to the campus represents the beginning of the story, the set of learning activities and choices along the path made by the user acts as the story development phase and, finally, the conclusion of the story is reached when the user obtains a certificate (i.e. a virtual degree).

The learning paths are arranged as stories within stories (Bottoni et al, 2010), each one with an arbitrary topological design (Bottoni et al, 2010a). Learning activities are connected to each other on a semantic basis – when starting an activity, the user is provided with links leading to other relevant activities. Moreover, the users themselves can create connections between activities based on individual preference, creating movements along and deviations from the main path (Fig. 3).

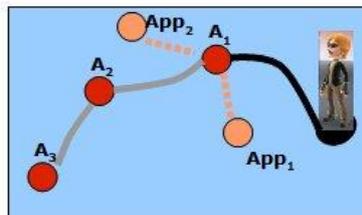


Figure 3: a story path with some deviations

Users can also create their own stories – in fact, the Digital Storytelling project (Rudnicki et al, 2006) provides a model which allows users to employ multimedia materials (text, images, videos, etc.) to create stories that can be assigned as homework as well as representing creative elaborations of learning contents.

According to Bruner (1991), narratives contribute to the creation of a culture and tradition. These narratives play an important role in DELE – the implemented metaphors focus on the importance of a “society” in building any learning context, and the society's culture is explicitly shown within the platform: it is visualized as news about campus events posted on the community board within the main square. This information is dynamic, continuously re-built by users through discussion and participation on the university campus.

This leads to one of the most important aspects of DELE: collaboration. The digital stories developed by

users could be used to help others, representing direct experiences of users facing learning issues and possible solutions on the platform. Users will have the choice to communicate with each other by sign language, text or video-conference.

DELE: technical aspects

DELE is being implemented as a single module of Moodle, which has been slightly modified in its core code. A general structure has been designed to represent the stories and sub-stories of the university campus. A formal meta-model of all the possible stories representing learning paths (Bottoni & al, 2010a) has been depicted to design the story-based behavior of the system.

While standard hardware (mouse, keyboard and webcam) will enable interaction with the platform, we are experimenting with a gesture recognition module which recognizes simple gestures through webcams. This module can be used to implement alternative ways to execute some general system commands, such as browsing the environment or asking for on-line help. DELE is entirely influenced by the concept of user-centered design, and tries to implement a deep human-level approach to computer systems development.

Conclusion

Although it may not be immediately obvious how a predominantly visual medium like the web can be inaccessible to people who are deaf or hard of hearing the points we have listed so far are worth noting.

When developing e-learning systems for the linguistic education of deaf people, not only text easification and a stricter application of the Web Content Accessibility Guidelines should be considered, but also making the whole learning experience more accessible through an effort of looking at online learning through deaf eyes.

We have suggested here a possible direction, suggesting how a simple change of perspective, starting from the real educational needs of deaf learners , could open new paths for inclusion.

References

Bhatia V.K. (1993). *Analysing genre: language use in professional settings*. London-New York, Longman.

- Bottoni P., Capuano D., De Marsico M., Labella A. & Levialedi S. (2010). Metaphor-based teaching for sensorially critical subjects. *Proceedings of ICSEC 2010, The 1st International Computer Science and Engineering Conference*. Chiang Mai, Thailand, 17-19 November, 2010.
- Bottoni P., Capuano D., De Marsico M., Labella A. & Levialedi S. (2010a, submitted). *DELE: a Deaf-centred E-Learning Environment*. Chiang Mai Journal of Science.
- Bruner, J.S. (1991). The Narrative Construction of Reality. *Critical Inquiry*, 18:1, 1-21.
- Caselli, M.C., Maragna, S., & Volterra, V. (2006). *Linguaggio e Sordità*. Bologna, Il Mulino.
- Chafe W. L. (1976). Givenness, contrastiveness, definiteness, subjects, topics, and point of view. In C. N. Li (ed.), *Subject and topic*. New York, San Francisco & London, Academic Press 25-55.
- De Mauro T. (1997.) *Guida all'uso delle parole*. Roma, Editori Riuniti.
- Fabbretti, D. & Tomasuolo, E. (2006). *Scrittura e sordità*. Roma, Carocci Editore S.p.A.
- Halliday M.A.K. (1967). Notes in transitivity and theme in English. In *Journal of Linguistics* 3 (2) 199-244.
- Imaz M. & Benyon D. (2007). *Designing with blends*. MIT Press.
- Johnson M. (2007). *The meaning of the body*. University of Chicago Press.
- Lakoff G. & Johnson M. (1980). *Metaphor We Live By*. University of Chicago Press.
- Lakoff G. (1992). The Contemporary Theory of Metaphor, in E. Ortony (Eds) *Metaphor and Thought*. Cambridge University Press.
- Lambrecht K. (1994). *Information Structure and Sentence Form. Topic, Focus, and the Mental Representations of Discourse Referents*. Cambridge, Cambridge University Press.
- Maragna S. (2003). *Una scuola oltre le parole. Educare il bambino sordo alla lingua parlata e scritta*, Volume 1. Milano, Franco Angeli.
- Marschark M., & Spencer P.E. (2003). *Oxford handbook of deaf studies, language, and education*. Oxford University Press US.
- McDrury J. & Alterio M. (2002). *Learning Through Storytelling in Higher Education: Using Reflection & Experience to Improve Learning*. Dunmore Press.

McKillop C. (2005). Storytelling grows up: using storytelling as a reflective tool in higher education. Paper presented at the *Scottish Educational Research Association conference (SERA 2005)*, 24-26th November, 2005, Perth, Scotland.

Paciello M. G. (2000). *Web accessibility for people with disabilities*. Focal Press.

Pizzuto E., Pietrandrea P., Simone R. (2006). *Verbal and signed languages; comparing structures, constructs and methodologies*. Berlino, New York: Mouton de Gruyter, 13-33.

Prince E. (1981). Topicalization, Focus-Movement, and Yiddish-Movement: A Pragmatic Differentiation. *Proceedings of the Seventh Annual Meeting of the Berkeley Linguistics Society*, 249-264.

Rudnicki A., Cozart A., Ganesh A., Markello C., Marsh S., McNeil S., Mullins H., Odle Smith D. & Robin B. (2006). The Buzz Continues. The Diffusion of Digital Storytelling across disciplines and colleges at the University of Houston. In C. Crawford et al. (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2006* (pp. 717-723). Chesapeake, VA: AACE.

Schirmer, B.R. (2000). *Language and Literacy Development in Children Who are Deaf*, Second Edition. Boston, MA: Allyn & Bacon.