

An e-Learning System for the Deaf people

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Abstract – This paper presents a Learning System (LS) which offers Greek Sign Language videos in correspondence to every text in the learning environment. The system is designed notably for deaf adults for the purpose of their lifelong vocational and educational training. In the LS, the special needs of Deaf learners are satisfied, e.g. bilingual information (text and sign language), high level of visualization, interactive and explorative learning, and the potential of learning in peer groups via video conferencing. In this environment, for the first time, Greek signers are able to learn in their own language, the sign language. In addressing the above context, the LS is adapted to the specific learning problems of the target group, i.e. deaf adolescents and young adults. The provided content is bilingual. Bilingual experiments (spoken and signed language) in schools of the deaf and hearing impaired have shown that the use of sign language in the classroom enhance reading competence significantly. The basic objective of the present e-learning environment is the support of the equal rights of Deaf people for their access and real attendance in the vocational and educational training. The development of LS and this paper has been supported by Leonardo Da Vinci Framework Program, “DELFE” project, of European Union.

Index Terms – e-learning, sign language, video, e-content, vocational training, deaf people.

UNDERSTANDING THE NEEDS OF E-STUDENTS WITH HEARING DISABILITY

During the last ten years a tremendous application of ICT and e-content has been remarked on the European VET sector (Vocational and Educational Training). A variety of target groups, that were facing inclusion problems in the labour market, have set the motivation for the realization of projects and strategies aiming at the rehabilitation of the certain population. This context has been mainly addressed by actions of e-learning and e-content development. However, few of the above actions have been devoted to the learning and inclusions problems Deaf people are facing.

It is important to note that every student has his or her own individual needs. Although it is possible to ‘measure’ and describe a person’s hearing ability in a variety of ways, understanding speech is a very complex process that can involve the eyes as well as ears and brain. It is therefore

possible for a student with ‘less’ measured hearing to actually be able to understand what is being said better than another student who has ‘more’ measured hearing. Hearing disability can change over time, and can also involve tinnitus (‘hearing ‘internally generated’ sounds) or additional disabilities [1] (e.g. visual).

GSL [4] is a natural visual language used by the members of the Greek Deaf Community with several thousands of native or non-native signers. Research on the grammar of GSL per se is limited; some work has been done on individual aspects of its syntax negation [11], morphology [12], as well as on applied and educational linguistics including comparison with spoken language [15]. It is assumed that GSL as we now know it is a combination of the older type of Greek sign language dialects with French sign language influence [13, 14, 15].

This paper presents a learning system (LS) which offers Greek Sign Language videos in correspondence to every text in the learning environment. The system is designed notably for deaf adults for the purpose of their lifelong vocational and educational training. In the LS, the special needs of deaf learners are satisfied, as e.g. bilingual information (text and sign language), high level of visualization, interactive and explorative learning, and the possibility of learning in peer groups via video conferencing. In this environment, for the first time, Greek signers are able to learn in their own language, the sign language.

OTHER PROJECTS AND STANDARDS

At the web site of World Wide Web Consortium (W3C) we drew useful information that has to do with the creation of accessible html pages for the Deaf and hard hearing persons. For any time-based multimedia presentation, synchronize equivalent alternatives with the presentation. A time-based presentation can include any form of multimedia, such as a movie, animation or slide show. Equivalent alternatives to these types of presentations are captions (which provide access to audio tracks) and audio descriptions (which provide access to visual tracks). They have already explained the need to provide a textual transcript for any audio track or video track, and a textual description of the video track. However, it must be admitted that a text transcript alone is not the ideal method for providing an equitable experience for persons with disabilities. It is widely accepted that on-screen captioning allows Deaf and hard-of-hearing people to more fully appreciate the experience of a movie or multimedia

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production. A separate textual transcript that must be read after the fact does not provide an equivalent experience [2].

The Access Board is an independent U.S. Federal Agency charged with developing accessibility requirements and guidelines, assisting in the implementation of accessible solutions, and enforcing accessibility standards for federally funded facilities. In 1998, Congress amended the Rehabilitation Act to include Section 508, requiring all U.S. Federal Agencies to make their electronic information accessible to people with disabilities. Compliance with the requirements set out by the Access Board in Section 508 is usually referred to as "ADA Compliant."

At this point, it must be noted that the presented e-learning system, namely DELFE [8], is compliant to the Section 508 [3] for technology-related programs and activities.

USERS' REQUIREMENTS ANALYSIS

The Greek Sign Language (GSL) is a natural visual language used by the members of the Greek Deaf Community with several thousands of native or non-native signers. According to the Office for the Disabled people in Greece there are 100000 people with special needs in Greece. About 10000 of them are Deaf and hard of hearing. Unfortunately, the statistics show that the unemployment increasing rate of the disabled people in Greece are three to four times higher than the corresponding rate of the remaining population. Two main reasons can be identified for these special employment conditions: One, an inadequate estimate of the performance abilities of the deaf, and, secondly, the communicative problems between deaf and hearing colleagues [4, 5].

The internet has proven to be a boon for people with disabilities. But just as it is important to design buildings with accessibility in mind, the same is true for the internet. Flexibility is the key to accessibility. It's important to keep in mind that people will be using a variety of technologies to access your home page. Keeping your page accessible mean keeping such options open. In an age of intelligent HTTP/WWW servers that can query clients about their feature-lists [6].

The choice of the technical advanced video in the e-learning system plays an important role. Video technologies offer great possibilities for better telecommunication between the Deaf people whose first language is the sign language. When selecting or developing systems for communication in sign language, a method is needed for determining the usefulness of a given system. Video communications offer great possibilities for better telecommunications for deaf people.

However, sign language poses great demands on the moving image. Especially, for sign language traffic sequences have different characteristics (exhibiting a higher video bit rate and frame rate) from those of typical head&shoulders sequences. The picture quality (frame size) and frame rate are both important factors in sign language perception. The resolution of the hands must be high enough to support finger spelling, while the resolution of the face is also important since facial affect may convey syntactic information [7].

In addressing the above context, the LMS is adapted to the specific learning problems of the target group, i.e. deaf adolescents and young adults. The provided content is bilingual. Bilingual experiments (spoken and signed language) in schools of the deaf and hearing impaired have shown that the use of sign language in the classroom furthers reading competence significantly. The basic objective of the present e-learning environment is the support of the equal rights of Deaf people for their access and real attendance in the vocational and educational training.

The above context is further verified by a requirements' analysis study performed in the DELFE project [8]. For the purpose of this study, we wrote a questionnaire concerning the familiarization of the Deaf students with the new technologies and their possible technological knowledge. The title of the questionnaire was "the diagnosis of educational needs of the hearing impaired on the new technologies". In the paragraph to follow, we present some statistical results that were derived from a certain question (see Table 1, figure 1). The question was the following: "would you like to have more friendly Information in Internet? Please describe how you would like it?"

TABLE 1
STATISTICAL RESULTS FOR THE DEAF PEOPLE

	Not at all	A bit	A lot	Uninterested
Text	14	19	15	1
More pictures and Animation	3	8	37	1
Sign Language	1	9	31	8
Sign Language and Text	1	6	39	3

E-MATERIAL FOR DEAF

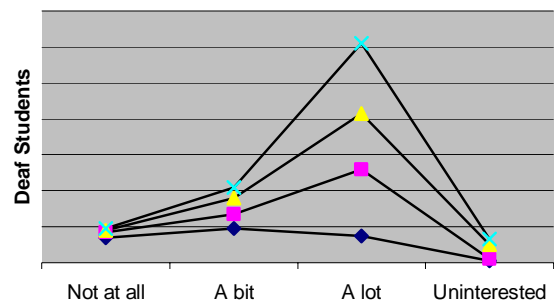
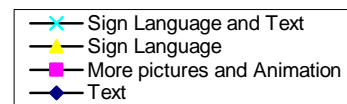


FIGURE 1
STATISTICAL RESULTS FOR THE DEAF PEOPLE

In Table 1, the numbers of answers per category are presented. As concluded by these results, the majority of the students (more than 90%) selected that they preferred the content to be presented in the Greek Sign Language and to be

consisted mainly of images and videos. This result is certainly in conformance with the national ideas and research results concerning the requirements of accessible content.

DESCRIPTION OF THE SYSTEM

We produced a prototype e-learning system, which satisfies the needs of the Deaf and hard of hearing people. The basic aim of this project was to include all multimedia and hypermedia elements and mainly video in GSL into the electronic learning material. According to the analysis of the specification of the DELFE project (questionnaires) [7], we designed a user interface prototype of the on the web, which is suitable for the certain target group.

As depicted in Figure 2, the user interface is divided into various sections-frames. On the left hand side we put the video window of the sign language interpreter, which in detailed reflected what the reader said. Above the video window we placed the title of the current lesson and chapter.

At the top of the user interface we put the basic buttons of using the e-learning system. We are trying as much to use as less buttons with large icons and font text size.

For the video clip we took into account certain criteria for the quality of video, like CIF video format and the speed of 128-384Kbps. In this case the details in motion can be reproduced so that fingers, eyes and mouth are distinguishable even for signs consisting of both hands and arms moving with all fingers displayed.

Finally, we present the student tools of the system where all the included features can be seen.

The system provides the following features that are properly adapted to the users' special requirements:

- **Search:** tool of content retrieval according to search keywords.
- **Site map:** a map of the site links and structure.
- **Glossary:** a glossary with the main terms of ICT in Sign Language.
- **Content extraction:** tool of content extraction for further study at home.
- **My tracker:** a tracker of the statistics of the student activities in each course. This tool helps the teacher track the student progress.
- **My tests & Surveys:** Evaluation of the student's progress via asynchronous tests from the teacher.

The system gives the choice of selecting the speed of the video depending on the line capacity allocated to the student. This is performed through the selection of the quality of graphics and video. The system also allows the off-line downloading of the Sign language content for better real time quality.

Now, we may turn our discussion to the e-learning models supported by our system. The system is based on asynchronous surveillance of the educational process and synchronous communication through chat. In the paragraphs to follow, we present the users of the system and some usage

scenarios. We can see the site map of the e-learning platform at the figure 3.

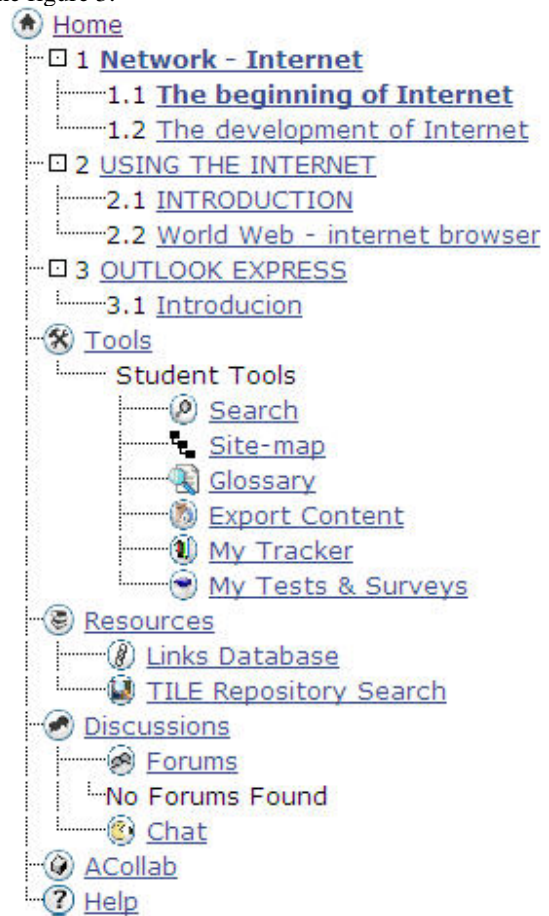


FIGURE 3

1.1 User Level

There are three user levels in the system, namely, teacher, student and administrator.

1.2 Teacher

- The teacher is provided the ability of announcing the new course via e-mail (electronic post), or via web bulletin board (newsgroup - team of discussions).
- Moreover, the teacher is able of escaping from the frames of the course and via special link to browse additional material for better and more thorough understanding.
- He/she has also the ability of separating the class in smaller teams at the duration of the course for the realisation of small work and then of linking the class. He/she can pose tests or questions of consolidation and assign homework.
- Finally, the teacher may answer and announce the questions of the students via asynchronous means of communication (web bulletin board, e-mail, chat).

1.3 Student

- The student is able of registering in a series of courses and of acquiring of a password and tracking system.
- The student is able of posing questions via functional web forms to the teacher or to the administration for any technical details with regard to the operation of system.
- He/she may access a web-based help of the e-learning system.
- If the instructor uses some difficult to understand terms or terminologies, the student has the potential to search via special links in a special dictionary for concise reports and explanations of corresponding term or corresponding terminology.
- Each question or query that the student submits, will be communicated via special web based bulletin board to all the members that participate in the self-learning. Thus, the instructor is not forced to repeat the question of the educated.
- The student has the potential of drawing selective information from the course, creating him his own total of personal notes of electronic form with links.
- It gives him the potential to attend the course and keep selective notes. Also, he can store and use links (links notebook) and go back to already existing material, which is stored to a local or remote database.
- Ability of submission of questions to the professor via special web forms. But also participation in discussions between educated via web bulletin board. The student can bring to the surface a new subject or answer in an already existing subject.
- The student can monitor his progress with simple and small tests via web forms. The results are evaluated later by the instructor for further evaluation.
- For the students, there is always the possibility of access to more material and electronic libraries for furthermore research regarding their work and their course.

1.4 Administrator

The administrator coordinates and manages the e-learning application via the administration tools. The administrator determines which user level-group has the permission to use the corresponding "informative" and "communication" tools. Moreover, the administrator can communicate with the instructor in order to be kept informed about the progress of the instructors' courses.

E-CONTENT

The development of the educational material has been done with respect to the following questions and principles:

- How does the student learn, what are the student's needs and special characteristics?
- How does the professor teach?
- How is the educational process evaluated?
- What will the student be supposed to do in order to learn?

The educational content help the student interact with the educational process. This is achieved through exercises of searching and inquiring information, of application, critical and of creativity.

Through proper exercises the student evaluates the knowledge acquired in order to proceed in further study.

PRINCIPLES AND E-LEARNING PROCEDURES

The analysis of needs and the description of services that is provided are impressed in three phases of educational process [14]: Preparation of visual class. (Asynchronous phase), Activities: Planning and parameterizations of interactive environment of courses via the internet with the use of special program of Reader of Web pages (Web Browser). The complete material of courses of distance education is stored in a local or removed (network) base from where the user might draw the information according to planning of environment of the distance education. Also the possibility of communicating with experts and announcing the course and the availability of material was given to the instructor. In the educated persons it gives the possibility of studying in first phase the under representation material and of submitting the first questions.

Operation of visual order (Modern phase), Activities: At the duration of course the professor via the system of videoconference, multipoint [16] video/audio, via text chat, shared whiteboards, web based pre-, post -, in class interactive program of interpellations, presents the material and the educated participate actively and can collaborate at teams. Also the system via network refers the educated in additional material. Also all the process is recorded for future report by the instructor but also by educated.

Operation of review (Asynchronous phase / Post - class), Activities: The review of class concerns the part of activity as the modern phase of visual class is completed. Naturally it can have a lot of phases at units and courses. The material that has been already presented in the visual order is accessible. There were questions of understanding the course, multiple test, so as to be a complete picture of progress of understanding the course from the educated.

Self - education (Asynchronous phase), Preparation of the Self-education: The self- education [15] is totally found in asynchronous phase. The educated have access (search and recuperation) in training and informative material, connected with the base of material, for various cognitive and more general subjects that interest him. Thus we use all the possibilities of visual class that are used in asynchronous phase. We have access (search and recuperation) in training and informative material for various cognitive and more general subjects that interest teachers.

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FIGURE 2