

Teaching of English to Hearing Impaired Individuals Whose Mother Language Is the Sign Language

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Abstract. The teaching of the English language as a second language to deaf and hearing impaired individuals, whose mother language is the sign language, through the prism of the project 'Dedalos', is the main topic of this article. More particularly, a special e-learning platform was developed, which incorporated special pedagogic methods of distant linguistic training as well as innovative and high-quality educational e-content, suitably adapted to the needs of hearing impaired people through the use of contemporary animation and digital video technologies. In addition, audits and evaluation tests were incorporated within the platform, in order to assess and evaluate the linguistic skills of the hearing impaired students and the educational e-content was divided into various levels according to the educational level of each e-student. Both the evaluation process and the setting of the e-content to the appropriate level are achieved through the use of an intelligent taxonomy system.

Keywords: E-learning, deaf and hearing impaired, sign language, videoconference, expert system, taxonomy.

1 Introduction

It is commonly known that despite the vast and rapid evolution of information and communication services and products, only a small percentage of these are used within the linguist training circle and even a smaller percentage of information and communication services and facilities is used to support the linguistic training of impaired people and especially of the deaf and hearing impaired people.

The general idea is that the majority of the Information and Communication Technologies (ICTs) [1], substructures and services targets the common citizen and user, and excludes handicapped people and other sensitive community groups. This fact provokes and creates the phenomenon that is commonly known as "digital divide", i.e. the exact opposite of e-inclusion, which is supported internationally by several policies, organized actions and also by projects like 'Dedalos'.

The main objective of the 'Dedalos' project is the promotion of the English language as a second language for Deaf and hearing impaired people whose first language is the sign language. For this, special pedagogic methodology of distant

linguistic training was designed and used as well as innovative educational e-content, suitably adapted to this special group of people. The whole process includes audits and evaluation of the linguistic skills of the e-students. The educational e-content has been designed to be divided into different levels according to the knowledge of the student. The system has been designed to evaluate the student and set the pedagogic material at the corresponding level using an intelligent taxonomy system. Particular emphasis was given to the quality and innovation of the educational material of self-paced learning where new animation and digital video technologies were extensively used into the Sign Language of each partner [2], [3], [4], [5], [6].

An important element of the project was the promotion of equality of the deaf and hearing impaired people through their participation in the European Community. Nowadays, the English Language as a second language constitutes an important resource and asset in the professional field, for all individuals. It is a common ascertainment that the deaf and hearing impaired people face adaptation problems in their social activities, especially in the European countries, where English is used as the main communication language. In addition, the ICT sector uses mainly the English language and the vast majority of information on the Internet is in English, while the terminology used in the economy and electronic trade sector requires the knowledge of English.

2 The Characteristics of GSL (Greek Sign Language)

The Greek Sign Language (GSL) is a natural visual language used by the members of the Greek Deaf Community, which counts several thousands of native and non-native signers [7], [8]. It is used widely in the Greek deaf community and the estimation for GSL users is about 40,600 (1986 surveys of Gallaudet University). There is also a large number of hearing non-native signers of GSL, mainly students of GSL and families of deaf people [9], [10]. The recent increase of mainstreamed deaf students in education, as well as the population of deaf students scattered in other institutions, minor town units for the deaf and private tuition may well double the total number of secondary and potential Sign language users [11], [12]. Official settings where GSL is being used include eleven deaf clubs in Greek urban centers and a total of fourteen deaf primary, secondary and tertiary educational settings [13], [14], [15].

3 Presentation of the ‘Dedalos’ Project

The basic objective of the ‘Dedalos’ project is to support the equal rights of deaf people for their access and real participation in professional training [16]. Moreover, the main aim of the project is the promotion of the English language as a second language for the deaf and hearing impaired individuals through distant linguistic training using innovative educational material (e-content) suitably adapted to the needs of this special group of people. In the present Leonardo Da Vinci ‘Dedalos’ project the following steps were followed:

a) Development of an e-learning environment for the deaf and hearing impaired people, adapted to their special needs via their sign language. The environment has

been designed and is based on the use of the advanced teleconference services of the Internet (network virtual classrooms) and offers a number of facilities and services that support education and training via an easy and user-friendly way, in the form of lifelong and continuous education and training for the deaf people.

b) Design and development of electronic informative and adaptive material (e-content) for the deaf and hearing impaired people on the Web. This informative material includes text and video (multimedia) and aims at the teaching of the English language (Fig. 1). The material has been designed to be translated in its entirety in the sign language via streaming digital video according to the e-content specifications of the A.I.C.C.

c) Design and use of innovative e-learning methods for the Linguistic Training of self-paced learning. Processes of synchronous learning and collaborative methods of asynchronous self-paced learning were used [17], [18].

d) Design and operation of an application for lifelong and distance training of the English language. In this application, all the aforementioned actions and developments were designed and coordinated so that the desired outcome of training is available to the deaf community for application and evaluation that will lead to the final improvements of the central as well as of the subsidiary design and developments. Taking into account the circumstances in Greece, deaf people do not have the proportional financial resources in order to be equipped with suitable material and technical systems for the use of e-learning. This being the case, the project aims at the creation of centers of distance training into the deaf / hard of hearing associations so that through the proportional material - technical equipment and parallel training of the

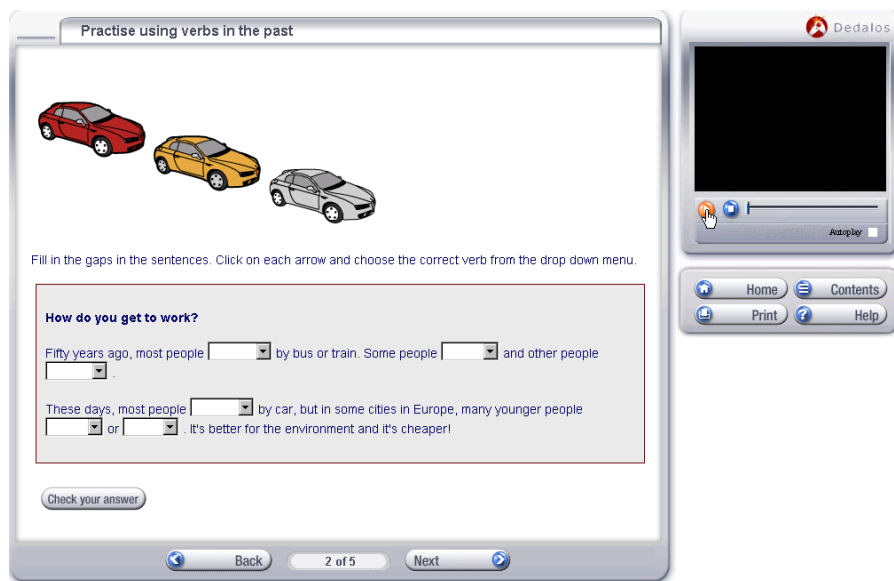


Fig. 1. Sample of the e-Material including Text and video

teachers of deaf people, the services of the new Information Society will be provided to the deaf and hearing impaired people.

4 An E-Learning Platform for the Deaf and Hearing Impaired Individuals

4.1 The E-Learning Platform

The 'Dedalos' environment has been designed using asynchronous services for the delivery of the educational material as well as modern and asynchronous services of communication and collaboration, trying to exceed the exclusions that are related with the time and the place of training but also to satisfy the needs of deaf and hearing impaired students with a variety of possibilities of equipment and communication.

Furthermore, the model of the visual classroom has been designed using videoconference services through images, at the same time with the possibility of realization of cooperative real-time activities (whiteboard, application sharing, file sharing).

Apart from the designed visual classroom model, the model of supported self learning is also in use. A basic rule that should condition the systems of tele-education for self learning is the control. This means that the educated person is simultaneously able to use the course but is also able to intervene in the flow and its structure. In this designed model the strategy is learner centered.

The designed services that are provided by the environment are categorized into three fundamental axes:

- Visual order: line of courses in real time with the possibility of interaction through the Internet.

- Self-instruction: access (search and recuperation) to training and informative material for various cognitive and more general subjects that interest teachers.

- Cooperative learning: communication and attendance in thematic circles of discussions and development of cooperative activities.

4.2 The E-Content

The purpose of the discussed special e-learning environment could be summarized as teaching - tutoring deaf students in order to meet the ESOL level 1 and level 2 standards (developed by the Department for Education and Skills (DfES) and the Basic Skills Agency (BSA)). One could figure out that each of these two levels consists of the same five sections namely A, B, C, D, and E. Their semantic differential is located on the language skills acquisition each level defines as necessary - appropriate.

An abstract e-learning schema of the final system is the following: The learning process consists of three phases. Each individual deaf student must successfully complete each phase in order to proceed to the next. Also, a fundamental assumption is that there exists a (logical - obvious) priority list containing all sections in a certain ascending order.

Section Priority List

- [A] Letter recognition and alphabetical order
- [B] Spelling - vocabulary

- [C] Grammar - sentence structure
- [D] Reading
- [E] Writing

The e-learning process is presented in length in the next paragraphs. Moreover, some key issues are being analyzed.

Phase 1 → [Acquiring the necessary language skills for each individual section] Per section questions or questionnaires are interchanged with corresponding instruction/lesson sessions. This process ends only after the deaf individual completes all sections successfully. In case an accurate assessment (according to statistical thresholds) of the student's language level cannot be reached, more questions are employed.

Phase 2 → [Acquiring language skills relevant to each section and to the section(s) lying above it]. The deaf student is provided with questions relevant to a certain section and simultaneously relevant to all the corresponding prerequisite sections (of the section under consideration). Two issues are of vital importance; answers could be simultaneously right according to some sections and wrong according to others and also the part of an answer relating to a specific section could be partially right. Moreover, the question itself exhibits different, in general, degree of relevance/weight with respect to each individual section (Fig. 2).

Phase 3 → [Overall verification - evaluation of the student's exact language level] Questions at this phase are more complex combining various arbitrary sections, which are chosen randomly instead of being selected in some formal way (for instance by depending on a priority table). Although these questions differ from the questions of Phase 2, their construction and internal structure is similar.

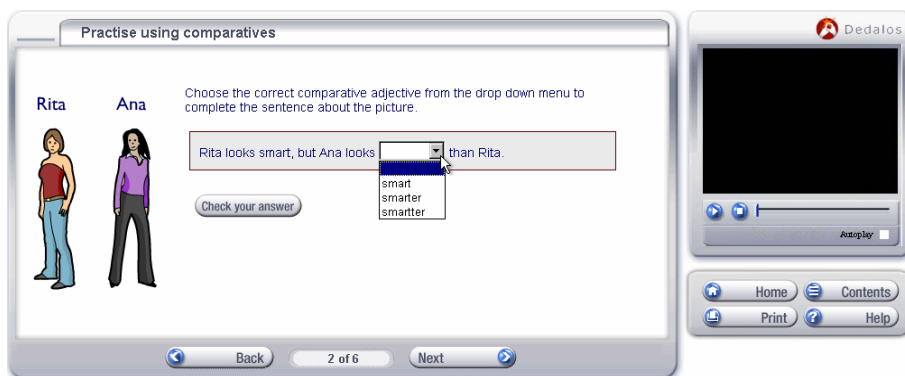


Fig. 2. Sample of the self assessment tests

4.3 Adaptive Fuzzy Subsystem for Assessing the Learning Procedure

The fuzzy inference system is a popular computing framework based on the concepts of fuzzy set theory, fuzzy if then rules and fuzzy reasoning. It has found successful applications in a wide variety of fields. Because of its multidisciplinary nature, the

fuzzy inference system is known by numerous other names, such as fuzzy-rule-based system, fuzzy expert system, fuzzy model, fuzzy associative memory and simply fuzzy system.

The basic structure of a fuzzy inference system consists of three conceptual components: a rule base, which contains a selection of fuzzy rules; a database (or dictionary), which defines the membership functions used in the fuzzy rules; and a reasoning mechanism, which performs the inference procedure upon the rules and given facts to derive a reasonable output or conclusion.

The target system under consideration is the language skill evaluation - assessment expert subsystem of the e-learning environment. The fuzzy system is then expected to be able to reproduce the behavior of the target system.

Literally, the designed expert system, which is part of the general e-learning environment, demonstrates functionality equivalent to adaptive fuzzy inference systems. Correspondingly, the proposed architecture - model is referred to as AFELS, which stands for Adaptive Fuzzy E-Learning Subsystem.

5 Conclusions

The implementation of an intelligent system for the evaluation of deaf students is in the immediate future work plans, in the framework of this project.

The final system uses modern techniques of neural networks and fuzzy logic. This system classifies the student in knowledge levels, which also determines the final structure of the educational material. More analytically, it is a system of measurement of the level of acquisition of knowledge and skills of the student for the duration of the training process.

The official approach becomes with the use of a short test in each unit. However, it is known that the process of learning is figured with various students behaviors that depend on the experience, the background and the particularities of the student. The approach that will be developed is the classification of various behaviors through unclear (fuzzy) proposals and their connection through fuzzy rules which will be used by an experienced system. The experienced system will choose the most suitable strategy for each student. All the processes will become through the follow-up of a hypertext environment through which we can represent the behavior of the student and which constitutes the condition in order to have the possibility of fuzzy inference.

The main limitations of the study are divided into linguistic, educational and technical limitations. Most of the limitations are typical in video streaming projects, and were expected before the beginning of the project. From a linguistic and educational point of view, the major issues that need to be addressed are the following:

In some areas of the language there are no standardized signs, so there may be some theoretical objections as to the use of particular entries. However, a platform such as the one described in this article allows multiple translations but also has some limitations as to the size of the files since these files have to be published in the form of streaming video through the web. A second problem is the ability to make changes in the database of video files.

The data available in GSL, for example when compared with data in Greek, are dauntingly scarce. Error correction mechanisms were sought after, in order to assure

reliability of results. Such back-up mechanisms are the use of approved dictionaries, the consulting of the Pedagogical Institute and the feedback from the deaf community along with the continuing data from GSL linguistic research.

Lastly, all schools in Greece have access to the Internet, deaf settings included. In practice however, there are many more accessibility barriers for a considerable number of deaf students who have additional special needs. Relevant provisions have been made according to general accessibility principles for these students (as to text size, keyboard settings etc) but the pilot implementation of the project after six months has indicated more points for development.

Technical problems include the following:

A qualitative videoconference sign language communication is highly expensive in terms of bandwidth. Especially in the case of multipoint continuous presence communication the demand of bandwidth is multiplied according to the number of the conferring signers. Under these circumstances, DSL links of at least 384Kbps are considered as the minimal requirement for a Sign Language Virtual Classroom.

Given that the platform under discussion consists of an original research object, successful completion of its development has opened the way to a complete support system for the education of the deaf community members in Greece.

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