Net4Voice: new technologies for voice-converting in barrier-free learning environments

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Summary

The Net4Voice project aims to increase the quality of learning opportunities promoting the adoption of barrier-free learning environments and the development of innovative methodologies which use speech recognition (SR) technologies. SR technologies can automatically transform a lecturer’s speech into digital text in real-time, generating an electronic transcription of the lesson or conference ready to be printed or delivered through different devices and channels.

This paper intends to disseminate information and results obtained so far through the Net4Voice project, financed by the European Commission under the Lifelong Learning Programme. In particular the objectives of this article are to present the project's objectives and the activities implemented to achieve them; describe the learning methodology developed and show the first outcomes of ongoing tests.

Net4Voice started in December 2007 and ends in November 2009. The project involves three universities and two high schools, where students with different kinds of auditory or motor disabilities can particularly benefit from the use of speech recognition technologies to follow lessons in an accessible learning environment without additional intermediary support. Second language learners also benefit from these technologies, as once the class has finished they are able to access the multimedia transcriptions available and read or listen the lessons again.

Net4Voice aims at defining a clear scheme to assess the impact of speech recognition technologies in education, by experimenting it in at least three different learning contexts: university, school and adult education classrooms. Moreover, the project monitors the effectiveness of a new learning methodology, a pedagogical support system, in order to use technology at its best, exploiting its potential, adapting it to students’ conditions and needs and combining software with personal teaching experience and methods.

Keywords: Net4Voice, learning methodology, education, innovation, technology, speech recognition, accessibility, eInclusion, e-inclusion, voice recognition, multimedia, barrier-free learning

1 Introduction

This article intends to disseminate information and results obtained so far through the experimentation carried out under the Net4Voice project. In particular the objectives of the article are:

- to present the project objectives and activities implemented to achieved them;
- to describe the learning methodology developed;
- to show the first outcomes in response to ongoing testing.

The paper is organized as follows: introduction presents the context of project, in section 2 the project is described in detail, along with its main software characteristics and requirements; in
section 3 the learning methodology is presented and discussed; in section 4 experiments are described; finally, in section 5 the evaluation and results obtained so far.

Speech-recognition (SR) technology converts speech automatically, such as a school lecture or a talk, into a digital text in real time. It generates an electronic transcription of the speech which can be printed or transferred to the user by means of specific devices. In this way, the lecture can be read or listened to once again to make sure that the content has been fully understood. This is possible because once the lecture is over the software saves the speech-recognition-generated transcript, audio, and PowerPoint slides as a streaming media file. This allows students to select the information from the lecture that best suits their individual needs or preferences.

In particular, Net4Voice aims at defining a scheme to assess the impact of speech-recognition technologies in education by experimenting it in at least three different learning contexts: university, school and adult education. Secondly, it also evaluates the impact on the key actors involved, students and teachers, by especially focusing on learning settings created for people with specific needs. Net4Voice assumes that education in traditional classrooms is still the most pervasive way to support learning, although it does not always properly satisfy certain needs related to accessibility and effectiveness of learning. The experiment is therefore aimed at evaluating: software accuracy in speech recognition in relation to the environment and the duration; the student’s viewpoint; the usability of side-products such as transcriptions of the speech; open issues. At the same time, describing and comparing the different learning situations, the teachers and lecturers involved are stimulated to develop a learning methodology such as a guideline supported by pedagogical assumptions. This learning methodology should offer a pedagogical support system in order to use technology at its best, exploiting all its potential, adapting it to students’ conditions and needs, and combining software with personal teaching experience and methods.

2 Description of the project: aims and requirements

2.1 Summary of the project

Three European universities (University of Bologna, Italy; University of Southampton, Great Britain; University of Ulm, Germany) and two high schools (Iris Versari High School, Italy; Totton College, Great Britain) are partners in the Net4Voice project, which consists of testing voice recognition techniques and methods within a variety of learning contexts. Speech-recognition technology transform lecturer’s speech into digital text in real-time, by generating an electronic transcription of the lesson, or conference material, to be printed or delivered through different devices and channels. The need to support the learning process with non-traditional technologies derives from the fact that teaching material is not easily accessible to users with disabilities in different learning contexts. The exploitation of interactive technologies helps students to learn by doing, receiving feedback, and continually refining their understanding. This facilitates participation in lifelong learning by people with various needs.

2.2 Objectives

The project main goal is to create empirically an optimal barrier-free model enabling access to information for people with disabilities in a variety of real world educational environments. Other objective consists in build centres of excellence for the development and delivery of innovative learning and teaching process and methods within the European Community. The project strengthens the worldwide competitiveness of the European Community by incorporating principles of universal design and inclusive education.

The project also aims to test various speech-recognition techniques and methods within various traditional and non-traditional learning contexts. Utilizing a collaborative action research framework, researchers investigate how the impact of speech-recognition technologies differs across categories of disability, languages, and across educational contexts. The final aim of the
The project is to increase the quality of learning opportunities for the whole of society, promoting the adoption of barrier-free learning environments and the development of innovative learning methodologies which utilise speech-recognition technologies.

Concrete aims of the projects are:

- develop a new learning methodology that experiments and evaluates the impact of speech-recognition technologies in at least three educational settings: school, higher and adult education;
- focus on different target user needs: people with disabilities, second languages learners, etc.;
- evaluate the scalability of the speech-recognition based learning methodology and to define a strategy for transferring to other EU countries;
- raise awareness and further in-depth knowledge about the impact of speech-recognition technologies in different educational settings.

In the medium/long term, the project aims at supporting the development and dissemination of innovative and well-balanced ICT educational tools and the design of new standardised pedagogical documentation for the lifelong learning in a European educational setting.

### 2.3 Main activities

During the first year, the project has aimed at developing a new joint speech recognition technology, based on new learning methodology in order to increase the accessibility and effectiveness of learning at all of its stages.

The main activities carried out have been:

- define a new learning methodology shared among partners;
- training of the professors identified by partners on the developed methodology.

Activities that are still playing:

- testing the speech-recognition technology;
- collect feedback from partners for the implementation and verification of the methodology developed.

Other important activities carried on during the project are:

- sharing and validation of the results of the experimentation;
- evaluation of the scalability of the testing results and planning of dissemination and exploitation activities;
- dissemination of project results.

### 2.4 Beneficiaries

The main beneficiaries of the project results consist in individuals that are clearly disadvantaged in traditional and non-traditional learning environments, as deaf or hearing-impaired that cannot access spoken content without intermediary support. People with physical disabilities, that cannot take their own notes and some with various learning disabilities, struggle with auditory, visual and tactile challenges. People without disabilities besides can also experience difficulties in accessing information under certain conditions; for example, second language learners, and all students in general, can take advantage of these technologies which enable them to exploit the available multimedia transcriptions a second time, after the lesson, by reading and listening to the lesson content again - anywhere and whenever they wish. This happens because, after the lesson, the software saves the speech recognition generated transcript, audio, and PowerPoint slides as streaming media file. This allows students to select lecture information that suits their individual learning preferences. In addition to text transcripts, the software creates a series of files (SMIL, XML, WAV, RT, RTF) that can easily be published on the web, creating a rich set of teaching resources for all the students (Wald M. 2006).
Moreover, Net4Voice supports teachers, professors and academic staff in taking a proactive, rather than a reactive, approach to teaching students with different learning styles. It provides educators with a practical means of making their teaching accessible, and improves the quality of teaching in the process.

2.5 ICT, accessibility and learning methodology

Net4Voice recognises that education in traditional classrooms is still the most pervasive way to support learning. Nevertheless, there are needs related to accessibility and effectiveness of learning that are not properly satisfied in the traditional classroom. In this regard, while extremely important and unique, traditional face-to-face (F2F) education presents constraints due to physical, temporal and cultural barriers that could hinder access to - and the effectiveness of - learning.

ICT can be an effective means to improve the quality of educational processes in term of accessibility and effectiveness. In this way the adoption of a universally accessible learning helps to promote a better quality of education for the whole community.

3 Learning methodology

3.1 Defining a new learning methodology

The learning methodology, carried out step by step as a shared document and developed through contributions coming from all the partners, defines a common methodology adopted within different educational levels and settings with various needs and constraints when using SR technology.

Its aim consists in making the professors involved in the project able to share and transfer all the information about their own methodological choices or tools to other local institution professors. In order to define the methodology, the following stages and goals have been planned:

- analyse and compare learning contexts of speech-recognition technology application;
- describe each educational setting where the speech-recognition technology is used;
- describe the speech-recognition technology experimentation in the different educational activities;
- analyse each learning approach to speech-recognition technology;
- define the learning methodology;
- testing the speech-recognition technology based on the learning methodology developed;
- sharing of the experimentation results.

3.2 Describing and comparing different learning situations (methods and tools)

The first activity of the Learning Methodology Work Package has focused on the comparative analysis of the educational settings features. This is fundamental in order to achieve a common knowledge of the similarities and differences that characterize the partners, and makes the further exchanges significant and effective.

The professors involved have been guided through an analysis of their educational setting features. The model for comparison that has been proposed takes into account some of the main variables occurring in educational processes in order to make each description easier and more sharable.
The first variable taken into account is the educational context: school education, higher education or adult education. Each partner has been asked to describe the main characteristics of his own situation.

The second very important variable is the learning setting: we had to distinguish between three possible situations: distance learning, presence learning or a blended learning perspective. It was also fundamental to be clear about the characteristics of students and teachers: are they disabled or not? Are they foreign or not? This is something that can have a certain impact on the teaching and learning methodology when using SR technology. Furthermore, teachers and lecturers were asked to reflect on their own educational approach in order to distinguish and compare it to that of the others. We have proposed three kinds of educational perspective for comparison and asked if they feel closer to.

Educational approach:
- Reproduction learning perspective, based on comprehension, memorisation, focused on elementary learning objectives and using traditional teaching methods;
- Construction learning perspective, based on construction-conceptualization, focused on intermediate learning objectives and using teaching methods based on problem solving, research methods, the use of tools, group work;
- Creativity learning perspective, found on learning processes based on discovery and learner autonomy, focused on higher learning objectives and preferring creative learning activities (Guerra L. 2006).

Each partner was asked to fill in a questionnaire with both closed and open questions, and to give a qualitative description of its own educational setting. The quantitative and qualitative data collected made it possible to describe the different learning contexts involved in the project.

The following table presents a summary of this first comparative analysis, highlighting the main characteristics of each learning situation. It was also used as a training tool in the first meeting of the project, to introduce the partners to the characteristics of each learning context and to reflect on the differences or common aspects as elements for comparison and starting points for sharing activities.

**Table 1. Comparative analysis tool**

<table>
<thead>
<tr>
<th>Learning situation no. 1</th>
<th>Educational context</th>
<th>Learning setting</th>
<th>Students’ characteristics</th>
<th>Teachers’ characteristics</th>
<th>Educational approach</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>School Education (SE)</td>
<td>Distance learning (DL)</td>
<td>Disabled (D) Not disabled (ND)</td>
<td>Disabled (D) Not disabled (ND)</td>
<td>Reproduction perspective (REP)</td>
</tr>
<tr>
<td></td>
<td>Higher Education (HI)</td>
<td>Presence learning (PL)</td>
<td>Foreign (F) Not foreign (NF)</td>
<td></td>
<td>Construction perspective (CON)</td>
</tr>
<tr>
<td></td>
<td>Adult Education (AE)</td>
<td>Blended perspective (BP)</td>
<td></td>
<td></td>
<td>Creativity perspective (CRE)</td>
</tr>
<tr>
<td>learning situation no. 2</td>
<td>HI</td>
<td>BP</td>
<td>D - ND - F - NF</td>
<td>ND</td>
<td>CON - CRE</td>
</tr>
<tr>
<td>learning situation no. 3</td>
<td>AE</td>
<td>BP</td>
<td>D - ND - F - NF</td>
<td>?</td>
<td>REP - CON - CRE</td>
</tr>
</tbody>
</table>

Other data was collected in order to have a clear view of the sample features: the course subject, the number of hours, the setting (classroom, laboratory...), the social learning organization (individual or group learning), the use of tools (blackboard, slides, PowerPoint, etc...), the assessment methods/ tools, etc.
3.3 Sample general features

According to the data collected from each partner, we can give a description of the main features of the learning contexts where the SR technology is tested. The three schools, university and adult education learning situations are represented in the sample. The classes where the SR technology is tested are mixed classes with both disabled and not-disabled students as well as foreign and not-foreign students. All the teachers and lecturers involved tend to use the three educational approaches hypothesised (reproduction, construction, creativity) according to the educational goals and the different teaching and learning stages. They tend to use a blended educational perspective and many teaching methods based on face-to-face, as well as interaction, communication and cooperation. Several tools are used in the experimental classes: PowerPoint slides, videos, blackboard, internet.

Considering the differences between the partners, we have to underline firstly the students’ age: the learner sample goes from adolescence to adulthood. This means a group of people with very different characteristics and learning needs. This data is very important to avoid superficial comparison or the simple transfer of methods and tools from one class to another without considering the age variable. Another difference between the learning situations is course duration: it varies from 10 to 60 hours or more. This means very different timetables and time management for each one when organising teaching methods and tools, and needs to be taken into account when defining the common learning methodology. The last significant difference between the partners’ learning situations is represented by assessment strategies, tools and methods. This differs greatly from one context to another, and needs to be analysed and compared very carefully. The comparative analysis should distinguish many aspects of the evaluation process: the assessment indicators, the assessment tools, the measurement process, the assessment scale, the evaluation. We also need to compare some important evaluation moments and aims: initial, formative and summative (Calvani A. 2000). This analytical approach to evaluation goals, moments, strategies and tools make the comparison between very different learning contexts feasible.

3.4 Possible problems or risks in the educational setting

The general data collected from each partner gives us a description of the main educational features of our sample. Analysing this information in relation to previous SR experimentations and to the scientific literature on this subject, we have made some hypotheses about the possible common problems or risks that can occur in the different educational settings (Leitch D., MacMillan T. 2003). In the methodological approach that has been proposed to the partners, these problems are not considered as constraints but rather as challenges for our educational strategies. This view tries to improve the learning methodology through problem solving. Teachers and lecturers need to be aware of the possible risks of SR technology in order to try also to identify some solutions.

The hypothetical difficulties that have been highlighted can be divided in four groups:

1. **Technological performance problems**: The first and most restricting problem in the use of SR technology in a classroom is the lack of accuracy that interferes with digitized lectures and produces errors that have been seen to be very distracting elements during speech.

2. **Environmental factors issues**: Previous studies (Kalyuga S. 2000) carried out into SR technology shows that the use of it provokes a redundancy of information: the same information is, in fact, given in an oral and in a written form at the same time. This means that students are required to manage more than one cognitive process at the same time. The possible consequences of this, in particular when students are not used to attending lessons with SR technology, are an overload of short-term or working memory, as an individual problem, and distraction in the classroom as a group difficulty.

3. **Problems related to students’ characteristics**: When using a very particular tool such as SR in a classroom, it's necessary to be aware that it cannot always be compatible with individual learning styles. Each student is different from the others when learning, and it
has been shown in testing this technology that not all students might benefit from digitized lectures (Leitch D., MacMillan T. 2002).

4. **Interaction and communication problems:** The use of this tool, very much centred on teacher speech, risks the limitation of dialogue in the classroom. In fact, it is very difficult for the SR technology to involve any interaction between teacher and students.

This list of possible problems or risks has been presented to the partners as a starting point for discussing what can be done for getting through, and to start working on the better educational strategies for SR technology.

3.5 **Pedagogical assumptions and support system**

The problem analysis in the use of SR technology highlights the necessity to give an educational intentionality to this particular tool. Students with disabilities in particular and also students in general need to be accompanied through a learning process using SR technology. For this reason, it is important to create and implement a pedagogical support system, or teaching and learning methodology. This is fundamental in order to use technology at its best, exploiting its potentials.

According to SR technology characteristics and to the learning contexts were it can be applied we have settled some educational assumptions though which define a common learning methodology:

**Beyond the traditional metaphor of Communication:** The first important educational point to take into account when using SR technology in a classroom is the idea of communication behind. Traditionally, communication is considered as a channel which links the transmitter to the receiver. This idea considers the receiver as passive and doesn’t attribute students with an active role in learning. On the contrary, learning is significant when the students don’t simply receive the message but elaborate, manipulate and gain it. We cannot consider educational communication as a one-way channel but rather as an action of giving-delivering and receiving-taking. Teacher and students are both active subjects in communication (Baldacci M. 2004).

**Individualisation – personalisation:** It is very important to plan and organize teaching and learning activities in order to find a good balance between the students’ needs for individualisation and personalisation. We need to enable each student to achieve the necessary skills that guarantee his/her right to equal treatment as well as his/her right to meet and develop his/her personal needs and attitudes. When we focus on individualisation or personalisation, we make very different educational choices in terms of goals, methods, learning strategies and evaluation tools. It is very important to be very clear on this when planning educational activities, in order to give to students both the opportunity, for every topic, to reach the fundamentals and to deepen personal interests and views thereabout.

**Improve students’ empowerment and participation:** When introducing new technologies and methodologies in a classroom, we often risk encountering resistance from students. This is why it is very important to improve students’ participation in the educational processes and choices and to work on student empowerment as a strategy for making students more and more active in learning activities. We need to stimulate both self and social empowerment in order to involve students and to make them as aware and active as possible when using SR technology.

**Disabled students as differently able learners:** SR technology is first of all a barrier-free technology focused on the needs of disabled students. In this view, it is not enough to simply apply the technology, it is fundamental to work towards the integration of disabled students. It is possible to involve the group as a tutorial tool, promoting mutual support and preferring cooperative learning strategies.
3.6 Educational strategies proposal

According to the pedagogical assumptions listed above, the learning methodology provides each partner with practical strategies and tools for using SR technology at their best, solving problems and exploiting all the educational potentials. We know, for instance, that introducing SR technology in a classroom, students might initially be intimidated, sceptical or unwilling to use the technology itself. Our educational experience and assumptions allow to avoiding this risk, for example by trying to promote student empowerment, involving them in the project by making aims and steps clear and shared.

Concerning planning, it is important to underline that the use of SR technology requires that teachers do it very much in detail, focusing on how they are communicating. It is also a very good opportunity to reflect on their teaching style and self-assess it. At the same time it is also very important, even when we follow an accurate programme, to be open to "unexpected" events. This is called serendipity: the ability to find what we wasn’t looking for.

Setting is another very important point to find the best strategies to overcome SR difficulties because of not all students may benefit from digitized lectures; in this case the classroom setting should be adjusted so that the screen can be placed more or less centrally for different learners, according to their needs and preferences.

Considering communication, it is clear that students interaction risks being constrained by SR technology. It is not always possible to repeat every student’s intervention, nor is it always effective. In order to solve this problem, teaching methods can be organized with the planning of specific activities for interaction, mediated by written texts that can be read by the teacher (e.g. discussion in small groups, each of which will produce a final written report or written brainstorming).

In the choice of teaching tools, is useful to use pictures rather than written texts while speaking, as a possible way of reducing the risk of making information redundant. Furthermore, this would involve different cognitive channels.

Concerning assessment, it is very important to apply both formative and final assessment in order to evaluate learning processes and products in order to adjust teaching strategies to students’ characteristics (Genovese L. 2006). Many tools and assessment methods can be used to assess the effectiveness of SR technology (observation check lists, interviews, satisfaction questionnaires, tests, etc.).

Thinking about SR technology from the educational point of view, we can consider its utility in learning processes; for example digitized lectures should be transformed in educational tools and be used as:

- recovery tools of previous lectures or classes;
- reading comprehension exercises (compensating for information that has been missed, giving the text to students and asking them to correct it);
- note-taking exercises: comparing students’ notes with the text of the whole lecture, improving notes, learning note-taking strategies;
- material for producing conceptual maps or reorganising the lecture.

The educational strategies that have been presented represent some possibilities for exploiting SR technology, and make it as effective as possible for every learning context. Many other solutions, and techniques can be found, and it is very important for teachers to look continuously for them. When using technology for educational purposes, we need to consider technology itself as an educational tool, an active approach to SR technology is needed in order to adapt it to students’ conditions and needs and combine it with personal teaching experience and methods.
4 Experiment description

Recognising that education in traditional classrooms is still the most pervasive way to support learning, there are needs related to accessibility and effectiveness of learning that are not properly satisfied in the traditional classroom. In this regard traditional face-to-face (F2F) education presents constraints due to physical, temporal and cultural barriers that could hinder access to - and the effectiveness of - learning.

Therefore, we try to demonstrate that ICT represents an effective means to improve the quality of educational processes in term of accessibility and effectiveness and that the adoption of a speech recognition technology based on an accurate and accessible learning methodology helps to promote a better quality of education for the whole community.

The experiment was planned as a cycle with three main phases:

1) registration during lectures based on power point slides;
2) off-line correction of transcription and generation of the updated voice profile;
3) upload of the new profile.

The equipment used during lectures consists of a laptop PC and a wireless microphone; it can be set up at the beginning of each lecture module with very little interference with the lecture itself.

For collecting feedback on the test (still in progress) and evaluation of results achieved were prepared questionnaires and interviews, which have already revealed some important results and considerations (reported in the next chapter).

The short-term expected outcomes of the experimentation are:

- experiment speech-recognition technology in a wide range of subjects, testing all the opportunities offered by this technology and the adoption of multi-channel learning methodologies;
- test and validate learning methodology that can be shared with other educational institutions in order to create a stable and broader network;
- provide educators with a practical means of making their teaching accessible, and improves the quality of teaching in the process.

4.1 Aims of the experiment

The experimentation starts from the assumption described above and its aims consist in evaluate:

- the learning methodology applied to the speech recognition technology;
- software accuracy in speech recognition in relation to the environment and the trial duration;
- the viewpoint of teachers and students;
- usability of by-products like transcription of the speech;
- open points/ issues to be addressed.

4.2 Accuracy results

Speech transcription was edited after each lecture to update the speech profile of the speaker. The accuracy was shown to be strongly dependent on the kind of speaker. It was noticed how slow speaking and well-articulated words can significantly influence the quality of the results. In any case, we suggest that, especially in the presence of disable or foreign students, the teacher should pay attention to this issue.

The accuracy results achieved so far are showed in attachment file, in which are reported number of recorded lessons, number of recorded lesson hours, number of corrected hours,
percentage of corrected hours over the total, initial accuracy, final accuracy (percentage of correct words) and the improvement of accuracy.

**Table 2. Teacher 1 experiment results**

<table>
<thead>
<tr>
<th>Number of recorded lessons</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of recorded lesson hours</td>
<td>11.92</td>
</tr>
<tr>
<td>Number of corrected hours</td>
<td>3.35</td>
</tr>
<tr>
<td>% corrected hours over the total</td>
<td>28%</td>
</tr>
<tr>
<td>Initial accuracy (% correct words)</td>
<td>40.91%</td>
</tr>
<tr>
<td>Final accuracy (% correct words)</td>
<td>80.05%</td>
</tr>
<tr>
<td>Improvement of accuracy</td>
<td>95.67%</td>
</tr>
</tbody>
</table>

**Table 3. Teacher 2 experiment results**

<table>
<thead>
<tr>
<th>Number of recorded lessons</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of recorded lesson hours</td>
<td>2.2</td>
</tr>
<tr>
<td>Number of corrected hours</td>
<td>0.81</td>
</tr>
<tr>
<td>% corrected hours over the total</td>
<td>37%</td>
</tr>
<tr>
<td>Initial accuracy (% correct words)</td>
<td>26.13%</td>
</tr>
<tr>
<td>Final accuracy (% correct words)</td>
<td>34.99%</td>
</tr>
<tr>
<td>Improvement of accuracy</td>
<td>33.91%</td>
</tr>
</tbody>
</table>

### 4.3 Influence of the environment

One of the main external factors which is expected to influence the accuracy of the process is represented by the situation offered by the room where the lesson takes place. In practice, the room can change from lesson to lesson and the environmental background noise is expected to play a role in the speech recognition process. The experiment was set up to assess the influence of background noise, by obtaining some registrations in a small room without people with minimal environmental noise. The preliminary results show that the improvement in speech recognition by the software can be significantly improved.

### 4.4 Students' viewpoints

Students are not really users during this trial but the reaction was however extremely positive and they showed interest also in the possibility to use the speech transcription as lecture notes (Hede A. 2002). In fact, the transcriptions contain both the recognized speech and the image of the slide to which the speech refers. This product can be useful also in the case, such as this, in which speech recognition is around 80%. It can help as a quite complete complement to student's notes.

### 4.5 Teachers' viewpoints

Teachers' feedback was extremely positive about the use of speech recognition technology in their classroom. In spite of this positive opinions and the great interest, it's important to underline some aspects that need particular attention during the use of this tool; in fact when using speech recognition, it's necessary to be aware that it's not always compatible with individual learning styles used by teacher. Moreover in presence of disable or foreign students, the teachers should pay attention to their explanation style because of this influence the quality of the transcription. Another aspect that can create resistances in teacher is connected to their information technology skills and to the performance of the technical instruments used.

### 4.6 Open points

This trial has outlined the ease of the methodology and its potential in supporting real-time text display of the speech. At the same time, it has been very useful for highlighting some open points to improve the effectiveness of the applied software.
The achievable accuracy greatly depends on the speaker. Should the speaker change, the lecture cannot be given with the same methodology.

In relation to low accuracy, words are proposed out of the lecture context. It could be useful if the original set of words could be changed in order to avoid words that the speaker does not use in the lecture context.

The maximum accuracy of recognition seems to be only slightly affected by the environment, if the microphone is correctly used.

The software training consists of the correction of transcription mistakes, and this activity requires a lot of time (an average of 8 hours for 1 hour’s registration), especially at the beginning of the training when the accuracy is still very low.

It is necessary to improve the accessibility of files created after the lesson by the speech recognition technology in order to make them useful also for students who use particular instruments while surfing the web.

5 Results

5.1 Expected results

The main expected results consist in to ascertain and verify the starting assumption according to which information and communication technology are effective means to improve the quality of educational processes, especially in terms of accessibility and effectiveness, and that the adoption of a universally accessible learning methodology helps to promote a better quality of education for the whole community.

5.2 Achievement of first results

The first results achieved through experimentation, currently in process, allowing some relevant considerations to the use of speech-recognition technology in different educational contexts. These considerations, which at the end of experiment will be integrated with other results and used to define precise guidelines, have been outlined by the matching between quantitative results (time record, level of accuracy, percentage of choice, etc.) and qualitative results (opinions, suggestions, evaluations, etc.). These considerations are:

- the improvement of accuracy in speech recognition can be significantly improved if accompanied by appropriate training of teachers;
- the value and utility of the material produced by the transcription has been demonstrated not only by their use to supplement the notes of the students. In fact, this material when used to review, integrate and diversify the content of the lesson, improves the quality and support learning, especially in student with particular needs;
- for effective utilization of the instrument is important to take into account multiple variables such as the students’ characteristics, the course subject, the number of hours, the setting, the social learning organization (individual or group learning), the use of tools (blackboard, slides, PowerPoint, etc.), teaching approaches and didactical strategies. Once analyzed all these aspects is necessary that become part of the construction process of the lesson to make effective use of technology;
- the use of technology is more effective in educational contexts who prefer methods based on face-to-face teaching;
- the use of SR technology and the adoption of multi-channel learning methodologies need to take into account the possible repetitions and redundancy in the presentation of content, so the choice of channels to be used (written, spoken, slide, transcription in real time) needs the awareness of this possible risk.

5.3 Issues to be addressed

The current experimentation is still ongoing (in April 2009), therefore some issues remain to be addressed, including:
− the accuracy depends by the kind of speaker, speaking in particular clear and well-articulated words can significantly influence the quality of the results. Therefore further experiments are carrying out on this issue, particularly in relation to style of exposure used in lessons;

− the speech recognition technology seems to have some limit in lectures with group work, discussions and laboratory activities. Are therefore ongoing in-depth studies on this issue;

− to achieve a high degree of accuracy is required a number of fixes and updates to the voice profile, activities that in some cases requires the presence of tutors for not burdening teachers of excessive work.

References


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