OPPORTUNITIES FOR COMPUTER-AIDED INSTRUCTION IN PHONETICS AND SPEECH COMMUNICATION PROVIDED BY THE INTERNET

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ABSTRACT

Spoken language engineering is starting to deliver technological products to the commercial market and has an important future role in supporting the multilingual structures of modern Europe. The field will be driven forward by basic science and applied research by experts drawn from a variety of backgrounds; among them: linguistics, psychology, computer science and electrical engineering. The wide range of expertise required in this discipline brings difficulties for our educational systems, but also challenges us to use our knowledge of technology and communication to improve the quality and effectiveness of teaching and learning.

This paper investigates how resources currently available on the Internet could be exploited in the education of phonetics and speech communication. It discusses the technology, outlines the requirements for computer-aided learning in the field, gives a taxonomy of the available components with examples, and criticises the main weaknesses in the current provision.

1. INTRODUCTION

The Socrates Thematic Network in Speech Communication Sciences brings together 80 academic institutions throughout Europe in the fields of Phonetics, Spoken Language Engineering, and Speech & Language Therapy. Its aims are to provide educational support, disseminate good practice and reflect on future developments. The Working Group in Computer Aided Learning and Use of the Internet aims:

- to bring together information about resources and tools for computer aided learning in the field,
- to promote the use of the internet to disseminate information and teaching materials,
- to make suggestions to potential authors for areas of resource development,
- to encourage the generation of comprehensive, high quality resources, and
- to create an infrastructure to survive beyond the end of the funded project.

This paper summarises the results of the first year's activities of the CAL/Internet working group. A full report will be published in [1]. In our first year we have restricted our activities to surveying existing resources currently available free of charge over the Internet. In the following sections we look at the match between Internet technology and educational requirements in general, highlight the requirements of Speech Sciences in particular, give a taxonomy of available resources (with examples), and criticise the current position.

2. INTERNET POTENTIAL FOR COMPUTER AIDED LEARNING

2.1 General Requirements

The Internet is an information carrier - a medium - which links information providers to information users. The CAL/Internet working group is concerned with the pedagogic potential of this medium: with its strengths and weaknesses in respect of educational provision and educational requirements.

In this paper the Internet is taken to mean both the physical hardware which interconnects millions of computers and the software tools which can be used to enable teaching and learning to take place worldwide. Few of the tools were originally designed for pedagogic purposes (many arose from efforts to enable Computer-Supported Cooperative Work and Computer-Mediated Communication) but many have been successfully used to enable teaching and learning over the internet.

Key categories of tools are:

- **computer conferencing** (e.g. news groups, Notes and First Class) which allow student and tutor participants to exchange file-based messages, and to organise and view these in a structured manner;
- **video conferencing** (e.g. PictureTel/ISDN, CuSeeMe) which allow audio and moderate quality video pictures between a number of participants;
- **chat facilities** (e.g. Internet Relay Chat, MS Comic Chat) which allow text based conversa-

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tions between multiple participants in real time;

- **electronic mail** (e.g. MS Mail) which allows files to be exchanged between multiple persons;
- **web documents and browsers** which allow multimedia content to be published (e.g. MS Front Page, HotMetal, MS Office97) and viewed (e.g. Netscape Navigator, MS Internet Explorer); and
- **co-operative applications** (e.g. Sun ShowMe) which enable multiple users to work collaboratively on a given application (e.g. a whiteboard or a word processor).

There are also tools which allow the **tracking of students** (e.g. WebCT, West, TopClass, Cafe-Mondial) as they progress through a course; these commonly include means for formative and summative assessment.

An important character of Internet education is the potential for teaching and learning at a distance from a host institution. The consequence of this *telematic* teaching is that the students may well be unable (for reasons of time or distance) to come together synchronously as a whole "class". For such students a key potential of the internet is its ability to link them together into a collaborating community (by means of file based computer conferences, e-mail and the web) so that they can benefit from a richer teaching and learning environment. Furthermore, this environment can include static information, active and interactive content (using Java, Visual Basic, Perl and other scripts as well as ActiveX and Java mini-applications) in full multimedia format.

While the technology of the Internet is seductive, it is nevertheless important that the technology be used to produce well motivated, pedagogically sound learning experiences which play to the strengths of the medium. These clearly lie in the facility with which material can be made available, maintained, updated and re-used. The sheer volume of the material available and the social dimension of community which telematics creates are strengths in themselves. After all, education is concerned with preparing learners to become fully fledged participants in a given arena. Participation means as much about acquiring skills in presentation, communication, analysis, debate and discussion as it does about knowledge itself. It is in this area that the Internet currently excels. It may not be always be appropriate to publish material on the Internet when a book or compact disc is more practical, but the Internet is good at bringing people together and creating electronic communities for teaching and learning.

2.2 Special Requirements of Speech Sciences

2.2.1 Multiple disciplines

The study of Speech Sciences is inherently multidisciplinary, involving elements of linguistics, modern languages, psychology, computer science and electrical engineering as well as many biomedical areas.

Traditionally expertise in these areas has been distributed across a number of academic departments, each with its own human resources, facilities and tools. Students find the multiplicity of disciplines hard to manage, as their background rarely prepares them in breadth. The Internet as a medium of communication can help in a number of ways:

- it gives students the means to draw on varied expertise throughout the community,
- it facilitates communication between `virtual' communities of teachers or students working in a particular sub-discipline,
- it enhances quality and reduces a duplication of effort in the creation of teaching materials, and
- it encourages the dissemination of good practice.

2.2.2 Distance learning

Many students (in modern languages or computer science, for example) find their interests in Speech Sciences cannot be satisfied by their local institution. There are relatively few specialised departments of Phonetics or Speech Science in Europe. The Internet can allow students to participate at a distance with teachers in other institutions, using the variety of mechanisms for computer mediated communication.

2.2.3 Language diversity

Speech Science education should be built on the universals and specifics of human languages. The Internet can allow easier access to linguistic resources, tutorial information and native speakers of any human language regardless of geographical location.

2.2.4 Multiple media

Speech processing is inherently multimedia in nature, involving both sound and vision. Current printed materials struggle to convey the co-ordination between articulation, sound production and sound perception. The Internet standards for audio, video and even three-dimensional models could lead to materials where such interactions become much clearer to the student (a 3D model of a vibrating larynx, for example).

2.2.5 Practical skills

The Speech Sciences student needs to acquire practical skills in listening, analysis and performance. This inevitably requires a lot of staff/student interaction at a time when there is pressure throughout European Universities to increase efficiency. Interactive assessment and peer assessment through the Internet can increase the efficiency of student self-study in these skills.

3. INVENTORY OF MATERIALS

3.1 Inventory of Internet Resources

Between February and June 1997, the CAL/Internet group surveyed Web sites worldwide for educational resources relevant to Speech Sciences. Through electronic mailing lists the group advertised its activities across Europe and collected a mailing list of 80 people interested in computer aided learning in Speech Science education. (If you would like to register your interest, send an e-mail to [URL1]). The group set up a Web questionnaire and a database to collate the resources found. (The questionnaire may be found at [URL2]). At the time of writing the inventory has 85 entries, which has allowed the resources to be catalogued under a number of headings. The category system is described below with some selected examples from the inventory. The complete inventory can be found at [URL3].

3.2 Taxonomy for Internet Resources

The group has developed the following set of nine categories to describe the types of educational resources currently available on the Internet.

3.2.1 General information
Documents relating to how the Internet may be used to deliver teaching and learning. These cover the pedagogical opportunities and problems arising from the use of the internet, to discussions of the individual technological services. An example is the paper by McManus [URL4] which gives an overview of Web-based instruction, its design and delivery.

3.2.2 General Tools
Internet accessible tools to aid in the delivery of tuition: both in terms of computer-based and internet-based technologies. This ranges from tools for authoring and interactive assessment to complete environments for the creation of telematic courses. An example is the WebCT package that covers student tracking, assessment, chat, discussion groups and e-mail as well as course material [URL5].

3.2.3 Tutorials
Educational materials relevant to the Speech Sciences theme, which are directed at the student. They can cover both large and small topics, from complete tutorials in Phonetics and Phonology, to a discussion of the principles of spectrography. An example is a tutorial on acoustic-phonetics [URL6].

3.2.4 Component Resources
These are smaller educational resources that could be included in tutorial material, but which are not currently suited to student self study. Two examples are a demonstration of categorical perception by one of the authors [URL7] and a recreation of the sights and sounds of the Haskins pattern playback machine [URL8].

3.2.5 Course Syllabus Information
Descriptions of a course syllabus or curriculum on the Web. These often contain lecture lists, reading lists and assessment details. These may be of more interest to teachers than to students of other institutions. A hyperlink page leading to such resources is the World Lecture Hall in Linguistics [URL9].

3.2.6 Bibliographies and Refereed Articles
Means of access to published research articles in the field. There are a number of Academic Journals that provide searching facilities on Contents or Abstracts; while some even provide full text papers. A useful resource is a searchable bibliography of Phonetics and Speech Technology papers with over 10,000 entries [URL10]

3.2.7 Links pages and other non-refereed articles
Collections of links to relevant material, which may be useful for researching particular topics. They often lead to descriptive material about 'state of the art' or research activities. Since such materials are not refereed, they can be of variable quality. An interesting example is the Human Languages Page which provides links to linguistic resources in a large number of the world's languages [URL11].

3.2.8 Speech Science Data
Acoustic, phonetic and linguistic materials accessible over the Internet and suitable for educational purposes. Currently the area is dominated by large corpora, and few have the capability for downloading samples without copyright restrictions and free of charge. The US Linguistic Data Consortium does make some phonetically annotated material available by FTP [URL12].

3.2.9 Speech Science Tools
Software that can be downloaded for speech and language analysis suitable for educational use. Many references to tools do not actually provide download facilities. Two that do are the 'sounds' directory of the SimTel archive for PCs [URL13], and the Speech Filing System tools developed by one of the authors [URL14]

4. CURRENT POSITION

As may be expected in a new and developing field, the material in the CAL/Internet group's inventory suffers from many kinds of biases with respect to language of instruction, geographical distribution and subject areas covered:

- The overwhelming majority of the material is in English and although there will be some bias due to our collection procedures, the bias to English is very striking. Much could be done

in the education field to ensure that tutorial materials are available in multiple languages.

- Telematic courses are predominantly although not exclusively based in the United States of America. A similar pattern is seen for course syllabus pages. The network should work to ensure the better representation and description of European courses in the field.
- With respect to content, there is a strong bias towards those areas where computers have been used for a long time (e.g. in practical phonetics, speech perception, spoken language engineering). Encouragement should be given to the more Arts-based and the more Medical-based aspects of our field to follow their lead.

There are many tools for aiding the construction of telematic courses and course materials, but these are only weakly integrated. There seems to be no single comprehensive and professional platform. Novice educators can learn a lot from how existing telematic courses are run, and this is an area ready for initiatives to disseminate good practice.

Finding and using internet based material may at present be problematic. Search engines based on keywords tend to produce a great deal of irrelevant material (e.g. 'speech' retrieves published speeches) and the quality of the relevant material can be very variable. The group would like to see a series of activities to address quality:

- a set of guidelines for the preparation of tutorial materials,
- a set of evaluation criteria which would allow tutorial materials to be indexed and retrieved according to need,
- an awards and grading system to encourage the production of high quality materials.

Limitations in speed and bandwidth is at present a problematic aspect, particularly when speech or video files have to be transferred. While this problem will reduce over time, it is important to match the complexity of interaction to the availability of bandwidth.

Copyright issues will need to be addressed, and special dispensations must be available for educational material. Samples from larger corpora could be disseminated free of charge; and tutorial material should contain copyright notices which allow student use but not commercial exploitation.

Linguistic tools are often specific to particular platforms, difficult to install and do not come with indications for suitable educational project work. Platform portability issues are being addressed through Java, and encouragement should be given to create tools with clear instructions and examples of use.

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REFERENCES

[1] SOCRATES Thematic Network in Speech Communication Sciences, Year 1 Report, OTS Publications, Utrecht, 1997.

Table of Uniform Resource Locators

URL1	mailto:tn-calint@essex.ac.uk
URL2	http://tn-speech.essex.ac.uk/tn-speech/project/groups/tn-cal/quest.html
URL3	http://tn-speech.essex.ac.uk/tn-speech/project/groups/tn-cal/tn-cal.html
URL4	http://www.csuhayward.edu/ics/htmls/Inst.html
URL5	http://homebrew.cs.ubc.ca/webct/
URL6	http://www.phonetik.uni-muenchen.de/AP/APHome.html
URL7	http://www.ling.umu.se:80/~anderse/education/Katper.html
URL8	http://www.phonetik.uni-muenchen.de/Haskins/Haskins/MISC/PP/pp.html
URL9	http://www.utexas.edu/world/lecture/linguistics/
URL10	http://www.uni-frankfurt.de/~ifb/bib_engl.html
URL11	http://www.dcs.warwick.ac.uk/~bear/Language-Page.html
URL12	http://www.ldc.upenn.edu/
URL13	http://sunsite.doc.ic.ac.uk/Mirrors/simtel.coast.net/SimTel/win3/sound/
URL14	http://www.phon.ucl.ac.uk/resource/sfs.htm