

CHAPTER X

COMPUTER-AIDED LEARNING AND USE OF THE INTERNET

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1 Introduction

1.1 Aims of the Working Group

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 (CAL) in the field
- ❑ to promote the use of the Internet to disseminate information and teaching materials
- ❑ to make suggestions of areas of resource development to potential authors
- ❑ to encourage the generation of a comprehensive set of high quality resources
- ❑ to create an infrastructure for the management of resources.

1.2 First and second year activities

Our main activities in the first year were concerned with a review of current practice. We first requested an expression of interest in the area through a message sent on a number of electronic mailing lists. We had over 70 responses from individuals interested in contributing to our survey of computer-based methods, or interested in hearing about the outcome of our survey [URL1].

We set up a Web-based database of teaching resources, to which individuals could contribute through a forms interface accessible by Web browser. The contents of the database are regularly converted to HTML so that it may be viewed from anywhere on the Internet [URL2]. We made the decision to focus on resources explicitly designed for educational purposes, and on materials that were accessible directly over the Internet.

In our reports on our first year activities (Huckvale *et al*, 1997a, 1997b) we reviewed the current use of the Internet for the provision of teaching materials in Speech Communication Sciences. We concluded that: (i) there was a need for computer-based teaching materials in the field, (ii) that the Internet was an exciting medium for the development and delivery of such materials, and (iii) that teaching materials of defined focus and limited range - which we called 'tutorials' - provided the best compromise in terms of flexibility and effectiveness.

In the second year we further developed the concept of tutorials and considered in more detail the framework in which such tutorials might be used. In Huckvale *et al* 1998, we looked at general issues about the design of teaching and learning materials in a telematic context; we

discussed how to bridge conventional classroom approaches to teaching and learning and their telematic equivalent; we gave practical advice on the design and development of tutorial components. We also set up a database of tutorial components which can be accessed and updated via the Web [URL3]. In doing so we had to develop a set of tutorial 'characteristics' by which tutorials could be indexed and searched.

1.3 Third year activities

This year we have turned to the evaluation of internet based teaching and learning materials. The evaluation of educational technology is a large and complex area, and in this chapter we seek only to give an introduction to the subject which highlights the main issues and to provide a simple instrument which may be of use to CAL courseware designers in Speech Science.

In Section 2 we discuss the background to evaluation, highlighting previous work in this area and current views about the effectiveness of evaluation applied to CAL. In Section 3 we present an evaluation instrument which could be used by courseware designers to check their work, or by external experts to provide feedback to designers. In Section 4 we discuss how the views of students might also be gainfully exploited in evaluation. An appendix provides a number of questionnaire outlines that have been developed for educational evaluation.

2 Courseware Evaluation

2.1 Introduction

"Evaluation is the collection of, analysis and interpretation of information about any aspect of a programme of education or training as part of a recognised process of judging its effectiveness, its efficiency and any other outcomes it may have." (Mary Thorpe, in Ellington, Percival & Race, 1993)

The evaluation of educational technology is a process with a large number of dimensions:

- what is the purpose of the evaluation?
- is the evaluation summative or formative?
- what is being evaluated?
- who is the evaluation for?
- when should the evaluation be done?
- who should perform the evaluation?
- what methods should be used in the evaluation?

Evaluation can have a variety of purposes: it can be to judge the designers; it can be to compare two or more tutorials on the same topic;

it can be to measure the cost-effectiveness of CAL over other methods; it can be to assess the need for human tutors or for student training; it can be to measure the ease with which students can gain access to the material. However mostly evaluation is considered as a process by which courseware is assessed for its effectiveness for teaching and learning. We take the view that the best reason for undertaking evaluation is to improve the quality of the courseware itself.

Summative evaluation of courseware aims to show whether the software *works*: to show that it is cost effective, that it operates correctly, that it is worthy of investment. Formative evaluation, on the other hand, simply aims to provide information to improve the design of the software: it does not necessarily make absolute judgements of worth. The general opinion is that summative evaluations are too costly and too problematic for CAL evaluation. For example: how do you control for the motivation of students, or for the skills of the teacher supporting the teaching and learning? To create an artificial learning environment in which such factors can be controlled is to make measurements that will have little predictive value for when the courseware is used in real environments. Summative evaluations are like large experiments: to obtain a significant result they need to be carefully designed and executed on a sizeable number of subjects. While such an investment might be justified to test a new educational theory, it is unjustified merely to assess one of the growing flood of new courseware (Draper, 1996).

When we consider what is being evaluated, it is impossible to completely separate the courseware from the educational environment in which it is used. What works well in one place might fail in another. Should we try to evaluate an entire degree programme, or a course unit, or a tutorial, or a single interaction? Are there absolute criteria that courseware should meet, or can we only judge courseware against its own stated objectives? Generally we take the view that tutorials can be evaluated separately from the teaching environment using principles of good design and by testing them against their own goals.

Evaluation is viewed differently by different stakeholders in the evaluation process. The funding body for some technology will be interested in the delivery of the software to specification; the designers will be interested in validation of the content and measures of ease of use; teachers wanting to use the tutorial will want to know of its effectiveness in promoting learning and its factual accuracy; students will be want to be assured that its meets their learning requirements and is straightforward to use; technical support staff will want to know what the computational demands are and whether bugs will be fixed. We prefer to concentrate on designers and teachers: the designers need to

be told how their product can be improved, and the teachers need to know whether the courseware is useful.

Evaluation can take place at many different stages in the evolution of some courseware: at the design stage; after prototypes of the user interface or the content have been constructed; in trials with conventional approaches to teaching the material; after the courseware is well established in the teaching programme. We see courseware development as related to software engineering and hence should be based on good engineering principles of sound design, modularity, prototyping and testing. Evaluation has a role to play throughout this lifecycle: it can validate design decisions, can help test the implementation; can prioritise needed changes.

Evaluation can be performed by a variety of individuals: by the designers and implementers themselves; by potential teachers wanting to use the courseware; by students; by external experts. Each bring different skills, different motivations and different prejudices to the evaluation. Designers can be blind to obvious defects; teachers may not know how best to exploit the resource; students are not experts in educational theory; external experts may not understand the problems of students. It is said that the observation of students learning is always more informative than consulting teachers or experts despite being more difficult and expensive (Draper, 1996). We take the view that expert opinion is cheap and useful to a degree, but that student opinions should also be gathered.

The evaluation itself can be conducted with a variety of methods: questionnaires, interviews, checklists, etc. The use of pre- and post-tests of knowledge make direct measurement of learning but need to be conducted close in time to the use of the courseware to be relevant. Such measures need to be simple in that the student does not have time to reflect or to digest the content of the tutorial. We describe a number of evaluation methods in section 2.3.

2.2 Design and use of formative evaluation

Formative evaluations of courseware concentrate on three main areas: academic accuracy, learning effectiveness and usability:

- *Academic accuracy* relates to the knowledge content of the courseware: whether it describes the accepted scientific view, whether it contains only true and justifiable facts, whether it presents a coherent and consistent argument.
- *Learning effectiveness* relates to how the courseware supports the process of learning: whether the students acquire the intended

knowledge, understanding or skills, whether the courseware promotes critical thinking, whether the students are able to apply their knowledge in new situations.

- *Usability* relates to the ease with which staff and students can use the courseware: whether it is easy to operate, whether it has an understandable interface, whether it is easy to navigate.

The evaluation criteria presented in section 3 are designed along these lines.

Formative evaluations should be performed within the development cycle of the courseware: tests on learners need to be performed while there are still resources available on the project to make improvements. Design flaws that are identified early in a project are cheaper to correct than when they are found late. Thus although evaluation of an early prototype may be limited in scope it can still give very useful results. Evaluation performed late in the development can be made more rigorous, but any necessary improvements may be much more costly to make.

2.3 Instruments for formative evaluation

There are a large number of possible evaluation techniques or *instruments* available for the evaluation of CAL courseware. Our aim here is to show the breadth of these instruments to encourage users not to concentrate on just questionnaires or just an expert opinion. When choosing an instrument, you should consider in advance what kinds of results would persuade you to make changes to your material. This section draws heavily on Milne & Heath (1997).

Observation

The observation of students using the courseware can be very productive. The observer can look for the answers to particular questions, such as: "did the students use the help facility?" or "how was navigation performed?". But the observer can also record problems with the software or the difficulties of students: "did the software crash?" or "did the students get stuck?". Watching students also provides feedback on motivation: "did the students lose interest?". If courseware is being used by pairs of students, then the interaction between them is also of interest, particularly when things go wrong.

Key questions test

That students have assimilated the most important points in the courseware can be checked with a few key questions after they have completed the material. Students could also be asked to state the most

important thing they have learned. Such a technique is simpler and faster than a proper examination.

Student questionnaires

Questionnaires used for evaluation by students have a common shape: a set of closed questions addressing specific aspects of the tutorial (e.g. "the tutorial was relevant to the aims of the course Y/N") and a set of open questions where extended comments are requested (e.g. "what problems did you have using the tutorial?"). In general such questionnaires address issues such as:

- what problems did the students have?
- did the courseware help students learn?
- was the courseware easy to use?
- did the students like using the courseware?

We return to issues of student questionnaires in section 4.2. Example questionnaires are given in Appendix A.1.

Student interviews

A structured interview of a student or a small group of students can provide a more reliable means of obtaining information about, for example:

- what the students think of the courseware
- what problems they have encountered
- what they have learned
- how their ideas have been affected by the courseware

Review by experts

The advantage of external experts is that they bring a different perspective: they can view the courseware without the bias arising from being involved in its commission, design or implementation. The evaluation criteria described in section 3 are suited to expert use.

Record of questions asked of demonstrators

When courseware is used in a laboratory setting, the questions asked by students of the demonstrators should be recorded. These will probably show common themes and hence give information about common misconceptions or problems with usability.

Pre- and post- tests of knowledge

Simple tests of knowledge immediately before and after using the courseware can show the extent to which the courseware is making a contribution to student learning.

Electronic monitoring

The courseware itself can collect statistics of student use: how much time was spent on each section, how many sections were completed at

one sitting, which facilities were rarely used, which questions were most often answered incorrectly.

Teacher questionnaires

Designers can also gain valuable opinions from the teachers that attempt to use the courseware in their own courses. They often have different views to students about the effectiveness of the material, the problems of use and the areas for improvement. A suggested format for a teacher questionnaire is given in Appendix A.2.

Learning checklist

Educational theorists divide the process of learning into four stages: the student must *want* to learn, must *do* or *practise* some activity, must receive *feedback* on what they do, and must *digest* the learning outcome. This leads to a checklist which can be applied to a given tutorial to see the extent to which these stages are supported. A suggested outline of such a checklist is given in Appendix A.3. Where courseware fails to satisfy items on the list, these should be the areas which need to be provided by alternative means within the educational programme as a whole.

Evaluation of documentation

The quality of the documentation supporting courseware is often poor since it is seen as less important than the software component. However information about the purpose of the courseware, its installation and operation is essential for its re-use by other teachers.

3 Evaluation Criteria

3.1 Introduction

The criteria presented in this section are designed to aid the evaluation of tutorial materials intended for self study in the field of speech communication science and delivered over the Internet. The criteria have been developed from analysis of good practice in the design of CAL materials and may be of use to designers as well as to the purchasers of tutorial materials. These criteria have also been published in Bowerman *et al* (1999b). Further information on design may be found in Gagne, Briggs & Wagner (1992). Further criteria for evaluation may be found in Machell & Saunders (1991).

Evaluation criteria such as these are only one means for the evaluation of teaching materials, as has been discussed earlier. Analysis of how students use, react to and learn from the materials are equally valid and often essential additional means of evaluation. However such student evaluations are rather difficult to undertake, are open to many sources

of bias and can take a long time. We see the evaluation criteria presented here as a faster, cheaper means of evaluation rather than a necessarily superior one.

3.2 Essential Terminology

The criteria refer to an idealised, abstract tutorial. This can make it hard to relate the terminology used in the listed criteria to the actual physical characteristics of the tutorial. In particular we contrast three abstract qualities of a tutorial: goals, objectives and content.

A *Goal* is a general description of the intended outcome of the tutorial. That is overall what the tutorial sets out to achieve. Take as an example a tutorial in spectrogram reading: its goal may be to give students the skill to decode unknown spectrograms in their language. This would be an ambitious goal - perhaps a more realistic one would be for students to be able to align a given phonetic transcription with a spectrogram. In either case, there is the expectation that students will have a demonstrable skill by the end of the tutorial.

An *Objective* is a specific description of one part or one step in achieving a goal. Thus one stage in spectrogram reading might be to segment the utterance into syllables, and the objective of a tutorial component might be to support the acquisition of such a skill. Notice that objectives, unlike goals, can build upon each other: the acquisition of segmentation skills may be a pre-requisite for the acquisition of labelling skills. You can think of a goal being a strategic result, while an objective is a tactical one.

Objectives are realised by *Content*. The content of a tutorial is the material that supports the achievement of its objectives.

3.3 Evaluation Criteria

Goals and Objectives

- Are the goals and objectives clearly stated?

For evaluation to be possible at all, the tutorial must be judged on whether it meets its goals and objectives. To assess the suitability of objectives we need a clear statement of the goals. Furthermore, the goals need to be clear enough that students and teachers can judge whether the tutorial would be useful to them.

- Does achieving objectives realise the goals?

Can the individual components of the tutorial, taken together, be said to satisfy the overall goals?

- ❑ Are the target audience and their pre-requisite knowledge clearly stated?

As well as the goals, both students and teachers need to know what knowledge and skills are expected in the tutorial.

Content

- ❑ Is the content coherent, consistent and factually correct?

Do the materials form a logically organised and coherent entity? Are they free from self-contradiction and use technical vocabulary consistently? Is the subject material accurate and up to date?

- ❑ Does the content appropriately reflect the stated objectives?

For each component of the tutorial in turn, the content of the teaching material needs to be relevant to and justified by the objectives of that component.

- ❑ Is the content appropriate and reasonable given the intended audience?

Firstly is the material an appropriate means of attaining the stated objectives? To answer this it is also necessary to take into account the target audience: is the material reasonable given the expected skills and background knowledge? It may also be necessary to assess its reasonableness with regard to the amount of time the tutorial takes or the computational resources it requires.

Teaching and Learning

- ❑ Is the tutorial a cost-effective means of achieving the stated learning goals?

Does the tutorial deal with a subject matter which can be taught effectively using the teaching and learning methods employed? It may be necessary to ask a more basic question: is the tutorial constructed in such a way that its cost-effectiveness can be measured at all? In other words, are the knowledge and skills learnt measurable?

- ❑ Is the content fully self-instructional?

The materials need to be sufficiently self-contained, easy to use and easy to understand that a student can use them without additional help.

- ❑ Are there means for students to test their understanding?

This almost always means that tutorials should have some built-in self-assessment materials. This is one good means of providing interactivity. Clearly these assessments should also be linked to the objectives.

- ❑ Does the tutorial create and maintain learner motivation and interest?

Students studying alone need to be motivated and encouraged.

- ❑ Does the tutorial encourage active learning?

Learning by making active choices is generally considered superior to rote or passive memorising of facts.

- ❑ Are there means for students to communicate with a tutor and/or to other students?

A significant benefit of Internet materials is the provision of many means of computer mediated communication: e-mail, news, chat, conferencing. Since tutorials can never be complete, and authors of tutorials can never pre-guess all possible questions, means must be available for students to ask for help.

- ❑ Are there means for students and teachers to provide feedback to the authors of the tutorial?

Tutorial development is a continuous process and feedback from users will help create and maintain an interesting and useful resource.

Implementation

- ❑ Is the topology of the material an appropriate way to implement the content and realise the objectives?

Tutorial materials can be: linear, hierarchical, networked or based on simulation. Linear presentation may be overly restrictive if students can come from a range of backgrounds or if the material is rather large. Expert users may want to skip introductory components. On the other hand, networked material may be hard to explore or use

effectively for learning. The current location in the tutorial and the available means of navigation should be clear at every stage.

- ❑ Is there a fair balance of time and content between different sections of the tutorial?

Students' expectations of the length of time required for each section should not be contradicted: this means that sections should be of approximately equal learning time.

- ❑ Is there a logical progression between the different sections?

Do later sections build on and re-inforce earlier sections? Is this logical development obvious to the users?

- ❑ Does the design of the tutorial make it easy for re-use by other tutorial authors?

If a tutorial is separable into independent components, then these may find use as parts of other tutorials. In the future we would like to see courses comprised of component tutorials from many authors. For this to happen, it must be possible to 'dip in' to a tutorial.

- ❑ Are the computational requirements clearly stated?

This is a particular issue with the current state of incompatibility between browsers. The use of high fidelity sound or video may mean that the tutorial is not effective over a slow network connection.

- ❑ Is the tutorial easily portable to other platforms?

Tutorials requiring specific computer hardware or software are more difficult to re-use than those based on widely-available non-proprietary technology.

- ❑ Is the design and presentation of content suitable for translation to other languages?

An issue here is the embedding of specific languages in graphics or simulations. It is assumed that basic text will always have to be translated by hand.

- ❑ Is the means of use of the materials matched to the expected computer literacy of the students?

If the tutorial requires specific computer skills, are these reasonable given the target audience, or are means of acquiring those skills provided?

3.4 Summary

It is difficult in writing a general set of criteria to address the actual *content* of the tutorial in any other than an abstract way. We propose that the content should be judged against the declared goals and objectives. This is fine when such objectives are stated clearly enough by the authors, but if these are missing the evaluators must decide what they feel are the expected outcomes and judge the tutorial accordingly. However in this case the evaluators' supposed goals must be stated in their report.

For the purposes of constructing an expert report with these criteria, it may be useful for the evaluator to put numerical ratings against each question on a scale of 1 (worst) to 5 (best). In addition, the evaluators should write brief justifications for their conclusions.

4 Evaluation by Users

4.1 Introduction

Expert opinion on courseware, possibly structured by the criteria listed in section 3, can be a valuable means of formative evaluation, but it is inherently limited. The current state of education is that no-one has a precise theory of learning that can be used to make specific predictions about a given learning situation. Thus expert opinion, drawing on the problems and solutions encountered in the past, may be more use than a novice's, but is not necessarily accurate. There are two key problem areas: firstly expert's questions tend to be too closed, too focussed on specific issues - this means that their evaluations can miss the unusual idea or the surprising result; secondly, expert opinion can not be a replacement for actual measurements - observations of students learning with courseware.

Obtaining useful, formative evaluation from students is not always an easy task: students themselves vary considerably in their skills and motivations. Students may be professional learners, but they are not professional educationalists: they may know what they like but not what is doing them good. In the next section we give some practical advice for how observations, questionnaires and interviews may be undertaken with students.

A perennial issue in student evaluation is how to assess whether the courseware under test is actually more effective than the existing or conventional approach. Such comparisons are very difficult to make for a number of reasons:

- ❑ any 'control' treatment, such as 'books only' may be unrealistic and inadequate learning method.
- ❑ the division of students into different groups is itself disruptive
- ❑ new methods are often taught with more enthusiasm than old ones
- ❑ new methods are appreciated more by students than old ones
- ❑ new methods often offer new learning objectives, invalidating comparisons with old methods
- ❑ differences may be too small to measure for typical class sizes

Thus studies which do not use control groups may make just as valid and valuable evaluations.

4.2 Methods

In this section we will discuss three main evaluation instruments for use with student learners: observation, questionnaires and interviews.

Observations

With observations of students using courseware it is advisable to prepare a structured observation sheet to focus the task on specific areas and to record your findings. A log of interactions between the student and the computer or between students or from student to teacher is a typical format. Room should be given for comments on the students reactions to problems with the content or with the use of the courseware.

Observations can be videotaped, but the presence of the camera may affect student behaviour.

Questionnaires

The advantage of questionnaires is that they can be used to collect feedback from a large number of users with little contact. However, questionnaires are rather complex measurement devices which need to be carefully calibrated to be reliable and interpretable. They are also notoriously sensitive to the circumstances in which they are administered. Therefore, they should be complemented by other evaluation activities, such as interviews or observation.

The questionnaire items should cover all aspects of the course, from contents to delivery, from navigation to problems with network connections, and especially on those aspects you would like diagnostic feedback. Closed answer forms with fixed ratings or Yes/No-boxes are easier to analyse than open questions; however, in open answers,

students may mention problems you had not thought of previously. As a good compromise, you could conclude a set of closed questions by the open questions “What did you like best/worst about this tutorial?”

A good strategy is to copy some questions from a validated course questionnaire and to add questions relevant to your specific objectives. If you ask users if they agree with certain statements about the tutorial on a scale of 1–5 or 1–7, it is helpful to change the polarity of the statements from positive to negative once in a while to catch respondents who insert values mechanically. Finally, remember that long questionnaires with lot of open questions are less likely to be filled out and returned than short, concise ones and set your feedback priorities accordingly. Appendix A.1 lists some sample student questionnaires.

Interviews

Interviews are a useful complement or follow-up to questionnaires. Interviews allow you to elaborate on points arising from the questionnaires, and to gauge if the open-response items written there are typical or atypical of the student group as a whole. While it is best to have some structured questions to limit the duration and the scope of the interview; you should leave room for discussion to roam beyond these to raise points not previously considered. Interviews can also be conducted with groups of students: a benefit being that one comment may encourage others.

5 Conclusions

5.1 Summary

This chapter has looked at issues in the evaluation of computer-aided learning materials. Evaluation has been introduced as a complex process, but one which forms an essential part of the development life-cycle of CAL materials. Evaluation can be performed with a wide range of instruments, and should be performed with more than one. Expert opinion is valuable and relatively cheap; but ultimately it is only through the observation of real learning by motivated students that the true effectiveness of courseware be established.

5.2 CAL/Internet Working Group

In the past three years the working group has made a significant contribution to improving the state of the art in Computer Aided Learning within the field of Speech Communication Science. The group has surveyed and reported on CAL in the area, presented guidelines for good tutorial design, and discussed how CAL might be evaluated. It has

reporting its findings in three conference papers (Huckvale *et al*, 1997b; Bowerman *et al*, 1999a; Bowerman *et al*, 1999b) as well as in the chapters in these yearly reports of the Thematic Network (Huckvale *et al* 1997a; 1998).

The working group has created two internet directories: one for educational resources in Speech Communication [URL2], and one for fully-fledged tutorials [URL3]. We hope that these will be maintained and will grow in the future.

Appendix

In this appendix we present the outlines of questionnaires that have been used for CAL evaluation. These have been drawn from a number of sources, as indicated in the text.

A.1 Student Evaluation Questionnaires

Milne & Heath (1997) provide a questionnaire for gauging students opinion of CAL courseware, which asks the following questions:

- What problems did you have using the courseware?

- Please respond to the following statements (Yes/Unsure/No):
 - The courseware was interesting to use
 - The courseware was easy to use
 - The content of the courseware was relevant to the course
 - It is clear why I am using the courseware
 - Using the courseware helped me learn (please give reasons for your answer)

In the Internet Tutorial directory [URL3], the following questions were posed of users:

- I have just completed '<tutorial name here>' and would rate it a */**/***/****/***** tutorial
- Here are up to three positive things about the tutorial:
 1. _____
 2. _____
 3. _____
- Here are up to three negative things about the tutorial:
 1. _____
 2. _____
 3. _____
- Here are some general comments

- I am a Teacher/Specialist student/Non-specialist student

Deakin University in Australia [URL4] suggest the following list of questions to judge student satisfaction with CAL. For each question, students should indicate whether they strongly agree, agree, are undecided, disagree or strongly disagree:

- The software was easy to use
- The interactive nature of the software made the subject more interesting
- The software enhanced my enjoyment of learning about this subject
- The software helped make the concepts easy to understand
- The content of the software did not assume too much prior knowledge
- The activities used in this software helped my learning of the topic
- The material in the software complemented the textbook
- The material in the software complemented the lectures
- The material in the software complemented the tutorials
- When needed, I found the written instructions to be helpful
- When needed, I found the support from academic staff to be helpful
- When needed, I found the support from technical staff to be helpful
- It was not difficult to find a spare computer in the laboratories
- I had no problems gaining access to the software in the laboratories

Student satisfaction with the teaching of the unit as a whole, of which the CAL component may only be one part, could be judged by these questions from Deakin University [URL4]. For each question, students should indicate whether they strongly agree, agree, are undecided, disagree or strongly disagree:

- The unit was run in a well-organised way
- The stated objectives of this unit were met
- Overall this unit was relevant and valuable
- I gained new knowledge and understanding from doing this unit
- I developed new skills from doing this unit
- This unit challenged me intellectually
- I found the work load for this unit to be reasonable
- The prescribed readings and materials were relevant and helpful
- The unit content was presented in a clear and logical sequence
- The teaching methods and instructional material used helped me to learn effectively
- The facilities and resources I needed to study this unit were available
- The ways in which the unit was assessed gave me appropriate opportunities to show what I had learned
- The feedback I got throughout the unit helped me to learn effectively

- I found that assistance with any aspect of the unit was readily available when needed
- The unit did not duplicate work covered in other units

A.2 Courseware Review

Milne & Heath (1997) provide a questionnaire suited for the review of CAL courseware by external subject experts which asks these questions:

1. Accuracy

- Is the subject material academically accurate? (Yes/No)
- Does the help system supply the necessary information? (Yes/No)
- Is the manual well laid out and of practical use? (Yes/No)
- Does the model¹ give sensible results? (Yes/No)
- Comment on the subject content:

2. Ease of Use

- Were the instructions provided with the courseware adequate? (Yes/No)
- Is the courseware simple to install and start? (Yes/No)
- Did you have any difficulty using any part of the courseware? (Yes/No)
- Did the courseware crash? (Yes/No)
- Is it easy to get to different parts of the courseware (is navigation easy)? (Yes/No)
- Is the courseware easy to use?

3. Support for Learning

- Does the courseware help students learn? (Yes/No)
- Are learning objectives adequately defined? (Yes/No)
- Would the courseware help you teach [the subject]? (Yes/No)
- Does the courseware add value over conventional teaching methods? (Yes/No)
- Does the courseware support activities that are otherwise difficult to teach? (Yes/No)
- Does the courseware have the potential to add anything new to the students learning experience that traditional teaching would not provide?

- Suggest how the courseware should be used in a course

- Will students learn by using the courseware?

4. Summary and Recommendations

¹ refers to simulation used in courseware

- Does the courseware support learning? Poor ... Very Good
- Can the lecturer use the courseware easily? Poor ... Very Good
- Is the subject content accurate? Poor ... Very Good
- Would you recommend the courseware for teaching students about this subject?

5. Improvements

- Can you suggest improvements to the courseware?

- What were the two best things about the courseware?
 1. _____
 2. _____
- What were the two worst things about the courseware?
 1. _____
 2. _____

Milne & Heath (1997) also provide this questionnaire to obtain the teacher's opinion of the courseware for feedback to the designers:

1. How used

- How did you embed the courseware in your course?
 - Practicals: Reinforce/Replace/Enhance
 - Lectures: Reinforce/Replace/Enhance
 - Tutorials: Reinforce/Replace/Enhance
- How many hours did your students use the courseware in scheduled classes?
- How many hours would a student take to complete the practical (including practical preparation, report preparation and any tasks associated with but not completed at the computer)?
- How many student contact hours are available in your course?
- Briefly describe the course in which you used the courseware:

- Please describe how you used the courseware in teaching:

2. How useful

- How useful was the courseware in your teaching? Very ... Unhelpful
- How could the courseware be made more useful to you?
- What were the best two things about the courseware?
 1. _____
 2. _____
- What were the two worst things about the courseware?
 1. _____

2.

- Did the courseware help the students learn?

- Did the courseware meet the needs for your course?

- Did the courseware save you any teaching time?

- Is the subject material academically accurate?

- Are learning objectives adequately defined?

3. Future use

- When you use the courseware again do you intend to make any changes to the way in which you present your course?

- How would you recommend that the courseware be integrated into a course?

- In future will the courseware save you time?

4. Ease of use

- Did you have difficulty using the instruction booklet that was provided with the courseware?

- Was there any problem installing the courseware?

5. Other Comments

- Do you have any other comments?

A.3 Learning Checklist

Milne & Heath (1997) provide a checklist for the evaluation specifically of the learning environment. The structure of this is based on the division of learning into *wanting*, *doing*, *receiving feedback*, and *digesting*, as suggested by Race (1994). This is an edited version.

1. Motivation

- Are the aims and learning outcomes clearly stated?
- Are the task goals clear so that students know when they have achieved them?
- Does the learner know why it is important to learn the material?
- Will students learn something about the learning objectives using this module?
- Do the tasks relate to the learning objectives?

- Do the tasks engage the students?
- Does the courseware add something to the students' learning experience that other media would not provide?
- Did you get a feeling of personal satisfaction from using the courseware?

2. Practice

- Are there plenty of tasks to do?
- Are there a variety of tasks to do?
- Do the tasks make the student think about the subject matter?
- Do students start doing things at the beginning of the module?
- Is trial and error supported?
- Are questions planted in the learner's mind (e.g. as you study this section try to find out ...)
- Are objectives always accessible?
- Are the tasks relevant to the learning objectives?
- Does the courseware adjust the task from the prior information that the learner has provided?

3. Feedback

- Are there lots of self assessment questions and activities?
- Does the feedback provide information on why the student was incorrect, not just that the answer was wrong?
- Are there procedures in place which stop students peeking at the feedback then copying this to the answer?
- Can the student try the interaction again?
- Can the learner see the results accumulate (see how much has been done and left to do)?
- Can the learner test out their ideas and receive feedback?

4. Digest

- Are the summaries and reviews clear and helpful?
- Do some questions elicit student's description?
- Can the learner select and take away anything that they can use, read, or do in the future?
- Does the feedback help students digest what they have done?
- Do students have control over their learning?

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Uniform Resource Locators

URL1 <mailto:calint@essex.ac.uk>

URL2 <http://www.phon.ucl.ac.uk/resource/cal-top.htm>
URL3 <http://www.phon.ucl.ac.uk/home/wbt/>
URL4 <http://www2.deakin.edu.au/dcad/FTL/evaluation>

References

- Bowerman, C., Eriksson, A., Huckvale, M., Rosner, M., Tatham, M., Wolters, M., (1999a) "Tutorial Design for Web-based Teaching and Learning", ESCA/Socrates MATISSE Workshop, London, April 1999.
- Bowerman, C., Eriksson, A., Huckvale, M., Rosner, M., Tatham, M., Wolters, M., (1999b) "Criteria for evaluating Internet tutorials in Speech Communication Sciences", Proc. EuroSpeech, Budapest, Hungary, 1999.
- Draper, S., (1996) "Observing, measuring, or evaluating courseware: a conceptual introduction", in *Implementing learning technology* G. Stoner (ed), Heriot Watt University Edinburgh.
- Ellington, H., Percival, F., Race, P., (1993) *Handbook of Educational Technology*, Kogan Page, London.
- Gagne, R., Briggs, L., Wagner, W. (1992). *Principles of instructional design*. Harcourt Brace Jovanovich.
- Huckvale, M., Benoit, C., Bowerman, C., Eriksson, A., Rosner, M., Tatham, M., Williams, B. (1997a). Computer Aided Learning and Use of the Internet. In *The Landscape of Future Education in Speech Communication Sciences: 1 Analysis*, G. Bloothoof et al. (eds.), Utrecht: OTS Publications.
- Huckvale, M., Benoit, C., Bowerman, C., Eriksson, A., Rosner, M., Williams, B., (1997b). Opportunities for Computer-Aided Instruction in Phonetics and Speech Communication Provided by the Internet. *Proceedings of the 5th Eurospeech Conference*, Rhodes.
- Huckvale, M., Bowerman, C., Eriksson, A., Rosner, M., Tatham, M., Williams, B., Wolters, M. (1998). Computer Aided Learning and Use of the Internet. In *The Landscape of Future Education in Speech Communication Sciences: 2 Proposals*, G. Bloothoof et al. (eds.), Utrecht: OTS Publications.
- Machell, J., Saunders, M., (1991) *MEDA: an evaluation tool for training software*, Centre for the study of education and training, University of Lancaster.
- Milne, J., Heath, S. (1987). Evaluation handbook for successful CAL courseware development, Centre for CBL in Land Use and Environmental Sciences (CLUES), University of Aberdeen.
- Race, P. (1994). *The Open Learning Handbook*. London: Kogan Page.